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THE GROWTH AND YIELD OF PADDY CIHERANG PLANTED IN DRY AND WET SEASON AND FERTILLIZED WITH ORGANIC AND INORGANIC FERTILIZERS

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ABSTRACT

The study aiming to know the growth and yield of paddy Ciherang planted in dry and wet season and applicated with organic and inorganic fertilizers was conducted in paddy soil in Batu, East Java, 900 m asl. 22^0C with andosol soil type. A factorial randomized block design was applied to arrange the treatments of time of planting (dry and wet season) and the type of fertilizer used i.e.: 100 kg N ha^{-1} + 50 kg P2O5 ha^{-1} + 70 kg K2O ha^{-1}, 50 kg N ha^{-1} + 25 kg P2O5 ha^{-1} + 35 kg K2O ha^{-1}, 20 t ha^{-1} cow manure, and 10 t ha^{-1} cow manure. Each treatment replicated three times. The result showed tha the growth and yield of paddy Ciherang in dry seasons was higher than that in wet seasons. Plant height in dry seasons was 86.9 cm tall, Leaf Area Index (LAI) was 4.18, time of harvesting was 125 days after planting (DAP), and the grains yield was 9.84 t ha^{-1}. The same characterstics of paddy Ciherang in wet seasons were 87.7 cm tall, with LAI 3.70, time of harvesting 105 DAP, and the grains yield 4.81 t ha^{-1}.

Keywords: cow manure, dry and wet season, fertilizers of organic and inorganic, paddy Ciherang

INTRODUCTION

Rice (*Oryza sativa L.*) is an important staple crop in India, China, and Southeast Asia. During the Green Revolution, the growth rate of rice production is higher than the growth of population and production in surplus. (Chauhan and Mahajan, 2013). In Indonesia (2013), the rice areas comprised 13,769,913 ha with productivity level reaching 5,146 t ha^{-1} (equivalent to 70,866,571 t ha^{-1}) (Central Bureau of Statistics, 2013).

One type of rice in Indonesia is rice Ciherang with an average production of 6 t ha^{-1} and yield potential 8.5 t ha^{-1}. In many cases, the production of paddy Ciherang resulting from the farmers is lower. The varied planting systems, plant spacing, numbers, and kinds of fertilizers used, irrigation system and time of planting, the presence of weeds, diseases and pests, harvesting system, and harvest handling affect the fruitfullness of rice planting (Anonymous, 2009). On the other hands, Yoshida *et al. (*1976) stated that rice cultivated in dry seasons results in higher dry grain weight than that in wet seasons.

Hatta (2011) suggests that the varieties which have a lot of seedlings should be planted at a larger distance than planting rice which have a least of seedlings. Each variety has its own ideal planting distance. Varieties also affect the yield components, panicle length, and the number of grains per panicle. Furthermore, Hatta (2012) reported that rice Ciherang with spacing (21 x 21 cm) resulted in the number of productive tillers per hill 11 tillers, panicle length 24.94 cm and the potential yield 7.4 t ha^{-1}. This is in line with what was proposed by Salahuddin *et al.* (2009), emphasizing that a spacing affects panicle length, the number of grains per panicle, and yield per hectare.

Sohel *et al.* (2009) indicated that at a spacing of 25 cm x 5 cm in one family, only 4-5 crops were produced. Qibtiyah (2014) planted paddy Ciherang at lowland areas (30 m above sea level and the temperatures is 32^0C) in Lamongan, East of Java, resulted the grains yield 6.12 t ha^{-1}, higher than the grains yield achieved by the farmers (4 t ha^{-1}). Kang and Banga (2013) and Krishnan (2011) also stated that the rice planted in the lowland areas (high temperature) resulted grain yield better than planted in highland areas.

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Chandel *et al*. (2010) indicated that the higher application of Nitrogen increased rice grain and protein contents. The application of organic fertilizers in wet season caused the plants to release nutrients longer, and it tended to lower the radiation and reduce photosynthesis ability, so that the growth of plants was inhibited. The rice cultivation in the dry season gave higher yield compared to the cultivation done during wet season. Yang *et al.* (2008) also reported that significantly higher grain yields were achieved in dry season (DS) than in wet season (WS) by 94% for 2003 and 35% for 2004. Mean daily radiation was higher in DS than WS, particularly during grain filling stage than before flowering. The greater radiation during ripening in DS contributed to the higher grain yield.

Another opinions was stated by Qibtiyah (2014), that planting rice Ciherang in wet season at Lamongan, East of Java, reported that the grain yield at harvest achieved an average of 6.12 t ha^{-1}. This rice production was higher than farmer's production (an average of 4 t ha^{-1}). It is also in line with the research conducted by Kumaraswamy (2000), Kang and Banga (2013) and Krishnan (2011), that planted paddy in wet season better than planted in dry season.

It can be indicated that the grain yield of paddy Ciherang was varied depend on altitude, types of soils, time of planting and type and dosages of fertilizers.

Based on those informations, a field research was conducted to know the growth and yield of paddy Ciherang planted in dry and wet seasons and fertilized with organic and inorganic fertilizers.

MATERIALS AND METHODS

The study was conducted in a rice field, from July to October 2013 (dry season) and February to May 2014 (wet season), in Ngujung, Batu, 900 m above sea level (asl), the average temperature was 22^0C with Andosol soil type.

The research used a factorial randomized complete block design with three replications. Factor 1 was the time of planting i.e.: dry season and wet season. Factor 2 was the type of fertilizer used, i.e.: 100 kg N ha^{-1} + 50 kg P2O5 ha^{-1} + 70 kg K2O ha^{-1}; 50 kg N ha^{-1} + 25 kg P2O5 ha^{-1} + 35 kg K2O ha^{-1}; 20 t ha^{-1} cow manure; and 10 t ha^{-1} cow manure.

The rice Ciherang (the origin of the cross IR18349-53-1-3-1-3 / IR19661-131-3-1// IR196 61-131-3-1/// IR64 IR64) (Anonymous, 2009) was fertilized with inorganic and organic fertilizer, namely: (a) 100 kg N ha^{-1} (urea), 50 kg P2O5 ha^{-1} (SP36) and 70 kg K2O ha^{-1} (KCl); (b) 50 kg N ha^{-1} (urea), 25 kg P2O5 ha^{-1} (SP36) and 35 kg K2O ha^{-1} (KCl); (c) cow manure 20 t ha^{-1}; (d) cow manure 10 t ha^{-1}.

Land was prepared by plowing and harrowing (using a hand tractor), and the plot areas were prepared with the size of 5 x 4 m^2 per plot.

Rice seedlings were about 14 days old, with 25 x 20 cm plant spacing (with row system of Jajar Legowo, 1:4), and the number of plants per m^2 was 17.5 (plant population: 175,000 per ha). The rice was planted by using two seedlings/hill. Fertilizer was applied a day after rice planting with the number of 1/3 parts of dosage of urea. P2O5 (SP36) and K2O (KCl) fertilizers was applied a day before planting, and the cow manure was also applied a day before rice planting. The remaining urea fertilizers (each 1/3 parts of dosages of urea) were applied to rice Ciherang 14 and 28 days after planting (dap). Irrigation, weeding, pest and disease control were done when necessary depending on field condition.

The growth and yields of rice i.e. plant height, the number of leaves, leaf area index, the number of tillers per hill, the number of grains per hill, the weight of 1,000 grains, weight of grains and straw at harvest per hill and per m^2 were meausured as the parameters of growth and yields of rice Ciherang. The observations were tested with the F test 5%, then if F was significantly different, the testing was continued by using the LSD 5%.

RESULTS AND DISCUSSION

Based on Table 1, it can be stated that agricultural environment condition is as follows: pH (in H_2O soluble); pH (in KCl soluble); Organic matter (%); %C; %N; C/N; P2O5 Olsen) ppm; K soluble Acid pH 7.1 N (me); Rainfall within 4 months (mm); Rainfall within 4 months (mm); Temperature (^{0}C), soil pH was neutral, the temperature was relatively cool (around 22^0C), soil nutrient content of the soil was relatively pure, the rainfall was lower during dry season (2013) and it was high in wet season (2014).

Table 1. Soil and rainfall characteristics in dry season (years of 2013) and wet season (2014) based on field experiment at Ngujung, Batu

No.	Soil and Climatological Data	Dry Season (June–September, 2013)	Wet Season (February-Mei, 2014)
1	pH (in H_2O soluble)	7.09	6.3
2	pH (in KCl soluble)	6.26	5.9
3	Organic matter (%)	1.14	0.84
4	% C	1.24	0.48
5	% N	0.14	0.04
6	C/N	10.8	13
7	P2O5 (Olsen) ppm	8.40	7.66
8	K soluble Acid pH 7.1 N (me)	0.25	0.19
9	Rainfall within 4 months (mm)	237 (160; 76; 1; -)	-
10	Rainfall within 4 months (mm)	-	669 (226; 222; 199; 28)
11	Temperature (^{0} C)	21.5	22.4

Remarks: *) Data from Department of Soil Science, FP, UB and Station of climatology, Punten, Batu

Table 2. Plant height, leaf numbers per hill (sheet), leaf areas (cm^2) and leaf area index (LAI) 70 days after planting

No.	Treatment	Plant height (cm)		Leaf numbers per hill (sheet)		Leaf areas (cm^2)		Leaf Area Index (LAI)	
		Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014
1	100 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl)	92.2 a	91.5 ab	93.3 a	84.9 b	31.8	31.3	5.19 a	4.65 ab
2	50 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl)	88.7 abc	89.7 abc	82.3 b	71.8 cd	30.4	30.9	4.37 ab	3.88 bcd
3	20 tons cow manure	84.4 bc	86.2 bc	73.6 cd	62.4 e	31.1	30.3	4.00 bc	3.30 cd
4	10 tons cow manure	82.6 c	83.5 c	60.1 e	55.8 e	30.1	30.4	3.10 de	2.96 e
	LSD5%	5.6		5.01		ns		0.88	
	CV (%)	6.37		6.77		15.00		22.32	

Remarks: Means in the same column followed by the same letters are not significantly different (P<0.05), ns: non significant, DAP: days after planting; (1) NPK 100 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl); (2) NPK 50 kg N ha^{-1} (urea), 25 kg P2O5 ha^{-1} (SP36) and 37.5 kg K2O ha^{-1} (KCl); (3) compost manure 20 t ha^{-1}, and (4) cow manure 10 t ha^{-1}

There were an interaction between time of planting and application of inorganic and organic fertilizers on plant height, leaf numbers per hill (sheet) and leaf area index (LAI). The application of 100 kg N ha^{-1} (urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl) in dry season resulted in the highest of plant height, leaf numbers per hill (sheet) and leaf area index (LAI). The application of organic fertilizer (cow manure) in wet season resulted the lowest of plant height, leaf numbers per hill (sheet) and leaf area index (LAI) (Table 2).

Table 3. Number of tillers per hill, number of panicles per hill, number of grains per panicle and the weight of 1,000 grains (g) at 125 DAP

No.	Treatments	Tiller numbers per hill		Panicle numbers per hill		Grain numbers per panicle		1,000 grains weight (g)	
		Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014
1	100 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl)	23.6 a	18.2 B	20.8 a	15.8 b	151.2 a	103.7 c	26.6	26.3
2	50 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl)	20.4 a	15.1 Bcd	16.7 b	12.9 cd	140.6 a	91.6 d	26	25.7
3	20 tons cow manure	16.2 bcd	12.5 cd	13.2 c	10.1 ef	132.9 b	83.3 e	26.6	25.4
4	10 tons cow manure	14.9 bcd	11.2 d	11.8 de	9.3 f	112.1 c	81.4 e	25.4	26.1
	LSD 5%	4.0		1.8		12.7		ns	
	CV (%)	24.43		13.37		11.09		10.9	

Remarks: Means in the same column followed by the same letters are not significantly different (P<0.05), ns : non significant, DAP: Days after planting; (1) NPK 100 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl); (2) NPK 50 kg N ha^{-1} (urea), 25 kg P2O5 ha^{-1} (SP36) and 37.5 kg K2O ha^{-1} (KCl); (3) compost manure 20 t ha^{-1}, and (4) cow manure 10 t ha^{-1}

The application of 100 kg N ha^{-1} (urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl) in dry season resulted in the highest number of tillers per hill, the number of panicles per hill, the number of grains per panicle of paddy Ciherang. The application of organic fertilizer (cow manure) in wet season resulted the lowest the number of tillers per hill, the number of panicles per hill, the number of grains (grains) per panicle of paddy Ciherang (Table 3).

The application of inorganic fertilizers (NPK) and organic fertilizes (cow manure) in dry season (2013) increased the number of tillers per hill, the number of panicles per hill, the number of grains (grains) per panicle, and the weight of 1,000 grains (g) of paddy cv Ciherang, with averagely 31.8%, 29.6%, 49.1% and 0.1%, respectively, higher than that grown in the wet season (year 2014).

The application of 100 kg N ha^{-1} (urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl) in dry season resulted in the highest grains weight (g) per m^2, straw weight (g) per m^2 and harvest index of paddy Ciherang. The application of organic fertilizer (cow manure) in wet season resulted the lowest grains weight (g) per m^2, straw weight (g) per m^2 and harvest index of paddy Ciherang (Table 4).

The application of organic and inorganic fertilizers and planting time of paddy Ciherang resulted the grain yield an average of 984.2 g m^{-2} (dry season) and 481.8 g m^{-2} (wet season), the percentage of filled grains 80.91% (dry season) and 76.10% (wet season), dry weight of strawed 1,126.9 g m^{-2} (dry season) and 720.6 g m^{-2} (wet season) and harvest index 0.45 (dry season) and 0.37 (wet season).

The application of fertilizers 100 kg N ha^{-1} (urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl) in dry season resulted the highest grain yield (1,464 g m^{-2}), percentage of filled grains (78.63%), dry weight of strawed (1,598 g m^{-2}), and harvest index (0.09). The lowest of grain yield, percentage of filled grains, dry weight of strawed and harvest index of paddy Ciherang were resulted by the application of cow manure 10 t ha^{-1} in wet season.

Table 4. Grains weight (g) per m^2, percentage of filled grain (%), straw weight (g) per m^2 and harvest index at harvest time (125 DAP in 2013 and 105 DAP in 2014)

No.	Treatments	Grains weight (g) per m^2		Percentage of filled grain (%)		Straw weight (g) per m^2		Harvest Index	
		Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014	Dry season in 2013	Wet season in 2014
1	100 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl)	1,464.0 a	746.8 C	78.6 bc	74.0 cd	1,598.1 a	965.3 c	0.47 a	0.41 ab
2	50 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl)	1,068.3 b	531.4 d	77.7 bc	74.3 cd	1,182.3 b	750.3 de	0.47 a	0.38 bc
3	20 tons cow manure	816.6 c	373.9 e	84.13 a	78.3 bc	967.3 c	638.5 def	0.45 a	0.38 bc
4	10 tons cow manure	587.9 d	275.1 f	83.16 ab	77.7 bc	760.1 de	528.3 f	0.43 ab	0.34 c
	LSD5%	74.05		5.22		142.98		0.06	
	CV (%)	9.94		11.31		15.23		16.45	

Remarks: Means in the same column followed by the same letters are not significantly different (P<0.05), ns : non significant, DAP: Days after planting; (1) NPK 100 kg N ha^{-1} (Urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl); (2) NPK 50 kg N ha^{-1} (urea), 25 kg P2O5 ha^{-1} (SP36) and 37.5 kg K2O ha^{-1} (KCl); (3) compost manure 20 t ha^{-1}, and (4) cow manure 10 t ha^{-1}

Those results indicated that planting rice in dry season and fertilized with inorganic fertilizers better than in wet season and fertilized with organic fertilizers, such as indicated by Chandel *et al*. (2010) that the higher application of Nitrogen increased rice grain and protein contents. Based on the climatological data (Table 1), high rainfall during the growth of paddy Ciherang decreased the number of leaves, leaf area and LAI (Table 2), then followed by decreasing the number of tillers per hill, number of panicles per hill and the number of grains per panicles (Table 3). The high rainfall decreased the plants photosynthesis and resulted the lower assimilation rate. Crop Growth Rate (CGR) in dry season is 140.7 g m^{-2} per day and 11.4 g m^{-2} per day in wet season.

This condition also reported by Chandel *et al*. (2010) that the application of organic fertilizers in wet season caused the plants to release nutrients longer, and it tended to lower the radiation and reduce photosynthesis ability, so that the growth of plants was inhibited. The rice cultivation in the dry season gave higher yield compared to the cultivation done during wet season. Yang *et al.* (2008) also reported that significantly higher grain yields were achieved in dry season (DS) than in wet season (WS) by 94% for 2003 and 35% for 2004. Mean daily radiation was higher in DS than WS, particularly during grain filling stage than before flowering. The greater radiation during ripening in DS contributed to the higher grain yield.

Qibtiyah (2014), planting rice Ciherang in wet season at Lamongan, East of Java, reported that the grain yield at harvest achieved an average of 6.12 t ha^{-1}. This rice production was higher than farmer's production (an average of 4 t ha^{-1}). It is also in line with the research conducted by Kumaraswamy (2000), Kang and Banga (2013) and Krishnan (2011) that planted paddy in wet season better than planted in dry season.

It can be indicated that the grain yield of paddy Ciherang was varied depend on altitude, types of soils, time of planting and type and dosages of fertilizers.

CONCLUSIONS

It was an interaction between paddy Ciherang planted in dry/wet seasons and application of inorganic and anorganic fertilizers.

The highest leaves number per hill (93.3 sheets), Leaf Area Index (5.19) and grain yield (14.6 t ha^{-1}) of paddy Ciherang was achieved by interaction of planted paddy Ciherang in dry seasons (years of 2013) and fertilized with 100 kg N ha^{-1} (urea), 50 kg P2O5 ha^{-1} (SP36) and 75 kg K2O ha^{-1} (KCl).

The lowest leaves number per hill (55.8 sheets), Leaf Area Index (2.96) and grain yield (2.96 t ha^{-1}) of paddy Ciherang was achieved by interaction of planted paddy Ciherang in wet seasons (years of 2014) and fertilized with cow manure (10 t ha^{-1}).

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