IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 8, Issue 1 Ver. I (Jan. 2015), PP 26-30
www.iosrjournals.org

The Effect of Application Time and Dosage of Biourine on Growth and Production of Rice (*Oryza Sativa* L.)

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Abstract: *Objective of the research was to study the effect of application time and dosage of biourine on increasing the growth and production of rice. The research applied the Split Plot Design by 3 replications. The main plot is the application time of biourine that comprises of 2 levels: in the morning and in the afternoon. The sub plot is the dosage of biourine that comprises of 4 levels: 0, 500, 1000, 1500 and 2000 l ha^{-1}. Result of the research showed a significant interaction between time of application and dosage of biourine on diverse-observed parameters and ages. On parameter of growth, the application time in the morning by dosage of 1500 l ha^{-1} and application time in the morning by dosage of 2000 l ha^{-1} could increase leaf area, numbers of plantlet per clump and total dry weight of the crops, which are better than other treatments. On parameter of yield, the application time in the morning by dosage of 1500 l ha^{-1} and application time in the morning by dosage of 2000 l ha^{-1} could increase numbers of panicle per clump, weight of harvested dry spikelets, and weight of 1000 spikelets, which are better than other treatments.*

Keywords: *Biourine, rice (oryza sativa* L.*), time of application, dosage*

I. Introduction

The achievement of self-supporting of rice is one of parameters for success of the national food sustainability, which will highly affect various aspects, such as social, economy, and politics. Therefore, these motivate some efforts to increase production and productivity of rice, and it is expected to be able to meet self-supporting of rice (Azwir, 2008).

Many ways have been done to increase production of rice. One of them is providing materials that could make the soil to be more fertile and the crops could grow well. It has been done because of the reducing quality of the rice-field, where the rice has been grown, such as the decreasing physical, chemical, and biological properties. (Dachlan *et al*., 2012).

The use of cow's urine that is mixed with stable manure, and other organic materials, which are fermented into biourine, is applied to the crops and the soil as fertilizer, and it is expected to be able to replace the use of other artificial fertilizers, which are costly and the farmers cannot afford to buy them, so that it would be able to fulfill the needs of nutrient by the crops (Santosa and Rudi, 2012).

Application of the nutrients is usually done by 2 ways, such as applying to the soil and through the leaf. Application to the leaf will be more quickly absorbed than through the soil. Absorption of the nutrients through stomata is highly affected by the environmental factors (Salisbury and Ross, 1995).

Application of the appropriate dosage of nutrient would be able to fulfill the needs for nutrients by the crops, therefore it is expected that both growth and production of the crop would be optimal. Less dosage would inhibit growth and development of the crops.

II. Material And Method

The research was conducted at Tambakrejo Village, Duduksampeyan Subdistrict, Gresik Regency, East Java-Indonesia, which lies at the altitude of 8 m asl (above sea level) in gromosol soil. The research started from December 2013 to April 2014. Materials of the research include rice seeds of Ciherang, cow's urine, stable manure (feces), rice straws, EM-4, sugar, water, urea, KCL, and SP 36. The research used Split Plot Design by 3 replications. Main plot: time of the biourine application has 2 levels: in the morning and in the afternoon. The sub plot is the dosage of biourine that comprises of 4 levels: 0, 500, 1000, 1500 and 2000 l ha^{-1}. Biourine is made by mixing 5 kg of cow's feses, 1 liter of cow's urine, 50 liter of water, 1 kg of rice straw, 1 liter of EM4 and ¼ kg of sugar. All materials were put into a drum and stored for 2 weeks in sealed condition. Following the 2 weeks, the biourine is ready to be applied. First, the applied biourine must be diluted with water. Ratio of the dilution is 1 : 10. The biourine is applied at 15, 30,45, and 60 days after planting by spraying it on crops with a proper dosage in accordance with the treatment.

Observation on growth comprised of: leaf area (cm^2), numbers of plantlet per clump, and total dry weight of the crops. Observation on harvest included: numbers of panicle per clump, weight of harvested dry spikelets, and weight of 1000 spikelets. Chemical analysis on soil and biourine was done before implementation

of the research (before planting). In Table 1. Data of the research was analyzed using analysis of variance (F-test) at level of 5% in order to find out effect of the treatment. If the result was significantly different, it would be followed by LSD test with significant level of 5% to find out the difference between treatments.

Table 1: Chemical Analysis of Soil at Tambakrejo Village, Duduksampeyan Subdistrict, Gresik – East Java-Indonesia

Parameter	Value	Status
pH H_2O	7.88	High
KCl	6.93	Very High
C-organic (%)	0.90	Low
N (%)	0.10	Low
Ratio C/N	9.00	Low
P_2O_5 Olsen (ppm)	10.80	Low
K (me)	0.37	Low

III. Result And Discussion

3.1. Leaf Area

Result for analysis of variance on leaf area observation showed an interaction between the application time and dosages of the biourine at 30, 45, 60 and 75 dap. Table 2 shows that the application time in the morning by dosage of 1500 l ha^{-1} and the application time in the morning by dosage of 2000 l ha^{-1} could increase leaf area of rice crop better than other treatments.

Table 2. Mean for leaf area of rice crop (cm^2) due to interaction between the application time and dosages of biourine on diverse days of observation

Days (dap)	Application time of biourine	Dosage of biourine (l ha^{-1})				
		0	500	1000	1500	2000
30	Morning	245.94 a	284.66 c	334.18 e	375.52 g	375.54 g
	Afternoon	245.94 a	270.13 b	302.98 d	355.52 f	355.56 f
	LSD 5 %			9.57		
45	Morning	345.99 a	484.70 c	534.23 e	576.02 g	577.14 g
	Afternoon	346.21 a	470.17 b	503.03 d	555.57 f	556.05 f
	LSD 5 %			9.92		
60	Morning	650.48 a	785.69 c	834.47 e	930.70 g	938.08 g
	Afternoon	650.58 b	768.39 b	794.70 d	842.84 f	850.61 f
	LSD 5 %			26.84		
75	Morning	667.23 a	790.24 c	869.39 e	965.82 g	968.25 g
	Afternoon	667.56 a	789.22 b	838.21 d	875.61 f	888.48 f
	LSD 5 %			20.91		

Notes: Numbers followed by the same letter on each day have shown insignificant difference on LSD (Least Significant Difference) test of 5%.

3.2. Numbers of plantlet per clump

Result for analysis of variance on observation of the leaf area showed an interaction between the application time and dosage of biourine at 30, 45, 60 and 75 dap (days after planting). Table 3 shows the application time in the morning by dosage of 1500 l ha^{-1} and application time in the morning by dosage of 2000 l ha^{-1} could increase numbers of plantlet per clump better than other treatments.

Table3. Mean for numbers of plantlet per clump of rice crop due to interaction between the application time and dosages of biourine on diverse days of observation

Days (dap)	Application time of biourine	Dosage of biourine (l ha^{-1})				
		0	500	1000	1500	2000
30	Morning	8.56 a	14.89 c	16.33 d	18.44 f	18.44 f
	Afternoon	8.44 a	13.11 b	15.00 c	17.33 e	17.44 e
	LSD 5 %			0.63		
45	Morning	12.56 a	16.11 c	19.11 d	22.67 f	23.00 f
	Afternoon	12.33 a	14.22 b	18.33 d	20.44 e	20.56 e
	LSD 5 %			0.89		
60	Morning	17.89 a	23.11 c	23.89 c	28.22 e	27.67 e
	Afternoon	17.56 a	20.57 b	21.67 b	25.67 d	26.33 d
	LSD 5 %			1.11		
75	Morning	17.89 a	25.44 c	26.00 c	29.67 e	30.11 e
	Afternoon	17.56 a	22.22 b	25.11 c	27.78 d	28.33 d
	LSD 5 %			0.62		

Notes: Numbers followed by the same letter on each day have shown insignificant difference on LSD (Least Significant Difference) test of 5%.

3.3. Total dry weight of crop

Result for analysis of variance on observation of total dry weight of the crop showed interaction between application time and dosage of biourine at 30, 45, 60, and 75 dap. Table 4 shows the application time in the morning by dosage of 1500 l ha^{-1} and application time in the morning by dosage of 2000 l ha^{-1} could increase numbers of plantlet per clump better than other treatments.

Table4. Mean for total dry weight of rice (g $plant^{-1}$) due to interaction between the application time and dosages of biourine on diverse days of observation

Days (dap)	Application time of biourine	Dosage of biourine (l ha^{-1})				
		0	500	1000	1500	2000
30	Morning	4.27 a	7.08 b	8.93 c	11.20 e	11.16 e
	Afternoon	4.26 a	7.04 b	7.48 b	9.71 d	9.77 d
	LSD 5 %			0.67		
45	Morning	8.26 a	11.07 b	12.92 c	15.08 e	15.04 e
	Afternoon	8.25 a	11.03 b	11.47 b	13.70 d	13.76 d
	LSD 5 %			0.74		
60	Morning	12.25 a	15.06 b	16.80 c	19.07 d	19.14 d
	Afternoon	12.24 a	15.02 b	15.46 b	17.65 c	17.74 c
	LSD 5 %			1.25		
75	Morning	14.76 a	17.74 c	19.39 d	21.88 f	22.01 f
	Afternoon	14.57 a	16.56 b	19.13 d	20.48 e	20.57 e
	LSD 5 %			0.89		

Notes: Numbers followed by the same letter on each day have shown insignificant difference on LSD (Least Significant Difference) test of 5%.

Result for analysis of variance on observation during the harvest, which included numbers of panicle per clump, weight of harvested dry spikelets, and weight of 1000 spikes, showed interaction between application time and dosage of biourine as presented in Table 5.

3.4. Numbers of panicle per clump

Table 5 shows interaction between application time and dosage of biourine on parameter for numbers of panicle per clump. For the application time in the morning by dosage of 1500 l ha^{-1}, it could increase numbers of panicle per clump for about 27.22, and it shows insignificant difference with the treatment of application time in the morning by dosage of 2000 l ha^{-1}, which could increase numbers of plantlet per clum for about 28.00. Both treatments are better than other treatments, particularly in increasing numbers of panicle per clum.

3.5. Weight of harvested dry spikelets (t ha^{-1})

Table 5 shows interaction between application time and dosage of biourine on parameter for weight of harvested dry spikelets. For the application time in the morning by dosage of 1500 l ha^{-1}, it could increase weight of harvested dry spikelets for about 8.48 t ha^{-1}, and it shows insignificant difference with the treatment of application time in the morning by dosage of 2000 l ha^{-1}, which could increase weight of harvested dry spikelets for about 8.47 t ha^{-1}. Both treatments are better than other treatments, particularly in increasing weight of the harvested dry spikelets.

3.6. Weight of 1000 spikes (g)

Table 5 shows interaction between the application time and dosage of biourine on parameter for weight of 1000 spikes. The treatment of application time in the morning by dosage of 1500 l ha^{-1} could increase weight of the harvested dry spikelets for about 28.00 g, and it has insignificant difference with the application time in the morning by dosage of 2000 l ha^{-1} that could increase weight of the harvested dry spikelets for about 28.00 g. Both treatments are better than other treatments, particularly in increasing weight of the harvested dry spikelets.

Table5. Mean for numbers of panicle per clump, weight of the harvested dry spikelets (t ha^{-1}) and weight of 1000 spikes (g) due to interaction between the application time and dosages of biourine

Treatment		Numbers of panicle per clump	Weight of harvested dry spikelets (t ha^{-1})	Weight of 1000 spikelets (g)
Application Time	Dosage (t ha^{-1})			
Morning	0	14.56 a	5.12 a	23.33 a
	500	22.00 c	6.56 c	24.67 b
	1000	22.67 c	7.26 e	25.00 b
	1500	27.22 e	8.48 g	28.00 d
	2000	28.00 e	8.47 g	28.00 d
Afternoon	0	15.44 a	5.07 a	23.67 a
	500	20.33 b	6.23 b	23.67 a
	1000	22.11 c	6.87 d	24.67 b
	1500	24.44 d	7.61 f	27.00 c
	2000	25.00 d	7.82 f	26.67 c
LSD 5 %		1.59	0.28	0.81

Notes: Numbers followed by the same letter on each day have shown insignificant difference on LSD (Least Significant Difference) test of 5%.

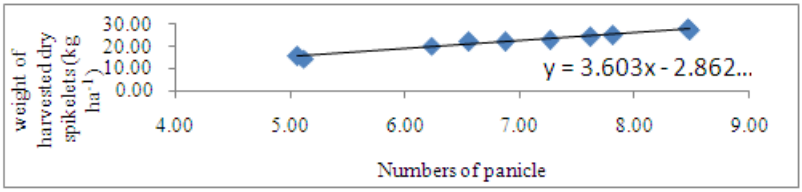

Figure1. Relationship between numbers of panicle and weight of harvested dry spikelets

Figure 1 describes the relationship between numbers of panicle and weight of the harvested dry spikelets after the treatment of application time and dosage of biourine. The increasing numbers of panicle have been followed by the increasing weight of harvested dry spikelets.

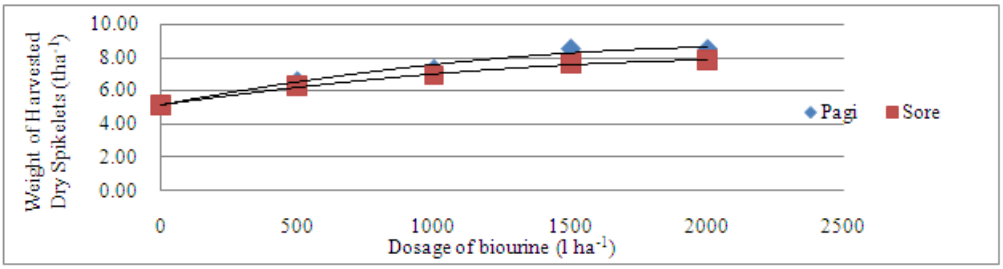

Figure2. Relationship between dosage of biourine l ha^{-1} and weight of harvested dry spikelets (t ha^{-1})

Figure 2 shows that the increasing dosage of biourine will increase weight of the harvested dry spikelets, as presented by the elevating trend on the graphic. The application in the morning is better than late in the afternoon. The Figure shows that the application in the morning by dosage of 1500 l ha^{-1} and application in the morning by dosage of 2000 l ha^{-1} have provided the same yield for weight of the harvested dry spikelets at the highest value.

The application of biourine has affected the growth and production of rice. On all parameters of the observation, an interaction has been found between the application time and dosage of the biourine. Result for the analysis of variance showed an elevating trend of result along with the increasing dosage of biourine that was applied on the crops. The application in the morning tended to have higher value than the application late in the afternoon.

Biourine contains organic nutrients as required by the rice crops besides other inorganic nutrients. Rahmatika (2009) described that nitrogen is highly required by the crop, particularly during the vegetative phase. Growth of the crop would increase proportionally if the nitrogen is sufficient for the crop. However, less nitrogen during the growth phase may restrict production and formation of new cells, which will support the growth and affect development of the crop.

Moreover, biourine contains some hormone of growth. According to Prawoto and Suprijadji (1992), if those cows are fed by greeneries, their urine will contain auxines and gibberreline hormones. Contents of both hormones range 162-783 ppm for auxines and 0-938 ppm for gibberreline. Both auxines and gibberreline hormones are highly important for growth of the crops, particularly during vegetative phase due to both hormones affect the growth of stems, roots, and leaves of the crops. Gibberreline hormone does not only affect on stem elongation, but also affect the entire parts of the crop. Gibberreline could also stimulate auxines synthesis, which is highly useful for root's development.

The cow's feces contains advantageous bacteria, such as : *Bacillus* sp, *Pseudomonas* sp, *Sarcina* sp, *E. coli* sp, *Acinetobacter* sp., *Micrococcus, Staphylococci* sp., *Penicillium* sp., *Rhizopus* sp., *Mucor* sp., and *Aspergillus* sp. Furthermore, it also contains nitrogen, carbon, potassium, calcium, sulphate, magnesium, sodium, and phosphor. Those elements are beneficial as nutritious sources for growth and development of microorganism. More nutrients contained in cow's feces will be highly beneficial if they are applied on crops along with the application of inorganic materials (Singh and Folekar, 2010). The fermented-cow's feces contain some microbes, such as Pseudomonas, Azotobacter, Lactobacillus, Bacillus, Aspergillus, Saccaromyces. Those microbes secrete protein, antioxidant in organic materials, organic acid, which will be changed into energy (Punitha et al, 2010). The fermented urine contains Nitrogen, Phosphor and Potassium 2.7 %; 2.4 %; 3.8 %, respectively (Martinsari *et al*., 2010).

Result of the analysis on biourine in the laboratory, it found that most of bacteria that contained in biourine are *Bacillus* sp. Besides acted as biological controller, *Bacillus* sp. could produce phytohormone that could affect growth of the crops, directly and indirectly. Indirectly, phytohormone of the bacteria will inhibit

activities of pathogen in the crops, and directly, the phytohormone will increase growth of the crops and it will be beneficial as facilitator in absorbing nutrients. *Bassilus* sp is bacteria, which is able to provide phosphate. It occurs by dissolving phosphor, which was previously existed in specific form that was not available for the crops, and then turned into phosphorus form that is available and readily used by the crops; therefore the crops would not have shortage of phosphate (Leskona *et al*., 2013). Phosphor is highly required by the crops during the vegetative and generative phases in order to increase production of the crops.

Application of the biourine through leaf is intended to avoid any loss of nutrients before they are used by the crop due to the nutrients, which are applied into the soil, would have fixation in the soil and they would not be absorbed anymore by the crops. This is due to the nutrients may lost or reduced during the fixation process as a result of leaching, denitrification, and volatilization, so that the nutrient availability for the crop may reduced. The application of biourine by spraying on the leaves in the morning is highly effective for the crop's growth, which will lead to the photosynthesis process along with sunlight. At late in the afternoon, the stomata will start to close along with the reducing temperature and light intensity, but it is not continued with photosynthesis process. Sitompul and Guritno (1995) stated that light is an important factor for the crop's growth due to the sun is the most important factor in photosynthesis process in order to produce photosynthates, which will be used by the crops. Besides the sunlight, it requires CO^2 and sufficient nutrients that will trigger the photosynthesis process.

Optimal photosynthesis process will produce optimal photosynthates in rice. According to Taiz and Zaiger (2002) in Fathonah *et al*.(2013), the external factors, such as intensity and temperature will have daily changes (diurnal). In the morning, the stomata will start to open widely due to the existence of light intensity, and low temperature, as well as sufficient moisture, and it increases turgor of the guard cell that opens the stomata. In the afternoon, high intensity of light, temperature, and evaporation will close the stomata, and it continues to late in the afternoon. Therefore, the application of biourine would be more effective to be applied in the morning.

Less dosage of nutrient would inhibit growth and development of the crops, and finally it may lead to the crops' death (Setyamidjaja, 1996). Appropriate dosage must be supported by appropriate application time as well, due to improper application time would make the nutrient's absorption and the use of the applied nutrients would not be optimally used by the crops because the nutrient's application should conform to the time when the crops require the nutrients and, of course, with appropriate dosage.

According to Lingga (2011), the application of organic and inorganic fertilizers would be able to increase the crop's growth. This is due to sufficient nutrients, as required by the crop, would increase the growth rate of the crop, therefore it would be more advantageous for the crops and, finally, it will produce more optimal yield.

IV. Conclusion

1. There is an interaction between application time and dosage of biourine to increase growth and production of rice.
2. Treatment of application time of biourine in the morning by dosage of 1500 l ha^{-1} and the application time of biourine in the morning by dosage of 2000 l ha^{-1} are treatments that could increase growth and production of rice better than other treatments.

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