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The Effect of Organic Fertilizer in the Increasing of Local Upland Rice Production on Marginal Land in North Buton Indonesia

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Demand for rice as a source of food in Indonesia continues to increase in line with the growth of population, while the capacity to produce paddy rice increasingly limited. One of the efforts is to develop upland rice by utilizing the dry land with organic fertilizer application. The research was conducted in North Buton using split plot design. The main plot was the treatment of manure dosage consisting of 4 levels of treatment and the second factor of local upland rice cultivars as a subplot consisting of 22 cultivars. Production characters were observed and assessments are panicle length, grain number, number of grain content, wet grain weight, dried grain weight, grain weight per culm, and grain yield (t ha^{-1}). The results showed that the yield potency of local upland rice cultivar in North Buton ranged from 3.11- 4.97 t ha-1 and the treatment of organic fertilizer can increase the yield components of upland rice.

Keywords: Upland rice, Progeny, Hybridization, Drought, Mineral stress.

Rice (*Oryza sativa* L.) is the most important cultivation crop consumed around 97% of Indonesian population[1]. Rice should always be available in sufficient quantity, quality and affordable price[2]. Efforts to develop upland rice has been made by utilizing the dry land. Dry land in Indonesia is estimated to be 60.7 million hectares or 88.6% of dryland area, spread over wet climates with low nutrient, low productivity and dominated by ultisol soil. Dry land is potential for the development of upland rice[3].

Dry land is dominated by acid soils, which are less favorable for plants due to low nutrient content, basic saturation and low cation exchange capacity (CEC), and high Al, Fe, and Mn concentrations. This condition will affect and inhibit crop production. Although ultisol productivity is low, it will respond well to appropriate management efforts, such as fertilization, calcification, and management of organic materials. Fertilization is a way to add nutrients needed by plants, especially nutrients N, P, and K, which are essential macro nutrients in addition to micro nutrients.

Fertilization is one of the decisive factors in increasing food production. The use of excessive inorganic fertilizer will increase the level of soil pollution[4] that can ultimately affect human health. Therefore, it is necessary to find alternatives to overcome these problems, such as with the use of organic fertilizer, to increase rice productivity system, environmentally sustainable has maintained.

Organic fertilizer is a fertilizer material derived from living things, most of the organic

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fertilizer in the form of solids such as manure and compost. Organic and manure materials are ingredients derived from plant or animal waste or by-products, such as cattle manure or poultry, composted rice straw or other crop residues, sewage on drains, cake, green manure and leguminous pieces[5].

Organic fertilizers play a significant role in creating soil fertility. The role of organic fertilizer is related to changes in the soil properties, i.e., physical, chemical, and biological properties of soil[6]. The effect of organic matter on soil chemical properties among others on CEC, anion exchange capacity (AEC), soil pH, soil buffer power and soil nutrient properties[7]. Microorganisms will decompose organic fertilizers in the soil into humus or soil organic matter[8]. The decomposition rate of organic matter depends on the plants, plant age, chemical composition, aeration, temperature, humidity, fertility and climatic factors[9]. The greatest role of organic fertilizer on soil physical properties includes structure, consistency, porosity, water binding capacity and equally important is the increase of resistance to erosion[7]

The effect of manure on crops has also been widely demonstrated to improve crop yields, beneficial to increased agricultural production in both quality and quantity, sustainably improving land quality. The results of the study on wet climates of dry land, the content of organic materials on ultisol can be maintained by applying recycling, namely the use of manure and agricultural waste[10].

Long-term use of organic fertilizer can increase the land productivity and prevent land degradation, improve groundwater holding capacity, stabilize soil structure and increase soil nutrients[11]. In rice cultivation on dry land, rice farmers do not fertilize, because the use of shifting cultivation model. In the pattern of permanent agriculture, the provision of fertilizer, especially organic fertilizer is needed. Therefore, this study aims to examine the potential yield and response of

Tabel 1. The influence of local upland rice cultivars from northern buton on the rice yield components

Cultivar (V)	Panicle Length	Grain Number	Number of grain content	Wet Grain weight	Dried Grain Weight	Weight Grain per Clum $^{-1}$	Grain Production (t.ha^{-1})
Wakombe	38.19^{c-f}	121.31^{d-g}	107.53^{ef}	39.16^{f}	30.61^{efg}	48.80^{cde}	3.59^{d}
Wabalongka	41.84^{a}	141.76^{b}	134.85^{b}	41.62^{e}	32.38^{e}	53.43^{ab}	4.23^{ab}
Warumbia Merah	36.12^{g-j}	120.45^{d-g}	107.01^{ef}	34.04^{hi}	24.77^{j}	42.21^{g}	3.16^{fg}
Patirangga	35.95^{hij}	123.72^{c-f}	111.20^{de}	34.25^{hi}	24.69^{j}	44.81^{fg}	3.33^{d-g}
Wa Apolo	40.50^{ab}	154.42^{a}	147.00^{a}	49.08^{c}	38.33^{c}	50.99^{bcd}	4.24^{bc}
Kasakabari	36.99^{f-i}	121.60^{d-g}	107.50^{ef}	39.15^{f}	30.04^{fg}	36.92^{h}	2.80^{h}
Wangkaluku	38.28^{c-f}	116.27^{fg}	103.30^{ef}	35.01^{h}	26.97^{hi}	42.35^{g}	3.15^{fgh}
Wangkariri	35.57^{h-k}	101.35^{h}	90.38^{g}	34.20^{hi}	25.65^{ij}	47.01^{def}	3.20^{fg}
Warangka	39.89^{bc}	125.73^{c-f}	117.39^{cd}	44.06^{d}	31.86^{ef}	53.07^{abc}	4.53^{c}
Wabila Kambawa	35.73^{h-k}	112.18^{g}	99.04^{f}	31.01^{j}	22.62^{kl}	43.68^{fg}	3.26^{fg}
Wakawondu	37.32^{e-h}	149.37^{ab}	137.31^{b}	53.80^{a}	44.88^{a}	56.65^{a}	4.81^{a}
Wajini	37.94^{d-g}	102.64^{h}	89.34^{g}	29.70^{j}	24.29^{jk}	49.45^{b-e}	3.23^{fg}
Wawonii	37.19^{e-h}	124.02^{c-f}	111.00^{de}	37.05^{g}	29.92^{fg}	48.89^{cde}	3.80^{d}
Mantebeka	39.00^{b-e}	128.88^{cde}	121.41^{c}	51.49^{b}	35.49^{d}	51.27^{bcd}	4.38^{c}
Wampogeru	34.90^{jk}	121.50^{d-g}	107.31^{ef}	31.16^{j}	25.38^{ij}	46.05^{efg}	3.07^{gh}
Wabila Lambale	40.69^{ab}	130.68^{cd}	118.09^{cd}	50.60^{bc}	39.44^{c}	52.07^{bc}	4.59^{c}
Warumbia Putih	33.93^{k}	120.34^{d-g}	103.77^{ef}	33.91^{hi}	24.77^{j}	50.23^{b-e}	3.55^{def}
Waburiburi	31.69^{l}	119.90^{efg}	105.10^{ef}	34.68^{h}	28.74^{gh}	50.33^{b-e}	3.68^{de}
Warara	39.55^{bcd}	132.50^{c}	123.70^{c}	51.31^{b}	41.56^{b}	56.80^{a}	4.65^{ab}
Wankatema	36.37^{f-j}	102.01^{h}	89.88^{g}	32.79^{i}	23.53^{jk}	49.29^{b-e}	3.43^{d-g}
Warema	36.57^{f-j}	123.37^{c-f}	111.26^{de}	37.53^{fg}	29.89^{fg}	50.05^{b-e}	3.52^{def}
Watanta	35.17^{ijk}	116.22^{fg}	103.53^{ef}	26.62^{k}	20.99^{l}	50.59^{bcd}	3.37^{efg}

Remark : Means in the same suffixed in same line are not sdifferent at 5% levels of significance according to DMRT

Table 2. Effect of Organic Fertilizer on Generative Components of Upland Rice

Parameter	Manure Dosage (P)			
	P_0	P_1	P_2	P_3
Panicle length	32.77[d]	36.51[c]	38.33[b]	41.37[a]
Grain number	111.12[d]	120.13[c]	126.40[b]	135.11[a]
Number of grain content	97.34[d]	106.73[c]	115.02[b]	125.80[a]
Wet grain weight	34.43[d]	37.06[c]	40.61[b]	42.86[a]
Dried grain weight	26.69[c]	28.45[b]	31.97[a]	32.30[a]
Weight grain per clum	41.56[c]	48.63[b]	53.50[a]	51.75[a]
Grain production (t.ha^{-1})	2.75[c]	3.40[b]	4.26[a]	4.41[a]

Remark : Means in the same suffixed in same line are not sdifferent at 5% levels of significance according to DMRT

various upland rice cultivars to organic fertilization on marginal land.

MATERIAL AND METHODS

The research arranged using split plot design. The main plot was the treatment of manure dosage consisting of 4 levels of treatment and the second factor of local upland rice cultivars as a subplot consisting of 22 cultivars. The main plot is the difference of organic fertilizer dosage as follows: without organic fertilizer (P0), dosage of organic fertilizer 3 t.ha^{-1} (P1), dosage of organic fertilizer 6 t.ha^{-1} (P2) and dosage of organic fertilizer 9 t.ha^{-1} (P3). While in subplot is the difference of cultivar of local upland from North Buton consist of 22 cultivars i.e., (V_1) = *Wakombe,* (V_2) = ultivar *Wabalongka,* (V_3) = *Warumbia merah,* (V_4) = *Patirangga,*(V_5) = *Wa Apolo,* (V_6) = *Kasakabari,* (V_7) = *Wangkaluku,* (V_8) = *Wangkariri,*(V_9) = *Warangka,* (V_{10}) = *Wabila Kambawa,* (V_{11}) = *Wakawondu,*(V_{12}) = *Wajini,* (V_{13}) = *Wawonii,* (V_{14}) = *Mantebeka,*(V_{15}) = *Wampogeru,* (V_{16}) = *Wabila Lambale,*(V_{17}) = *Warumbia Putih,* (V_{18}) = *Waburiburi,*(V_{19}) = *Warara,* (V_{20}) = *Wankatema,* (V_{21}) = *Warema,*(V_{22}) = *Watanta.*

RESULTS AND DISCUSSIONS

The results showed that there were differences in the character of local upland rice cultivars from the North Buton (Table 1), especially for the productive component of the plant. Based on the generative character, it appears that the highest panicle length is in *Wabalongka* cultivar. The maximum grain number and the largest number of grain contents is on *Wa Apolo* cultivar. The highest grain weight is in *Wakawondu* cultivar; The highest grain per clump is in the *Warara* cultivar, and The highest grain production is *Wakawondu* cultivars.

Analysis of variance showed that the treatment of organic fertilizer on local upland rice cultivars significantly affected the local upland rice yield components. The result revealed that the generative character is increased due to the treatment of biological fertilizer. The increase occurred are mainly on the parameters of panicle length, the grains number, the grain content number the grain weight, the dry weight grain, the grain weight per clump, the weight of 1000 grains and the grain production (t.ha^{-1})

The results showed that the dosage of organic fertilizer increase of upland rice yield component (Table 2). It included in the parameter of panicles length, grain number, the grain content number, wet grain weight, grain weight and grain weight (ton ha^{-1}). In general, the highest result obtained on components of treatment doses of manure 9 ton ha^{-1}. The results showed that the higher the dose, the more fertilizer increased plant growth.

The results of this study prove that the provision of organic materials can improve soil fertility so as to give effect to the improvement of local upland rice component growth. This is because organic matter is a source of nutrients N, P, and K. The contribution of organic matter to

planting growth is originated from its effect on the physical, chemical and biological properties of the soil. Organic matter acts as a nutrient addition of N, P, K for plants from mineralized microorganisms, transformation by microorganisms from an element of organic material into inorganic so available to the plant.

Nitrogen element plays an important role in stem elongation that occurs due to the process of cleavage, elongation, and enlargement of new meristematic of stems and leaves that cause the plant to grow taller[12]. Furthermore, it is explained that the administration of organic materials rich in N can increase chlorophyll, which can further enhance the photosynthate of plants so that the accumulation of photosynthetic produced higher. The high accumulation of photosynthates results in enlargement and differentiation of cells expressed in the increase in height or length and addition of leaf size and area. Various research reports have proved that organic fertilizers can increase crop production because organic fertilizers are improving the physical, chemical and biological conditions of the soil thus providing conditions conducive to plant growth[13]. In addition, organic fertilizer in the process of decomposition can release nutrients slowly, so it can provide residual effects are very useful for the next planting.

CONCLUSION

Based on the research concluded that the yield potency of local upland rice cultivar in North Buton ranged from 3.11- 4.97 t ha^{-1} and the treatment of organic fertilizer can increase the components of upland rice.

REFERENCES

1. Supriadin., A, Ete., U, Made. Karakterisasi Genotip Padi Gogo Lokal Asal Kabupaten banggai *J. Agrotekbis.,* 2013; **1**(5):443–450.
2. Sondari, N. Pertumbuhan, Kadar Logam Berat Pb, dan Hasil Padi Gogo (*Oryza sativa* L.) Akibat Pemberian Kombinasi Limbah Batubara Bottom ASH dan Bokashi Bottom Ash. *Jurnal Ilmu Tanah dan Lingkungan.,* 2009; **9**(2):88-94.
3. Sadimantara, GR., Muhidin. Karakterisasi Morfologi Ketahanan Kekeringan Plasma Nutfah Padi Gogo Lokal Asal Sulawesi Tenggara. *Jurnal Agroteknos.,* 2012; **2**(1) : 50-56.
4. Sahiri, N. 2003. Pertanian Organik: Prinsip Daur Ulang Hara, Konservasi Air dan Interaksi Antar Tanaman. Makalah Individu Pengantar Falsafah Sain. Institut Pertanian Bogor.
5. Bawolye, 2006. 2006. Bahan Organik dan Pupuk Kandang. IRRI Rice Knowladge Bank. Philipina. www.litbang.deptan.go.id. Accesed on 23 March 2017.
6. Soepardi, G. Sifat dan ciri tanah. Jurusan Ilmu-ilmu tanah, Institut Pertanian Bogor. 1983.
7. Haryono. Strategi Kebijakan Kementrian Pertanian dalam Optimalisasi Lahan Suboptimal Mendukung Ketahanan Pangan Nasional. Prosiding Seminar Nasional Lahan Suboptimal "Intensifikasi Pengelolaan Lahan Suboptimal dalamRangka Mendukung Kemandirian Pangan Nasional". Proceeding on suboptimal land in Palembang, September 20-21, 2013.
8. Setyorini, D., S. Rasti, dan K.A. Ea. 2006. Kompas: Pupuk organik dan pupuk hayati. Seminar sehari penggunaan pupuk organik BPTP. Yogyakarta.h: 11 – 40.
9. Brady, NC., Weil RR. The Nature and Properties of Soils. 14 ed. Pearson-Prentice Hall, Upper Saddle River, NJ. 2002. 990 pp. .
10. Sopandie, D., Utomo, HI. Pengelolaan Lahan dan Teknik Konservasi di Lahan Kering. Makalah Penunjang Diskusi Pengembangan Teknologi Tepat Guna di Lahan Kering untuk Mendukung Pertanian Berkelanjutan. Bogor, 27 November 2014.
11. Brady, NC., Weil, RR. The Nature and properties of Soils. Twelveth Edition Prentice Hall. Upper Saddle River, New Jersey. 1999. 881p.
12. Gardiner, DT., Raymond WM. Soil in Our Environment. 10th ed. Pearson Education, Inc., Upper Saddle River, New Jersey. 2000. 641p.
13. Lins, CS., Binns, MR., Lefkovitch, LP. Stability analysis: where do we stand. *Crop Sci*., 1986; 26:894-900.