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Authors' contributions

This work was carried out in collaboration among all authors. Author Novriani designed the study, author Gribaldi wrote the protocol and wrote the first draft of the manuscript, correspondence, author Nurlaili performed the statistical analysis. Authors ND and FS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Upland rice production at South Sumatra is still low compared to national average production level due to low soil fertility. Therefore, effort to increase soil fertility level is needed such as through application of *Trichocompost* and NPK fertilizers at dry land area. This research objective was to determine the application effect of *Trichocompost* produced from rice straw and NPK fertilizers on the growth and yield of upland rice crop of henic strain at dry land area. The methods used in this research was a 2 by 3 Factorial in Completely Randomized Design with two treatment factors and three replications for each treatment. *Trichocompost* fertilizer treatments (T) were consisted of: T0 (without *Trichocompost:* 0 ton/ha; T1: 10 ton/ha *Trichocompost*; T2: 20 ton/ha *Trichocompost* and T3: 30 ton/ha *Trichocompost*, whereas NPK fertilizer treatments (P) were consisted of: P1: 200 kg NPK/ha; P2: 300 kg NPK/ha and P3: 400 kg NPK/ha. All data from this research was analyzed using Analysis of Variance to determine the given treatment effect by using SPSS 17.0 software. The results showed that application of *Trichocompost* produced from rice straw and NPK fertilizers had effect on the growth and yield of upland rice of henic strain at dry land area. Application of

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Trichocompost fertilizer produced from rice straw at dose of 30 ton/ha and NPK fertilizer at dose of 400 kg/ha tend to produce higher rice yield with magnitude of 4.6 kg/plot than that of other treatments.

Keywords: Dry land; NPK fertilizer; Trichocompost from rice straw; upland rice of henic strain.

1. INTRODUCTION

Foods production especially rice should be increased in continuous manner. Therefore, agricultural enterprise at dry land is one of potential alternative to be developed in order to increase production and to fulfill foods requirement. The coverage area of dry land in Indonesia was 148 million ha in which about 25.09 million ha was appropriate for annual crops [1], whereas dry land area at Ogan Komering Ulu (OKU) District was 92,905 ha and the area that is already cultivated for annual crops was 8,288 ha. This area provides opportunity for development of upland rice, especially local upland rice such as henic strain at Ogan Komering Ulu District [2]. However, upland rice productivity at dry land was still lower than that of paddy field rice having average value of 5.3 ton/ha [3]. Low productivity of upland rice is due to some factors such as low soil pH, Al toxicity, low soil fertility and dryness [4]. Effort to increase upland rice productivity at dry land can be done through soil fertility improvement by application of organic and inorganic fertilizers such as *Trichocompost* fertilizer and NPK fertilizer. Addition of organic matter on soil will determine soil ability to support crops growth. According to Leszczynska D et al. [5], application of organic matter as organic fertilizer can increase nutrients level, increase chemical and physical capabilities as well as soil microbia activity. Organic fertilizer of *Trichocompost* produced from rice straws contains several nutrients such as 0.50% N; 0.28% P; 0.42% K; 1.035 ppm Ca; 958 ppm Fe; 147 ppm Mn; 4 ppm Cu and 25 ppm Zn [6] (BPTP Jambi, 2009). Research results [7] showed that application of 20 ton/ha compost fertilizer and 486 kg/ha compound NPK fertilizer gave the best result for the growth and production of corn crop. In addition, research results [8] showed that application of 10 ton/ha manure + 250 kg Urea/ha + 75 kg SP-36/ha + 75 KCl/ha had highly significant effect on maximum tiller numbers, productive tiller numbers and harvested dry weight of rice crop. Inorganic fertilizers such as NPK fertilizer is readily available for crops so that its effect is noticeably faster. However, intensive use of inorganic fertilizer results in decrease of soil organic matter content into very low level [9,10]. Research result [11] showed that application of 300 kg/ha NPK fertilizer can increase upland rice production. The recommended dose of compound NPK fertilizer for rice crop is 200-300 kg/ha [3]. The objective of this reseach was to determine the application effect of Trichocompost fertilizer produced from rice straw and NPK fertilizer on the growth and yield of upland rice of henic strain at dry land area.

2. MATERIALS AND METHODS

2.1 Field Experiment

This research was conducted at Experimental Farm, Agricultural Faculty, Baturaja University, Kemiling Village, Baturaja, Ogan Komering Ulu (OKU) District, South Sumatra from April to July 2018.

2.2 Research Materials

Materials used in this research were seeds of local upland rice of OKU District (henic strain), rice straw, rice bran, animal dunk, NPK Phonska fertilizer, *Trichoderma*, sugar, bucket, measuring glass and polybag plastic.

2.3 Experimental Design and Procedures

This research used Factorial Completely Randomized Design with two treatment factors and three replications for each treatment. *Trichocompost* (T) fertilizer treatments are consisted of: T0: without addition of *Trichoctompost*; T1: 10 ton/ha *Trichocompost*; T2: 20 ton/ha *Trichocompost*; T3: 30 ton/ha *Trichocompost,* whereas NPK fertilizer (P) treatments are consisted of: P1: 200 kg NPK/ha; P2: 300 kg NPK/ha; P3: 400 kg NPK/ha. Land is cleared from weeds and roots left over, hoed at depth of about 20 cm followed by plot construction having size of 2 x 3 m. The distance between plots was 50 cm and the distance between replications was 100 cm. Upland rice seeds of henic strain is previously soaked in water for 15 minutes [12]. Subsequently seeds are directly planted in land with planting distance

of 25 x 25 cm and each planting hole is filled with 2-3 seeds at depth of 3-4 cm. Application of organic fertilizer (*Trichocompost*) produced from rice straw is applied 1 week before planting through evenly mix with soil surface by using hoe. Application of organic fertilizer dose is adjusted to each treatment, whereas inorganic fertilizer is applied two times, i.e. first application is done 1 week after planting with half dose and the remaining dose is given when crop age is 21 days after planting.

2.4 The Measured Parameters

Observation agronomic characteristics were consisted of crop height (cm), crop dry weight (g/clump), productive tiller numbers (tillers/clump), fully rice weight (g/clump), empty rice weight (g/clump), weight of 1000 rice grains (g) and harvested dry rice per plot.

2.5 Statistical Analysis

All data from this research was analyzed using Analysis of Variance to determine the given treatment effect by using SPSS 17.0 software.

3. RESULTS

Analysis of variance results for the treatment effect of NPK and *Trichocompost* fertilizers on each observed parameters can be seen in Table 1. The between treatments effect of *Trichocompost* fertilizer had no significant effect on every observed parameters except on crop height, crop dry weight and weight of harvested dry rice, whereas between treatments effect of NPK fertilizer had no significant effect on every observed parameters except on productive tiller numbers. Treatment interaction of *Trichocompost* and NPK fertilizers had no significant effect on every observed parameter, except on empty rice weight.

3.1 Plant Height

Application of *Trichocompost* and NPK fertilizers had effect on plant height. Results of LSD test at 5 percent level showed that application of *Trichocompost* fertilizer produced from rice straw (T1, T2, T3) is not significantly different on plant height, but it is significantly different on treatment of without *Trichocompost* addition (T0) (Fig. 1). The highest plant height is obtained on *Trichocompost* addition at dose of 20 ton/ha (T2) with magnitude of 136 cm.

3.2 Plant Dry Matter Weight

Application of *Trichocompost* and NPK fertilizers had effect on plant dry matter weight. Results of LSD test at 5 percent level showed that plant dry matter weight on *Trichocompost* fertilizer treatment produced from rice straw at dose of 30 ton/ha (T3) is significantly different than that of other treatments, except for *Trichocompost* fertilizer treatment produced from rice straw at dose of 20 ton/ha (T2) (Fig. 2A). The highest plant dry matter weight is obtained on *Trichocompost* fertilizer treatment produced from rice straw at dose of 30 ton/ha (T3) with magnitude 182.5 g/clump or 23.3 percent increase of plant dry matter weight than that of without *Trichocompost* treatment (Fig. 2B).

3.3 Productive Tiller

Application of *Trichocompost* and NPK fertilizers had effect on productive tiller numbers. Results of LSD test at 5 percent level show that productive tiller numbers on NPK fertilizer treatment at dose of 400 kg/ha (P3) is significantly different than NPK fertilizer treatment at dose of 200 kg/ha (P1), but it is not significantly different than NPK fertilizer treatment at dose of 300 kg/ha (P2)(Fig. 3). The highest productive tiller numbers is obtained on NPK fertilizer treatment at dose of 400 kg/ha (P3) with magnitude of 15.7 tillers/clump.

3.4 Yield and Yield Components

Application of *Trichocompost* and NPK fertilizers had effect on yield and yield components of upland rice of henic strain. Appication of *Trichocompost* fertilizer at dose of 30 ton/ha and NPK fertilizer at dose of 400 kg/ha (T3P3) tend to show higher rice yield than that of other treatments, i.e. 4.6 kg/plot (Fig. 4). In addition, T3P3 treatment also showed higher yield components compared to other treatments, even empty rice weight in this treatment is significantly different than that of other treatment with the lowest empty rice weight of 1.95 g/clump (Table 2).

4. DISCUSSION

Application of *Trichocompost* and NPK fertilizers had effect on the growth and yield of upland rice of henic strain at dry land which can be seen from the change in crop height, crop dry weight, productive tiller numbers as well as yield and

yield components. Application of *Trichocompost* fertilizer produced from rice straw at dose of 30 ton/ha and NPK fertilizer at dose of 400 kg/ha (T3P3) tend to show higher rice yield than that of other treatments. This is shown by higher yield components such as weight of 1000 rice grains and fully rice weight as well as the lowest empty rice weight which in turn can increase rice yield. According to Khairullah I [13] *in* [14], yield potential is determined by prediction of all yield components per clump multiplied by population numbers per hectare. In addition, according to Mareza E et al. [15], yield components contribute to total rice weight per clump. Moreover [16], had stated that rice crop having higher productive tiller percentage, high rice weight per panicle and low percentage of empty rice will produce higher total rice weight per clump. High productive tiller numbers in this research was found on NPK fertilizer treatment at dose 400 kg/ha (P3). This indicates that application of NPK inorganic fertilizer is capable to increase tiller numbers and subsequently increase of rice yield.

The good growth of crop can be seen from crop dry weight. The highest crop dry weight in this research was found on application of *Trichocompost* fertilizer produced from rice straw at dose of 30 ton/ha (T3) and there was 23.2 percent increase in crop dry weight than that of treatment without *Trichocompost* application. This showed that the best growth of upland rice of henic strain was found in this treatment. This is in accordance with the opinion from [17] which stated that crop development is increasing with the increase of crop dry weight.

Table 1. Results of variance analysis for the effect of *Trichocompost* and NPK fertilizers on upland rice of henic strain related to the observed parameters

No	Observed parameters	*Trichocompost*	NPK	Interaction
1	Crop height (cm)	3.45*	2.16 ns	0.92 ns
2	Crop dry weight (g/clump)	3.30*	1.60 ns	0.86 ns
3	Productive tiller numbers (tiller/clump)	1.90 ns	3.94*	1.31 ns
4	Weight of 1000 rice grains (g)	1.26 ns	1.88 ns	0.21 ns
5	Fully rice weight (g)	3.01 ns	1.16 ns	0.27 ns
6	Empty rice weight (g)	1.92 ns	0.14 ns	3.59*
7	Harvested dry rice yield (g/clump)	3.30 *	1.34 ns	0.29 ns

*Remarks: *= significantly different*
ns= not significantly different

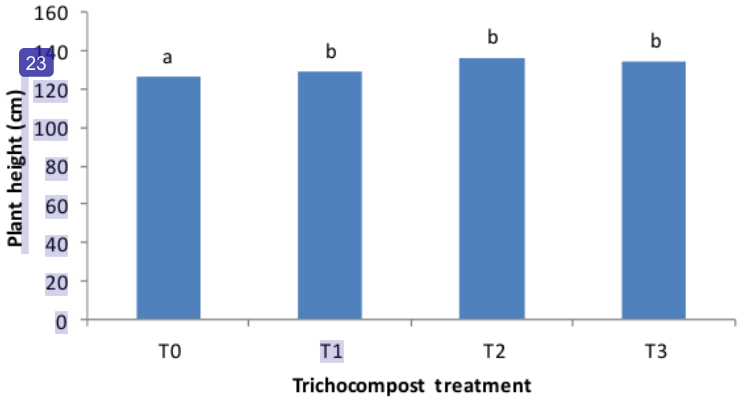

Fig. 1. Plant height of upland rice of henic strain at several doses of *Trichocompost* fertilizer at the end of research

Means with different letters on the histograms are significantly different at the 5% threshold (LSD test).
T0: Without Trichocompost addition; T1: 10 ton/ha Trichocompost; T2: 20 ton/ha Trichocompost;
T3: 30 ton/ha Trichocompost. ($LSD_{.05}$: 7.7)

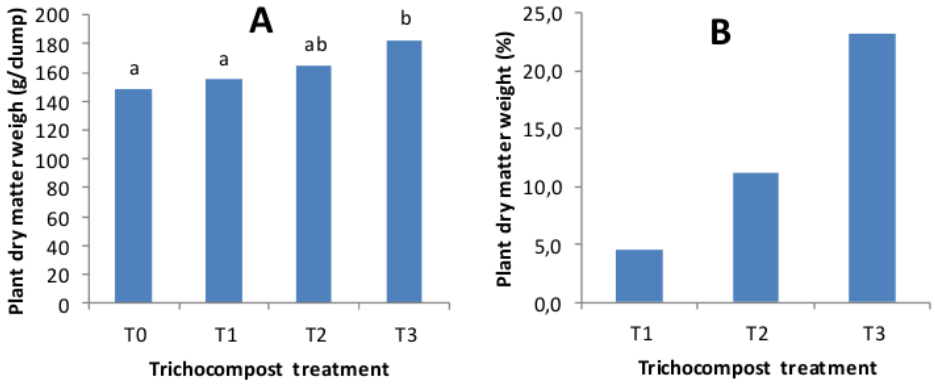

Fig. 2. Plant dry matter weight at several doses of *Trichocompost* fertilizer produced from rice straw (A) and increase of plant dry matter weight without *Trichocompost* fertilizer treatment (B) at dry land

Means with different letters on the histograms are significantly different at the 5% threshold (LSD test). T0: Without Trichocompost addition; T1: 10 ton/ha Trichocompost; T2: 20 ton/ha Trichocompost; T3: 30 ton/ha Trichocompost. ($LSD_{.05}$: 18,1)

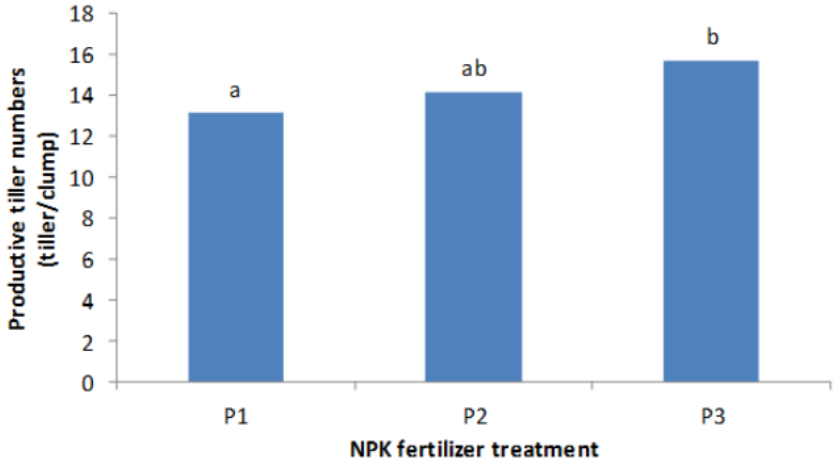

Fig. 3. Productive tiller numbers at several NPK fertilizer doses for upland rice of henic strain at dry land

Means with different letters on the histograms are significantly different at the 5% threshold (LSD test). P1: 200 kg NPK/ha; P2: 300 kg NPK/ha; P3: 400 kg NPK/ha. ($LSD_{.05}$: 1,89)

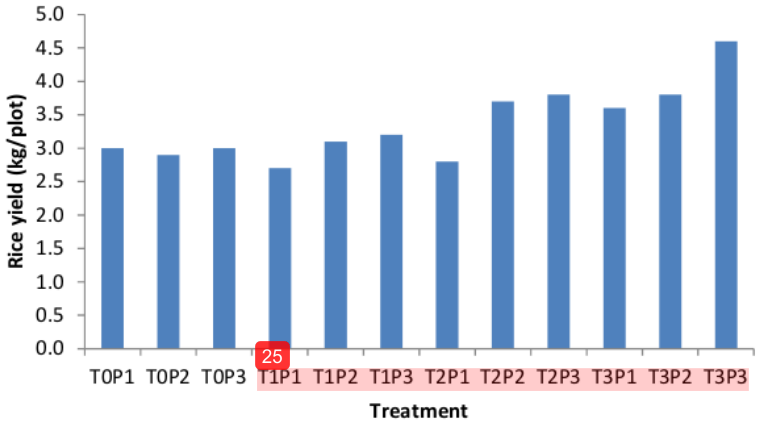

Fig. 4. Rice yield (g/clump) at several doses of *Trichocompost* fertilizer and NPK fertilizer for upland rice of henic strain at dry land

T0: Without Trichocompost addition;
T1: 10 ton/ha Trichocompost; T2: 20 ton/ha Trichocompost; T3: 30 ton/ha Trichocompost.
P1: 200 kg NPK/ha; P2: 300 kg NPK/ha; P3: 400 kg NPK/ha.

Table 2. Yield components at several doses of *Trichocompost* fertilizer and NPK fertilizer for upland rice of henic strain at dry land

Treatment	1	2	3
T0P1	18.49	35.53	2.33 abc
T0P2	19.99	35.40	2.18 ab
T0P3	20.24	35.63	2.33 abc
T1P1	19.22	32.51	2.46 abc
T1P2	20.31	37.29	2.53 abc
T1P3	20.26	37.80	2.64 abc
T2P1	19.62	34.40	2.58 abc
T2P2	20.54	44.46	2.27 abc
T2P3	20.51	47.65	3.41 d
T3P1	20.68	46.08	2.74 bcd
T3P2	20.54	46.28	2.97 cd
T3P3	21.28	54.53	1.95

*1. Weight of 1000 rice grains (g), 2. Fully rice weight (g/clump), 3. Empty rice weight (g/clump) ($LSD_{.05}$: 0,72). *Means followed by the same letters within columns of each treatment and measured trait are not significantly different based on LSD test at P ≤ 0.05.*
T0: Without Trichocompost addition; T1: 10 ton/ha Trichocompost;
T2: 20 ton/ha Trichocompost; T3: 30 ton/ha Trichocompost;
P1: 200 kg NPK/ha;
P2: 300 kg NPK/ha; P3: 400 kg NPK/ha

5. CONCLUSION

Research results showed that treatment of *Trichokompos* fertilizer application produced from rice straw and NPK fertilizer had effect on growth and yield of upland rice of henic strain at dry land. Application of *Trichokompos* fertilizer produced from rice straw at dose of 30 ton/ha and NPK fertilizer at dose of 400 kg/ha tend to produce higher rice yield with magnitude of 4.0 kg/plot than that of other treatments.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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