

## **The Study of Straw Organics Products and JajarLegowo Utilization toward Rice Production Increase (*Oryza sativa* L.)**

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**Abstract:** This study aims to understand the influence of Straw Organics products and JajarLegowo Utilization toward Rice Production Increase. The research applied the Randomized Completely Block Design by 3 replications. The first treatment consists of four levels, those are: without straw organic product, burnup straw, bokhasi straw, and biochar straw. Jajarlegowo treatment consist of four levels, those are: conventional, jajar legowo 2 : 1, jajar legowo 4 : 1, and jajar legowo 6 : 1. The results showed significant interaction between straw organic product and jajarlegowo on various observed parameters and various ages. On growth parameters, Straw Bokhasiandjajarlegowo treatment, 6: 1 can increase plant height, leaf width, number of Numbers of plantlet per clump than other treatments. On results parameter, Straw Bokhasiandjajarlegowo treatment, 6: 1 can increase the number of panicles, grainweight per panicle, dry weight of total plant, weight of harvested dry grain. As addition, weight of 1000 grain is better than other treatments.

**Keywords:** rice, bokhasi, biochar, burnt, straw, jajarlegowo, straw organic products

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### **I. Introduction**

Food needs in Indonesia increases each year because of the increasing population, especially for need of hulled rice, because it is still the staple food of the people in Indonesia. The need for hulled rice is still collateral to the increase of rice production in the country. This happens because rice production is still constant from year to year (Sumardi, *at. al*, 2007).

The role of the environment is assumed to have a considerable role in suppressing the number of empty panicles, so the attempts to do is to manipulate the environment of rice crops by optimizing the natural resources that exist in the residence surrounding, and in land of rice farmers in particular, so that farmers will be able to do the correct cultivation system..

One rice production factor can not be maximized because the organic material on agricultural land, especially paddy fields continues to decline in quantity and quality. Thus the addition of organic material is needed to improve the texture of the soil in rice fields, and increase nutrient uptake by plants. One of the organic materials that can be utilized is paddy straw. The straw can be processed into organic products in the form of burnt straw, Straw Bokhasiandbiocharstraw. It is expected that the three of straw organic products could increase rice production.

According to Kuruseng (2012), adding organic fertilizers will improve the physical, chemical and biological characteristic of soil. It can make the soil more fertile, affect the growth of micro-organisms in the soil and also increase the water-binding capacity of the soil. In soils with high C-organic, the nutrient will be more available to plants so that fertilization could be more efficient.

Other factor which results in no maximum production of rice is the dense spacing of the conventional planting pattern. This leads to maximum sunlight can not be obtained by the whole plant, so that the spacing rice plants must be considered. Jajarlegowo is a planting pola that makes more edge plants appearing, because it is known that plants at the edge will result more production (Mustakim, 2008). Jajarlegowo planting pattern is a pattern in which an empty space without rice plants in one row. There are several types jajarlegowo planting patterns, those are 2:1, 4:1 and 6:1 (Azwir, 2008).

### **II. Material And Method**

This study was conducted in the Tambakrejo village, Dukuksampeyan District, Gresik, East Java, which lies at an altitude of 8 m above sea level with gromosol soil type. The study is conducted in March until July 2015. The materials used are Ciherang rice seed, rice straw, EM-4, sugar, water, urea, KCl, SP 36, vats biochar, plastic cover. This study uses a randomized block design with 3 times replications. The first treatment that is kind of straw organic products comprises 3 levels: without organic products of straw, burnt straw, bokhasi straw, and biochar straw. Jajarlegowo treatment consists of four levels, those are: conventional, Jajarlegowo 2:1, Jajarlegowo 4:1, Jajarlegowo 6:1.

The manufacture of straw organic products is started with the Straw Bokhasithat is made by spreading straw on the floor and dousing it with EM4 solution consisting of 1 liter EM4 mixed with 2 tablespoons of sugar and 10 liters of water. After flushed, the straw is covered by canvas. Bokhasi straw can be used in four weeks. The making of burnt straw is to burn straw out door. When all is burned, burnt straw is ready for use. While biochar-making is by putting the straw in steel vats, then setting fire to the straw, then closing the vat so that the burning can be done with minimal oxygen. After 4 hours, the barrel was opened, and Straw Biochar ready for use. Then, the furrow of Jajarlegowo planting patterns is made in the processed ground. The furrow called Jajarlegowo 2: 1 means that there are two rows and then one blank line, and so on. Jajarlegowo 4: 1 means there are 4 rows of plants then one blank line (without plants), the pattern Jajarlegowo 6: 1 ie there are 6 rows then one blank line (without plants), whereas the conventional pattern is planting with the floor tile system. Straw organic products is given on the processed field in accordance with the treatment, and left for 14 days. Rice seed is implanted in fields of research at the age of 20 days after planting using Jajarlegowo planting pattern.

Observations of growth include: plant height, leaf width (cm<sup>2</sup>), numbers of plantlet per clump. Harvest Observations include: grains weight per panicle, weight of harvested dry grain, and the weight of 1000 grains, and total weight of the plant. Chemical analysis of total dry weight of the soil and straw organic material is conducted prior to the implementation of the study (before planting). Observation data obtained were analyzed by analysis of variance (F test) at 5% level to determine the effect of treatment. If the results are significantly different then the test is followed by Least Significant Different (LSD) test with 5% significance level to determine differences between treatments.

### III. Result And Discussion

#### 3.1. Plant height

Based on analysis of variance result on the observation of leaf width, it is known that the interaction between the treatment of straw organic products and Jajarlegowo at the age of 15, 30, 45, 60 and 75 days after planting. Table 1 shows Straw Bokhasi and Jajarlegowo 6: 1 treatment can increase the height parameter of plant better than the other treatments.

Table 1. Rice plant height average (cm) due to the interaction between the kind of straw organic products and jajarlegowo

Treatment	Plant height average (cm) on the observations at the age of				
	15 days	30 days	45 days	60 days	75 days
Without straw organic product and conventional	53.18 a	53.18 a	63.27 a	83.33 a	99.15 a
Without straw organic product and Jajarlegowo 2 : 1	55.12 b	55.12 b	65.37 b	84.49 b	101.91 a
Without straw organic product and jajarlegowo 4 : 1	60.79 d	60.79 d	71.06 e	89.52 g	103.95 b
Without straw organic product and Jajarlegowo 6 : 1	62.52 e	62.52 e	72.11 f	90.58 h	103.29 b
Burnt straw and conventional	54.34 b	54.34 b	70.12 d	89.02 g	102.82 b
Burnt straw and jajarlegowo 2:1	55.12 b	55.12 b	65.44 b	85.38 c	101.91 a
Burnt straw and jajarlegowo 4 : 1	60.81 d	60.81 d	71.09 e	92.73 i	103.97 b
Burnt straw and Jajarlegowo 6 : 1	62.16 e	62.16 e	72.77 g	93.57 j	106.01 c
Straw Bokhasi and conventional	55.09 b	55.09 b	65.44 b	84.84 b	98.47 a
Bokhasi jerami and Jajarlegowo 2:1	58.06 c	58.06 c	68.29 c	85.62 c	100.47 a
Straw Bokhasi and Jajarlegowo 4:1	57.93 c	57.93 c	68.37 c	87.58 e	107.53 c
Straw Bokhasi and Jajarlegowo 6:1	64.32 f	64.32 f	74.52 h	94.23 k	113.07 d
Straw Biochar and conventional	58.19 c	58.19 c	68.27 c	86.85 d	106.53 c
Straw Biochar and Jajarlegowo 2:1	58.01 c	58.01 c	68.83 c	86.17 c	106.58 c
Straw Biochar and Jajarlegowo 4:1	60.04 d	60.04 d	69.88 d	89.59 g	108.97 c
Straw Biochar and Jajarlegowo 6:1	62.22 e	62.22 e	71.21 e	88.48 f	111.81 d
LSD 5 %	0.82		0.82	0.52	0.68

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

### 3.2. Leaf width

In observation of leaf width, it is obtained that there are interactions on the treatment of straw organic products and Jajarlegowo at the age of 15, 30, 45, 60 and 75 days after planting. Table 2 shows that bokhasi straw and Jajarlegowo 6: 1 treatment can increase rice leaf width better than the other treatments. At the age of 15, 30, 45, 60 and 75 days after planting, the lowest plant height in the control treatment (without straw organic material and conventional planting patterns) are respectively 276.28, 377.77, 435.99, 767.11 cm<sup>2</sup>.

Table 2. Average of rice plant leaf width (cm<sup>2</sup>) due to the interaction between straw organic products and jajarlegowo

Treatment	Average of rice plant leaf width (cm <sup>2</sup> ) on the observationat the age of				
	15 days	30 days	45 days	60 days	75 days
Without straw organic product and conventional	276.28 a	377.77 a	435.99 a	767.11 a	837.37 a
Without straw organic product AndJajarlegowo 2 : 1	296.40 b	397.47 c	489.83 b	765.47 a	840.91 a
Without straw organic product and jajarlegowo 4 : 1	297.84 b	399.92 d	487.89 b	786.44 b	844.89 a
Without straw organic product and Jajarlegowo 6 : 1	303.79 c	406.99 d	484.09 b	783.73 b	841.34 a
Burnt straw andconventional	279.06 a	382.88 b	477.28 b	767.35 a	875.42 b
Burnt strawandjajarlegowo 2:1	325.46 g	427.27 f	520.57 e	816.49 c	876.52 b
Burnt straw andjajarlegowo4 : 1	335.13 h	437.36 g	530.33 f	824.64 c	895.31 b
Burnt straw and Jajarlegowo6 : 1	343.07 j	444.64 i	537.80 f	834.00 d	906.10 bc
Straw Bokhasi and conventional	297.37 b	398.98 c	493.95 b	777.11 a	915.78 bc
Bokhasijeramiand Jajarlegowo 2:1	336.08 h	439.92 h	505.73 c	827.63 c	941.81 cd
Straw Bokhasi and Jajarlegowo 4:1	345.79 k	447.90 j	540.89 g	839.50 d	927.81 c
StrawBokhasi and Jajarlegowo 6:1	356.00 l	457.76 k	549.43 g	855.45 e	963.67 cd
Straw Biocharand conventional	309.05 d	413.44 d	515.70 d	787.87 b	917.88 bc
StrawBiochar and Jajarlegowo 2:1	323.17 f	424.80 e	517.99 d	813.83 c	915.29 bc
Straw Biocharand Jajarlegowo 4:1	339.70 i	437.32 g	530.53 f	824.90 c	910.91 bc
Straw Biochardan Jajarlegowo6:1	318.73 e	440.00 h	532.46 f	828.47 c	922.42 bc
LSD 5 %	0.98	1.28	10.58	13.86	23.21

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

### 3.3. Numbers of plantlet per clump

The analysis results of the number of plantlet per clump showed the interaction between the treatment of straw products and jajarlegowo at the age of 15, 30, 45, 60 and 75 days after planting. In table 3, it can be seen that the treatment of bokhasi straw and jajarlegowo 6: 1 is better than the other treatments because of the increasing number of plantlet per clump of rice plants were bigger than the other treatments. The table 3 can be seen below :

Table 3. Average number of tillers per clump of rice plants due to the interaction between straw organic products and Jajarlegowo

Treatment	Average number of tillers per clump on the observation at the age of				
	15 days	30 days	45 days	60 days	75 days
Without straw organic product and conventional	4.33 a	8.47 a	15.53 a	19.87 a	19.87 a
Without straw organic product AndJajarlegowo 2 : 1	6.07 b	11.47 c	17.93 c	22.33 c	22.33 c
Without straw organic product and jajarlegowo 4 : 1	10.4 e	14.67 e	20.93 f	24.53 f	24.53 f
Without straw organic product and Jajarlegowo 6 : 1	10.67 e	14.8 e	21.67 f	25.33 f	25.33 f
Burnt straw andconventional	6.47 b	11.47 c	19 d	23.53 d	23.53 d
Burnt strawandjajarlegowo 2:1	4.40 a	9.53 b	16.07 b	21.13 b	21.13 b
Burnt straw andjajarlegowo4 : 1	8.20 c	13.27 d	19.93 e	23.8 d	23.8 d
Burnt straw and Jajarlegowo6 : 1	9.00 d	14.2 e	20.73 f	24.87 f	24.87 f
Straw Bokhasi and conventional	10.33 e	15 e	21.8 f	26.13 g	26.13 g
Bokhasijeramiand Jajarlegowo 2:1	11.27 e	15.8 e	22.73 f	26.07 g	26.07 g
Straw Bokhasi and Jajarlegowo 4:1	11.6 e	16.67 e	23.53 g	26.33 g	26.33 g
StrawBokhasi and Jajarlegowo 6:1	13.27 g	18.4 f	25.13 h	28.00 h	28.00 h
Straw Biocharand conventional	8.20 c	13.2 d	19.93 e	24.33 e	24.33 e
StrawBiochar and Jajarlegowo 2:1	11.00 e	16.13 e	22.47 f	26.2 g	26.20 g
Straw Biocharand Jajarlegowo 4:1	12.47 f	17.2 e	23.33 g	26.13 g	26.13 g
Straw Biochardan Jajarlegowo6:1	10.87 e	16.17 e	23.27 g	26.33 g	26.33 g
LSD 5 %	0.76	0.56	0.76	0.98	0.98

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

In observation of the harvest which consists of number of panicles per clump, dry grain harvest weight, and weight of 1000 grains showed an interaction between treatment of straw organic products and jajarlegowo based on an analysis. It can be seen in table 4 below.

### 3.4. Number of panicles per hill

Table 4 shows the interaction between the treatment of straw organic products and Jajarlegowo at the parameter number of panicles per hill bokhasi and Jajarlegowo 6: 1 treatment can increase the number of panicles per clump at 27.47. That treatment is better than other treatments to increase the number of panicles per clump of rice plants.

### 3.5. Total dry weight of plants

In Table 4 it can be seen the interaction between straw organic products andJajarlegowo treatment on the total dry weight of the plant parameters. Bokhasi and Jajarlegowo 6: 1 treatment is a better treatment than the other treatments with total plant dry weight of 24.23 g tan<sup>-1</sup>.

### 3.6. The weight of grain per panicle

Table 4 shows the interaction between of straw organic product and jajarlegowo.Bokhasi and Jajarlegowo 6: 1 treatment is a better treatment than the others. On this treatment, grain weight per clump is 35.64 g.

### 3.7. Weight of dry grain per hectare

On the results of the analysis, it is known that there is an interaction between straw organic product and jajarlegowo. In Table 4, bokhasi and Jajarlegowo 6: 1 treatment is a better treatment than the other treatments.

Table 4. Average number of panicles per clump, total dry weight of the plant, grain weight per clump, grain weight harvested per hectare (t ha<sup>-1</sup>) and weight of 1000 grains (g), as a result of the interaction between straw organic products and jajarlegowo

Treatment	Number of panicles per clump	total dry weightof plant (g plant <sup>-1</sup> )	Grain weight per clump (g)	Grain Weight Harvested per hectare(t ha <sup>-1</sup> )	Weight of 1000 Grains (g)
Without straw organic product and conventional	14.13 a	15.02 a	21.52 a	6.51 a	23.73 a
Without straw organic product AndJajarlegowo 2 : 1	17.20 d	15.15 a	21.44 a	6.91 a	24.07 b
Without straw organic product and jajarlegowo 4 : 1	18.60 e	17.82 c	23.61 b	7.63 d	24.73 c
Without straw organic product and Jajarlegowo 6 : 1	19.53 f	16.69 b	26.12 c	7.35 b	27.20 g
Burnt straw andconventional	15.20 c	19.48 d	27.49 d	8.36 d	26.93 f
Burnt strawandjajarlegowo 2:1	19.40 f	20.92 e	30.74 e	7.54 c	27.20 g
Burnt straw andjajarlegowo4 : 1	20.93 g	20.69 e	33.62 g	7.52 c	26.73 f
Burnt straw and Jajarlegowo6 : 1	14.13 a	20.79 e	33.44 g	9.16 g	26.07 e
Straw Bokhasi and conventional	21.07 h	18.10 c	27.71 d	8.46 e	24.73 c
Bokhasijeramiand Jajarlegowo 2:1	21.73 h	19.88 d	33.75 g	8.81 f	25.33 d
Straw Bokhasi and Jajarlegowo 4:1	24.93 j	22.72 f	34.58 h	9.4 g	27.40 g
StrawBokhasi and Jajarlegowo 6:1	27.47 k	24.23 g	35.64 i	10.21 h	28.00 h
Straw Biocharand conventional	15.13 b	17.73 c	26.28 c	7.34 b	26.93 f
StrawBiochar and Jajarlegowo 2:1	19.47 f	19.68 d	30.81 e	8.7 f	27.20 g
Straw Biocharand Jajarlegowo 4:1	20.93 g	22.39 f	33.68 g	8.41 e	26.07 e
Straw Biochardan Jajarlegowo6:1	23.87 i	19.58 d	32.76 f	9.43 e	26.20 e
LSD 5 %	0.74	0.45	0.16	0.31	0.36

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

Organic fertilizer is the best and nature fertilizer ofmade fertilizer. Fertilizer soils material derived from an organic material can prevent erosion, cracks, drought of the soil, and also can retain soil moisture and improve internal drainage (Kuruseng, 2012).

Organic material is free grains gluten and is nitrogen, phosphorus and sulfur main source, so that organic can increase the amount of water held in soil and the amount of water in the plants. Organic material is microorganism energy source, so without organic material, all biochemical activity is stopped(Taufik, 2004).On the results of the studies,straworganic products interact with Jajarlegowo both on the growth and development parameters.Bokhasi and Jajarlegowo 6: 1 treatment is a better treatment than the others. It is due to bokhasiwhichis processed rice straw with EM-4, and considerable potential as an organic material.

The use of straw Bokashi manure P is expected to increase the availability of P, increasing the fertility of the physical, chemical, and biological soil, and further increasing rice production. The addition of bokhasi into the soil will add organic matter and nutrients to the soil. This causes N received by the ground will be higher. The N element is needed by plants during vegetativeperiode. Nitrogen is needed in composition of amino acids, proteins and chlorophyll pigments which are important components in photosynthesis. If the need for nitrogen is less, plant growth and development will be impaired and can not be optimal because of disturbed formation of chlorophyll in plants which is as material for photosynthesis (Junaidi, 2009).

Rahmatika (2009), explains that the nutrients nitrogen is needed by the main crop in the vegetative phase. Plant growth will maximum increase if the nutrients nitrogen fulfilled. If the nitrogen nutrient is less on plant vegetative phase, there will be restrictions on the production and the formation of new cells that will support growth and will result less maximum plant development.

On the results of laboratory analysis conducted after bokhasi, biochar and burnt straw manufacture, it is known that bokhasi has the highest N content among the three products. It is as well as the organic material and carbon content (appendix 1). This can be as a reference that bokhasi is a better organic material than the burnt and biochar for nutrient supplier of rice plants.

Bokhasi is an organic fertilizer which can improve the physical, chemical, and biological of soil. It can improve crop production and quality and quantity plants yield that is ultimately expected to reduce the use of inorganic fertilizers for nutrient needs of plants (Setiani, 2014).

Bokhasi is a kind of organic fertilizer that can replace the use of chemical fertilizers to improve soil fertility and can reduce soil damage as the result of excessive inorganic fertilizer use. (Atikah, 2013).

According to Tufaila *et al* (2014), based on research that has been done, bokhasi can enhance the growth and development of rice plant, which is on the number of productive tillers, fresh grain weight and dry grain weight.

The use of Jajar legowo as rice cropping pattern can improve rice production on field. According to Suwono *et. al.* (2000), the superiority of jajar legowo method compared to tile planting system higher number of plants per wide unit so that the production is bigger. Alternate spacing causes more air circulation and absorbed sunlight that can reduce pest disease. It can also cause easier weeding and fertilizing.

At Jajar legowo 6: 1, the plant population more than the Jajar legowo 2: 1 and 4: 1, so that rice production is better than the other Jajar legowo. This can be seen in Table 4 which shows yields on bokhasi treatment and Jajar legowo 6: 1 resulted better crop parameters compared with other treatments on weight of dry grain per hectare at 10.21 ton ha<sup>-1</sup>.

According to Zaini *et. al.* (2007), the results of research that has been conducted shows that the application of Jajar legowo planting system can improve dry grain harvest in big farmer technology at about 18% or 1.0 t ha<sup>-1</sup>. Furthermore Suprihatno *et. al.* (2007) explain that rice production can be increased by about 16-27% more than average production obtained by farmers through Jajar legowo planting. According to Bahren (2003), jajar legowo planting systems can increase the production of dry grain per hectare of 16.3-25.6%, this was due to increased production per clump as entire rows of rice plants get higher sunlight as well as on the edge of the existing plants in tile cropping systems.

Sunlight is an important factor for plant growth; it is because the sun is the most important factor in the process of photosynthesis to produce material that will be used by plants. In addition to sunlight, CO<sup>2</sup> and nutrients are fulfilled will spur photosynthesis process. Optimal photosynthesis process will produce the optimal yield on rice plants (Sitompul and Guritno, 1995).

The response of plants is increased, along with the increasing temperature and light intensity. This is because the sunlight will form reducing energy, called ferredoxin reduced. Reducing the energy will play a role in the process of reduction of nitrate to ammonia. After ammonia undergone several stages of biochemical reactions, it will produce nitrogen in a form that is readily absorbed by plants, for example NO<sup>3</sup>. While the optimum temperature will assist in the assimilation of nitrogen to be smooth, both in the soil and are already in the plant tissue. With nitrogen assimilation process smooth the crop needs for nutrients nitrogen fulfilled (Haryanti, 2010).

The purpose of Jajar legowo planting pattern is to maximize the absorption of sunlight by rice plants so that the photosynthesis process is higher then maximizes the charging of grains. It can reduce rat attack because the land is relatively open, the rat is less like staying in it, and can suppress disease. On land that is relatively open, the humidity will decrease, so the disease will also be reduced. It facilitates the implementation of fertilization and pest / disease. The position of those who carry out the fertilization and pest / disease can be freely on the space between two legowo rows, that can facilitate the maintenance of the plant.

Rice plant land attempted for crops by farmers is suitable with bachelor class category that is very compatible for plant rice and suitable with doctoral category that is marginal. It has a limiting factor availability of oxygen. So to obtain optimum productivity, it is required good drainage and inorganic and organic fertilizer (Anwar *et. al.*, 2007).

#### **IV. Conclusion**

Based on the results of the research study titled The Study of Straw Organic Products and Jajar legowo Utilization toward the increase of rice production, it can be concluded that:

1. There was an interaction between straw organic product and Jajar legowo treatment
2. Bokhasi and Jajar legowo 6: 1 treatment can promote the growth and production of rice better than the other treatments.

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## Appendix

### Appendix 1. The Pictures of Straw Organics Products



Picture 1



Picture 2



**Picture 3**

notes:

1 : Straw Bokhasi

2 : Burnt Straw

3 :StrawBiochar

**Appendix 2.**

Chemical Analysis of Soil at Tambakrejo Village, DuduksampeyanSubdistrict, Gresik – East Java -Indonesia

Parameters	Value	Status
pH H <sub>2</sub> O	6.21	Medium
KCl	5.75	Medium
C-organic (%)	1.08	Low
N (%)	0.10	Low
Ratio C/N	10.80	Low
P <sub>2</sub> O <sub>5</sub> Olsen (ppm)	53.00	Very heigh
K (me)	0.57	Medium

**Appendix 3..Analysis Result of Straw Organic Product**

Straw Organics Products	pH soluble H <sub>2</sub> O	Organic Material			Organic Material (%)	Soluble H <sub>2</sub> SO <sub>4</sub> + H <sub>2</sub> O <sub>2</sub> (%)		
		% C	% N	C/N		P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Mg
Straw Bokhasi	10.84	9.00	0.76	11.84	15.51	0.58	0.68	-
Burnt Straw	7.59	14.40	1.19	12.10	24.81	0.52	0.93	-
Straw Biochar	11.39	8.60	0.58	14.83	14.82	0.69	1.18	-