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Effects of decomposition rate of *Chromolaena odorata* and straw rice in fresh and compost form to the growth and yield of rice

R Agustina*, R Jumadi, U Firmani and Faisal Abdul R H

Department of Agrotechnology, Agriculture Faculty, University of Muhammadiyah Gresik, East Java, Indonesia

E-mails: rohmatin@umg.ac.id

Abstract. The potential of *Chromolaena odorata* in bringing high Carbon and Nitrogen contents to the soil instead of its existence as shrub in any rice farms should be optimized to support soil fertility as an alternative of inorganic fertilizer. Meanwhile, the straw was usually burned by rain-field farmers which directly impact the air purity. This study was aimed to examine the decomposition rate of *C. odorata* and rice straw in the fresh and composted form to the growth and yield of rice on latosol rain field at Lamongan, East Java Province. The experiment was split plot randomized design with 6 treatments and 3 repetitions. The treatment consisted of control, *C. odorata* fresh, *C. odorata* compost, fresh rice straw, straw compost, and inorganic fertilizer. Obtained data were analyzed using analysis of variance (ANOVA); Duncan's Multiple Range Test (DMRT) with significant level 0.05 was used for further analysis. The result showed decomposition rate of C, N, and organic matter of soil of organic fertilizers were significantly different with inorganic fertilizer the trend was identical from 2nd until 8th week. The yield of dry weight rice grain, the straw fresh fertilizer can almost level the yield of inorganic fertilizer.

1. Introduction

The actual rice productivity of a rain field in East Java province approaches 5-6 t/ha, while its potential can reach until 8-10 t/ha. This low productivity can be caused by some agronomy or cultivation, soil fertility, and ecology factors. The cultivation system follows rain season. While the ecosystem and environment can only settle in long term. So, then the soil fertility we could attain to be better. The soil fertility level indicates by the soil organic matter (C-organic). The soil was fertile when its organic matter content at minimum of 2.5-4%. But we found that observed soil content of rain field in Lamongan district at 2017 was accordingly as low as 1.72% (University of Brawijaya Laboratory, 2017). We shall then promote organic matter instead of commonly use of inorganic fertilizer to preserve soil fertility. We choose rice straw and *C. odorata* as the organic matter agents. The straw which usually slashed and then burned by farmer [1] obviously impacting to the air freshness; in bigger effect it could seriously increase the greenhouse effect. This condition should not happen when we can directly utilize it for organic fertilizer. Meanwhile, the *C. odorata* or siam weed can be found easily in any field or farm areas. Also, on the rural backyard for instance, the weed can grow notoriously.

The leaf of *C. odorata* are rich in many of soil nutrients [2, 3]. The plant contributes high nitrogen ingredient (3.79%) as the soil sample reported from the Land laboratory at University of Brawijaya. The *C. odorata* plant has quick rate with initial N-total content of 0.6% while the *C. odorata* decomposition



rate for 21 days can release N as much as 88.66% so that *C. odorata* is expected to be efficiently improving the plant quality. On the other hand, the straw has 40% C nutrient and the 1/3 N total of rice plant reserved by straw which means that this natural resource should be put back into the field.

Apart from utilization of *C. odorata* as fertilizer [4,5,6], the leaf of *C. odorata* also been found to be beneficial as a potion in medicinal herb [7], profitably as energy conversion solution [8], or as a cattle feed [9]. Without neglecting inorganic fertilizer, the organic materials naturally have many uses in improving soil properties such as a granulator which can improve soil structure, nitrogen nutrient sources, phosphorus, Sulphur, micro elements and others, which adds the ability of the soil to hold water, hold nutrients and enhancing the biochemical activity of microorganisms.

The ease and availability in applying organic fertilizers to the soil also of consideration for farmers. The application of organic fertilizer into soil can be either in the form of compost and fresh. The smaller size of the organic material then the decomposition rate increases because it will be more easily attacked by microorganisms. The application of fresh and compost organic matter into the soil is expected to have beneficial effect for soil. Plants will give a positive response if the land provides conditions that are good for growth and development. This study aimed to determine the decomposition rate of organic matter of straw and *C. odorata* in the fresh and compost form to increase the productivity of rice yields.

2. Materials and methods

The experiment was conducted on a rain field in the Kadung Rembug village, Sukodadi sub-district, Lamongan district, East Java Province at 7 meters above sea level on March until June 2018. Rice variety used in this experiment was the Inpari 30 hybrid superior variety. The fertilizers consisted of fresh straw, compost straw, fresh *C. odorata*, compost *C. odorata*, and inorganic of NPK (Nitrogen Phosphat Kalium).

The method in this study conducted in randomized complete block design (RCBD) or split plot with 6 treatments and 3 repetitions. The treatments consisted of control, *C. odorata* fresh 7 t/ha, *C. odorata* compost 5 t/ha, straw fresh 36 t/ha, straw compost 12 t/ha, and inorganic fertilizer. Preparation of organic fertilizer was both *C. odorata* and straw chopped in 3-4 cm size, then mixed with a decomposer solution until damp and stored in 15 days. Finished fertilizer used at cultivation direct into the soil. The planting space were 20 cm length and 15 cm wide of *jajar legowo* system 40 cm.

3. Results and discussions

The observed result of soil fertility of the natural parameters C, N, C/N ratio, and organic matter represented at 2nd, 4th, 6th, and 8th weeks after planting in Table 1 and Table 2. While the crop yield put in Figure 2 showing plant weight and dried grain weight.

Table 1. Total Carbon & Nitrogen

Treatment	Carbon				Nitrogen			
	2 nd	4 th	6 th	8 th	2 nd	4 th	6 th	8 th
Control	1.69 c	1.86 cd	0.62 b	0.71 a	0.075b	0.078b	0.099ab	0.097a
C.od compost	1.97 b	1.78 d	0.58 b	0.57 ab	0.090b	0.073b	0.088c	0.085b
C.od fresh	1.97 b	1.92 bc	0.76 a	0.55 b	0.081b	0.075b	0.103a	0.105a
Straw compost	2.44 a	1.81 cd	0.71 a	0.66 b	0.125a	0.077b	0.088c	0.104a
Straw fresh	1.78 bc	2.11 a	0.49 c	0.61 b	0.084b	0.091a	0.093bc	0.099a
NPK	1.77 bc	2.01 ab	0.52 c	0.43 b	0.078b	0.076b	0.087c	0.097a
DMRT 0.5%	s	S	s	s	s	s	s	s

Note: s – significant, ns – not significant

3.1. Decomposition rate

At 8th week after planting (Table 1) carbon composition of natural soil without any fertilizer was the highest at 0.71 and the straw compost was the second highest at 0.66, while the inorganic fertilizer was

the lowest at 0.43. This indicated that inorganic fertilizer could be replaced by other organic fertilizer. *C. odorata* compost has the lowest composition of N content in organic fertilizer.

On the other hand, in Table 2, the C/N ratio of the lowest composition at 8th week after planting was inorganic fertilizer, though this value was depending on both C and N divisions. Meanwhile, the organic matter of non-fertilizer application was the best value at 1.23. Which again, the inorganic fertilizer could be replaced as the value only 0.74.

Table 2. The C/N ratio and organic matter

Treatment	C/N				O			
	2 nd	4 th	6 th	8 th	2 nd	4 th	6 th	8 th
Control	22.62	23.82	6.33de	7.26 a	2.93 c	3.22 bc	1.08 b	1.23 a
C.od compost	21.96	24.33	6.67cd	6.65 a	3.41 b	3.07 c	1.01 b	0.98 ab
C.od fresh	24.14	25.78	7.39 b	5.13 bc	3.40 bc	3.32 b	1.32 a	0.95 ab
Straw compost	20.38	23.73	8.04 a	6.36 a	4.22 a	3.14 c	1.22 a	1.14 a
Straw fresh	21.09	23.48	5.25 f	6.18 ab	3.08 c	3.64 a	0.84 c	1.06 a
NPK	22.87	26.60	5.94 e	4.44 c	3.07 c	3.48 ab	0.90 c	0.74 b
DMRT 0.5%	ns	ns	s	s	s	s	s	s

Note: s – significant, ns – not significant

In Figure 1, the straw compost achieved the best composition in first observation at 2nd week after planting for Carbon, Nitrogen, and organic matter contents at 2.44%, 0.125%, and 4.22% respectively. But in the next observed weeks, all kind fertilizer moving in same manner with similar composition rates.

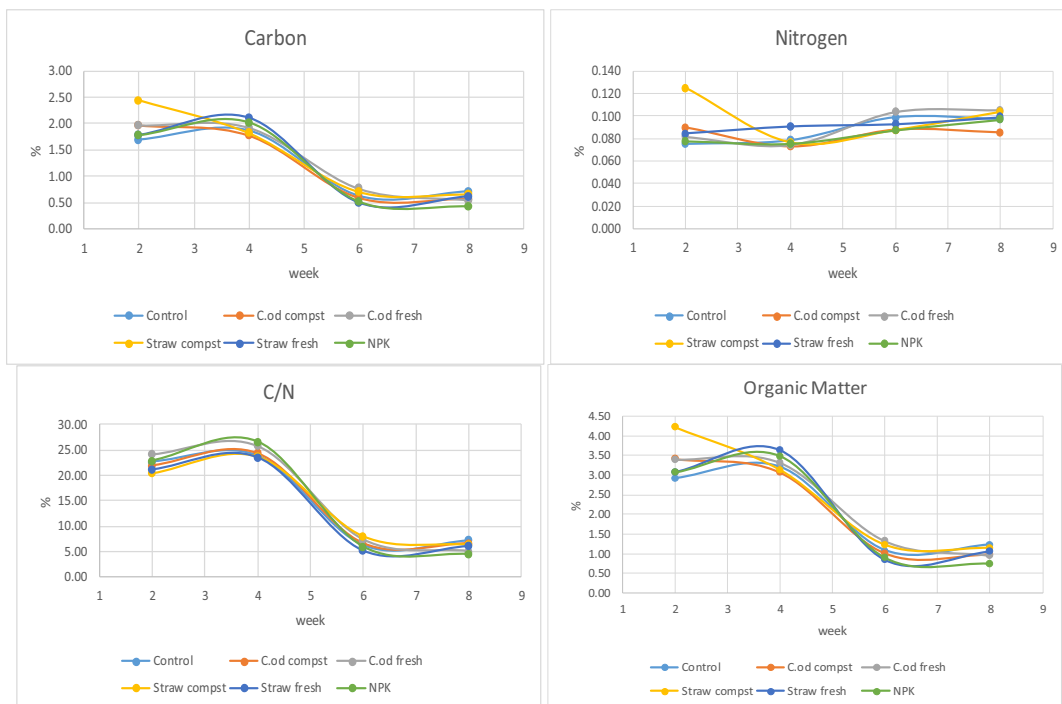


Figure 1. The decomposition graph in 2, 4, 6, & 8 weeks after planting

As we can see the graphs of Figure 1, the fourth ingredients C, N, C/N, and organic matter showed similar composition values. This could mean that we can exchange the soil fertilization from inorganic into organic fertilizer which have several advantages for the soil, crop, and cultivation way.

3.2. Rice Yield

In Table 3, the rice-crop yield productive tillers without any significant difference of all type of fertilizers. But the next detail, *C. odorata* compost had the worst grain yield with only 85.2 quantity of filled grain though we can still expect *C. odorata* fresh since the quantity of filled grain at 92.2.

Table 3. Significance level of rice yield

Treatment	Number of productive tiller	Number of filled grain	Number of empty grain	plant weight (t/ha)	dried grain weight (t/ha)
Control	11.57	97.02	7.75	10.23 ab	2.86 c
C.od compost	11.13	85.20	6.47	8.54 b	2.54 c
C.od fresh	12.40	92.20	8.20	11.00 ab	2.67 c
Straw compost	10.27	93.00	11.6	9.42 b	2.33 c
Straw fresh	12.47	117.67	4.75	11.96 ab	3.92 ab
NPK	12.40	106.30	8.79	12.69 a	4.44 a
DMRT 0.5%	Ns	ns	ns	s	s

Note: s – significant, ns – not significant

If we see the yield in the graphs in Figure 2, the nearest plant weight to inorganic fertilizer (12.69 t/ha) was fresh straw (11.96 t/ha) with the addition of showing its consistency deviation. While *C. odorata* fresh came close at 11 t/ha but the data had wide range of deviation. Reciprocally, only fresh straw (3.92 t/ha) can compete with the inorganic fertilizer (4.44 t/ha) in dried grain yield weight.

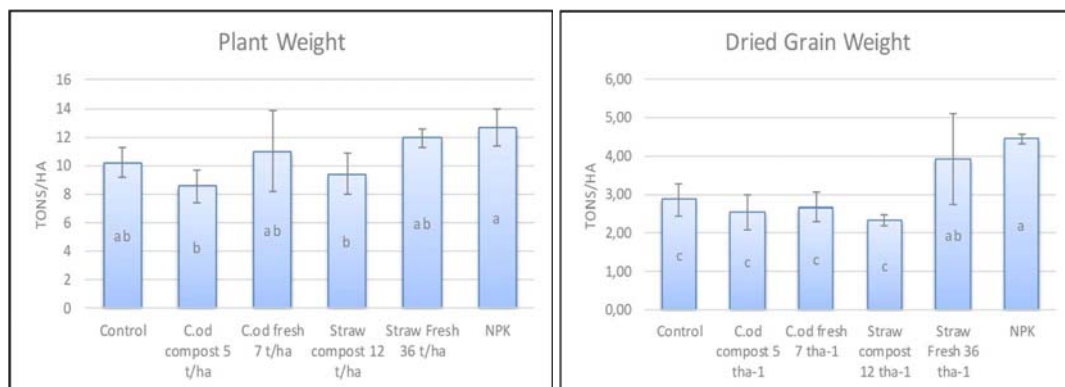


Figure 2. Standard deviation of rice yields due to application of *C. odorata* and straw

4. Conclusion

To maintain the value of soil ingredient encouraging sustainable agriculture, we should then use both *C. odorata* and straw as organic fertilizers replacing the inorganic since the decomposition rate flowed in the similar values until 8th week observation. In the meantime, the rice yield production using inorganic fertilizer can nearly achieved by using straw fresh fertilizer according to result of dried grain weight.

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