AGRIVITA VOLUME 35 No. 2 JUNE - 2013 ISSN : 0126-0537

ENRICHED-GRANULAR COMPOST (EGC) FROM CAMPUS ORGANIC WASTE AS SOIL CONDITIONER IN INTENSIVE RICE FARMING SYSTEM

Nur Azizah*), Budi Prasetya and Syahrul Kurniawan

Faculty of Agriculture, University of Brawijaya Jl. Veteran Malang 65145 East Java Indonesia
*) Corresponding author Phone: +62-341-551665 E-mail: nurazizah@ub.ac.id

Received: November 11, 2012 / Accepted: May 18, 2013

ABSTRACT

Effort to reduce the high dependence of farmers on inorganic fertilizers is introducing compost as soil conditioner. The objectives of this research are to create enriched granular-compost (EGC) and to test its effect on nutrient availability, plant growth, and grain yield in intensive farming systems. The research was conducted in two consecutive years (2011-2012), consisting of three steps: production of EGC, incubation and field experiment. Incubation experiment was designed by randomized complete design with 5 treatments (control, 4, 6, 8, and 12 Mg ha^{-1}), andthe design of field experiment was randomized block design with 7 treatments (control, inorganic fertilizer (IF), 25% EGC + 75% IF, 50% EGC + 50% IF, 75% EGC + 25% IF, 100% EGC + 100% IF and 100% EGC). The results showed that application of EGC increased total-N and P-available 12.5% and 33% respectively on the 10th day after incubation. The highest grain yield (6.13 Mg ha^{-1}) was gained from the application of 100% EGC + 100% IF. The productivity of rice is closely related to the number of productive panicles per plant (r = 0.507*) and percent of filled grain (r = 0.685*).

Keywords**:** enriched granular-compost, nutrient availability, grain yield

INTRODUCTION

The areas of paddy field in Indonesia increased from 10.28 million ha in 1991 to 11.40 million ha in 2006 (approximately 1.12 million ha) to fulfill the demand of rice (Wurjandari and Syam, 2007). The expansion of paddy field impact on fertilizer demand. Increasing fertilizer application not only took place in Indonesia but also worldwide. In general, the mineral fertilizer used worldwide increases annually about 1.7% from 2007/2008 to 2011/2012 as 15 Mg, in which approximately 69% of it took place in Asia (FAO, 2008; Naher *et al.,* 2011). In addition, from 1975 to 2005 the fertilizer (Urea, AS/ZA, TSP/SP36, and KCl) demand in Indonesia increased 5.04 million ton (Wurjandari and Syam, 2007). Rochayati and Husnain (2010) reported that fertilizer demand for rice cultivation in Indonesia increased approximately 1.2 million ton from 1990 to 2005. As a consequence, the price of chemical fertilizer tends to increase and many farmers in Indonesia face difficulty in getting it.

Intensive rice farming systems depend on nutrient input not only to replenish nutrient which is taken by plant but also to maintain soil fertility. Dobermann and Fairhust (2000) noted that to produce one ton of rough rice caused loss of 16-19 kg of N, 2.5-3.5 kg of P, and 19-25 kg of K from soil. Referring to the regulation of the Indonesian Agricultural Ministry (2007), fertilizer recommendations on paddy field at location with low productivity (< 5 Mg ha^{-1}) and nutrient status of low P and K were 200 kg ha^{-1} Urea, 100 kg ha^{-1} SP-36, and 100 kg ha^{-1} KCl respectively. In fact, success in improving rice production in Indonesia through the implementation of green revolution since 1960's led to very high dependence of farmers on inorganic fertilizers in intensive rice farming system, even its use is often excessive. However, since the1990's the rate of the increase in rice production and fertilizer use became imbalanced with a ratio of1:10. Many previous researchers showed that increases in fertilizer dose were closely related to rice production and grain quality (Cho *et al*., 2008), but the application of excessive chemical fertilizer caused the increase of nutrient loss through leaching, run off, denitrification or volatilization that contribute to decrease environ-mental quality and soil degradation.

Accredited SK No.: 81/DIKTI/Kep/2011

http://dx.doi.org/10.17503/Agrivita-2013-35-2-p184-192

A continuous application of chemical fertilizer in intensive rice farming system impacted negatively on soil degradation, which is indicated by increase in soil bulk density, low soil N content because of leaching, volatilization, denitrification, and run off (Cho, 2003). Many previous research were conducted to solve the problem such as deep placement of NPK fertilizers (Islam *et al.,* 2011), using plant growth promoting microor-ganism (Dobbelaere, Vanderleyden, and Okon, 2003), and applying organic fertilizer (Lin *et al.,* 2011) and compost (Zai *et al.,* 2008).

Among the management practices in the application of fertilizer to minimize nutrient loss and increase rice production is the use of organic fertilizers especially compost. Zahir *et al.* (2007) explained that composting have many benefits such as returning nutrients present in organic materials to the soil, managing large volumes of organic wastes in environmentally sound manners, controlling the undesirable features of organic materials (such as pathogen and odor), improving the organic matter status, soil health and physic-chemical properties of the soil, and supporting plant growth and crop productivity.

One of compost materials that is abundantly available is campus organic-waste. Therefore, this research was aimed to create enriched granular compost from campus organic waste combined with inorganic fertilizer and to test its effects on improvement of soil fertility, plant growth, and production in intensive rice farming system.

MATERIALS AND METHODS

This research was conducted in two consecutive years (2011-2012). The first step was focused on production of enriched granular-compost (EGC). In the second year, incubation and field experiment were conducted to test the effectiveness of EGC in releasing nutrient in order to increase soil fertility which finally would support crop productivity. Producing EGC and incubation experiments were done in Compost Supporting Unit (CSU) and Soil Chemistry Laboratory, Soil Science Department, Faculty of Agriculture, University of Brawijaya. Further-more, EGC was applied in rice cultivation in experiment field of Faculty of Agriculture University of Brawijaya, located in Kepuharjo village, Karangploso district, Malang regency, East Java, Indonesia.

Producing Enriched Granular-Compost (EGC)

This research was started by producing compost from campus organic waste, such as litter and grass. The steps of producing compost include: 1) collecting organic waste, 2) selecting material, 3) crushing the material and adding bio-activator (EM-4) to accelerate composting, and 4) composting. As much as 40 ml of EM-4 was mixed with 40 ml of molasses and 10 liters of water. This solution was introduced into 40 kg of organic waste. The humidity and temperature of composting were monitored every 5 days. Furthermore, all of the materials were covered by plastic to keep the heap warm and moist.The compost is usually mature for ±21 days indicated by no smell, black color, water content <30%, fine texture, and the heap temperature <30^{0}C. After the compost was mature, the plastic cover was removed, then C-organic, N-total and pH compost were measured to record nutrient content in compost.

The activities of producing enriched granular-compost consist of: 1) grinding compost material (size < 3 mm), 2) enriching the compost material by adding 75 g of NPK fertilizers per kg compost material and making granular compost by using granulator, and 3) analyzing N, P, and K content of enriched granular-compost. The speed of granulator determined the size of enriched granular-compost.

Incubation Experiment

The incubation experiment was designed by randomized complete block design, which consisted of five treatments and two replications. The treatments were four dose levels of enriched granular-compost (EGC) : 1) control or no fertilizer (C), 2) 50% of optimum dose (OD) or equal to 4 Mg ha^{-1} (P1), 3) 75% of OD or equal 6 Mgha^{-1} (P2), 4) 100% of OD or equal to 8 Mgha^{-1} (P3), 5) 150% of OD or equal to 12 Mgha^{-1} (P4).

Hairiah *et al.* (2000) reported that the optimum doses of organic matter to maintain soil organic matter at 2% content are 8 Mgha^{-1}of organic matter. It was used as a reference optimum dose in this research. The soil sample was taken from the top layer (0-20 cm) in experiment field, located in Kepuharjo village, which is classified as Inceptisol (Soil Survey Staff, 2010). The soil sample was air dried for 2 weeks, grounded and sieved through 2 mm. 500 g of air-dried soil were mixed with enriched granular-compost regarding each treatment in the plastic bag. Soil moisture was adjusted at approximately 90% of its field capacity. The soil sampling for laboratory analysis was conducted at 10, 20, and 30 days after incubation (DAI) to measure total N, P-available, and K-exchangable in soil.

Field Experiment

The field experiment was conducted from March to August 2012 in Kepuharjo village, Malang regency. The soil properties were characterized by pH (H_2O) 6.3; pH (KCl) 5.2, soil organic matter content 2.47%, CEC 36.88 me $100g^{-1}$, base saturation 47%, total N 0.15%, P-available 4.71 ppm, and K-exchangable 0.52 me $100g^{-1}$. The experimental site has annual rainfall of approximately 1500 mm $year^{-1}$.

The design of this experiment was Randomized Block Design (RBD) with three replications and seven treatments. The treatments were:(1) C: control or no fertilizer, (2) A:optimum dose (OD) of inorganic fertilizer (IF) (200 kg ha^{-1} urea, 100 kg ha^{-1} SP-36, and 100 kg ha^{-1}KCl), (3) B: 25% of OD of EGC + 75% of OD of IF, (4) D: 50% of OD of EGC + 50% of OD of IF, (5) E: 75% of OD of EGC + 25% of OD of IF, (6)F: 100% of OD of EGC + 100% of OD of IF, (7) G: optimum dose (OD) of EGC (2 Mg ha^{-1}). The optimum dose of enriched granular-compost tested in this research was 2 Mg ha^{-1} (Siavoshi *et al.,* 2011). The dose of inorganic fertilizer based on fertilizer recommendation (Urea, SP-36, and KCl) in paddy field from Indonesian Agricultural Ministry (2007). Soil tillage and seeding were done at two weeks before transplanting. Rice seedlings (Ciherang variety) were transplanted at 14 days old in 25 cm x 25 cm spacing. Enriched granular -compost according to the treatment was applied at 5 and 20 days after transplanting (DAT). Inorganic fertilizer following each treatment was applied three times, i.e. 10, 20, and 30 DAT.

Plant sampling in each treatment was randomly selected (3 plants m^{-2} per sub plot) to measure plant height, leaf number, tiller number per hill, and shoot biomass at 15, 30, 45, 60, 75, and 90 DAT. The harvest samples were taken from 1 m^2 of sub plot to observe the number of panicles m^{-2}, number of productive tillers $plant^{-1}$, number of filled grains $panicle^{-1}$, percent of filled grains, 1000 grain weight (g), and grain yield ($Mgha^{-1}$). Furthermore, at 60 DAT (end of vegetative phase) plant samples (leaf) were analyzed to measure the uptake of N, P, and K.

The collected data were subjected to analysis of variance using program of MS Excel to find the effect of the treatments on plant growth and yield (Gomez and Gomez, 2010). The differences between mean values of each treatment was analyzed by Tukey's honestly significance difference (HSD) test with significance level at $p<0.05$. Correlation analysis was conducted to study which harvesting variables were closely related to grain yield.

RESULTS AND DISCUSSION

Nutrient Content in Compost and Granular-Enriched Compost

The characteristics of the organic waste were slightly base (pH H_2O 7.7 and pH KCl 7.4), total C 15.5 %, total N 1.54%, total P 0.78 %, total K 0.67%, and C/N ratio 10.In comparation, Tan (1993) reported that nutrient contents such as N, P, and K from chicken manure were 1.5%, 0.77%, and 0.89%, respectively, and the concentration of N, P, and K of cow manure was 0.65%, 0.15%, and 0.30% respectively. Therefore, the compost from campus organic waste contained higher total N and P than that of chicken and cow manure, but it had low K-value. Furthermore, the nutrient content (N, P, and K) in enriched-granular compost increased three fold higher than the common compost, i.e. total N 3.96%, total P 2.23%, and total K 3.51%. It showed that the enrichment of N, P, and K in enriched granular-compost was proven effective in increasing the nutrient content of compost.

Effect of Enriched Granular-Compost (EGC) on Nutrient Availability (Incubation Experiment)

The trends of total-N, P-available, and K-exchangable dynamics in soil showed that application of EGC in many dose levels tended to increase total N and P-available at 10 days after incubation (DAI), whereas K-exchangable tended to decrease, except in the application of 2 $Mgha^{-1}$ EGC (Fig.1 a-c).EGCapplication had total-N and P-available higher than those in control at approximately 12.5% and 33% at 10 DAI. In general, the highest total-N reached at 10 DAI. It is indicate that rapid nitrification occured before 10 DAI, while other research showed that the rapid nitrification in soil treated with lawn clippings and commercial compost occured between 14 and 28 DAI.

There are two mechanisms that explain the increases of N and P concentration occuring at

10 DAI: 1) the main part of nutrients in EGCwas already in available form, and 2) these fertilizers had C/N ratio< 13, therefore it can be decomposed fast and released the nutrient.In addition, the increases of doses level of EGC significantly (P<0.05) increased the average of total-N in soil for 30 DAI (Figure 1 d-f). Overall, this research showed that EGCwas suitable to be used in intensive rice farming system to increase nutrient availability in the soil.

Plant Growth

The application of enriched granular-compost (EGC) combined with inorganic fertilizer (IF) gave short and long term available nutrient in soil solution for supporting plant growth. The plots receiving inorganic fertilizer and enriched granular-compost either individually or in combination significantly (P<0.05) affected an increase in plant height, leaf number, number of tillers per hill and shoot biomass. The effect of treatments on plant height occurred after 60 DAT (day after transplanting). Combination of EGC and IF (100% of OD) (F treatment) produced higher plant height than the other treatments at 60 and 90 DAT (Table 1). Combination 25% of OD of EGC and 75% of OD of IF (B treatment) showed the same effect as the application of inorganic fertilizer alone (A treatment) on plant height (Table 1). This research also noted that reducing 25%, 50%, and 75% of OD of IF (B, D, E treatments) substituted by EGC indicated the same effect in plant height. The research conducted by Khalid *et al.* (2003) reported that different level of NPK application affected significance (P<0.05) difference on plant height F Treatment (2 Mg ha^{-1} EGC + 200 kg ha^{-1} Urea+ 100 kg ha^{-1} SP-36 + 100 kg ha^{-1} KCl) had the highest plant height (74.67 cm) at 60 DAT than the other treatments. Ndaeyo *et al.* (2008) reported that application of 200 kg ha^{-1} of NPK (15:15:15) resulted plant height as much as 109.6 cm on 9th weeks therefore the effect of EGC application on plant height was 31% lower than the results of research by Ndaeyo *et al*. (2008).

All treatments showed significance difference (P<0.05) on leaf number at early phase of plant growth, i.e. 15 and 30 DAT. The combination of EGC and IF with the proportion 75%+25% (E treatment) had more number of leaves than the proportion of 100% EGC + 100% IF (treatment F) at 15 DAT (Table 1). At 30 DAT, B and D treatment, it was shown that more leaf number was apparent than the number of leaves in the other treatments. The plots receiving application of combination of enriched granular-compost and inorganic fertilizer (100% + 100%) (F treatment) had the lowest leaf number.

The application of EGC, IF, and their combination significantly affected tillers per hill at 30, 75 and 90 DAT and biomass at 30 DAT. The highest number of tillers per hill at 90 DAT was found in plots treated with EGC alone (G treatment). It is indicated that EGC positively impacted tillers per hill at 90 DAT because this fertilizer might release nutrient until 90 DAT. Furthermore, the combination of EGC and IF with the proportion of 25% + 75%, respectively (B treatment) resulted in the highest shoot biomass (2.80 g m^{-2}) at 30 DAT (Table 1).

Yield Components

The treatments significantly increased (P<0.05) the number of productive tillers per plant and 1000-grain weight. It indicated that application of fertilizer in this research enhanced nutrients availability in soil particularly in total N and P-available (from 0.15 % to 0.19 % of total N, 4.71 to 5.58 ppm of P-available), while the K-exchangeable in soil in harvesting was lower than it was in the beginning (0.33 me 100 g^{-1} than 0.52 me 100 g^{-1}).

The results of this study on 100-grain weight was consistent with Muhammad (2008), that application of 30 Mg ha^{-1} organic manure gave the highest effect to 1000-grain weight (45.26 g) in intensive rice farming system. Furthermore, Siavoshi *et al.*(2011) reported that the increase in plant height, number of tillers per hill, spikelet number per panicle, grain yield, and 1000-grain weight in response to application of organic and chemical fertilizers was probably due to the enhancement of nutrient availability.

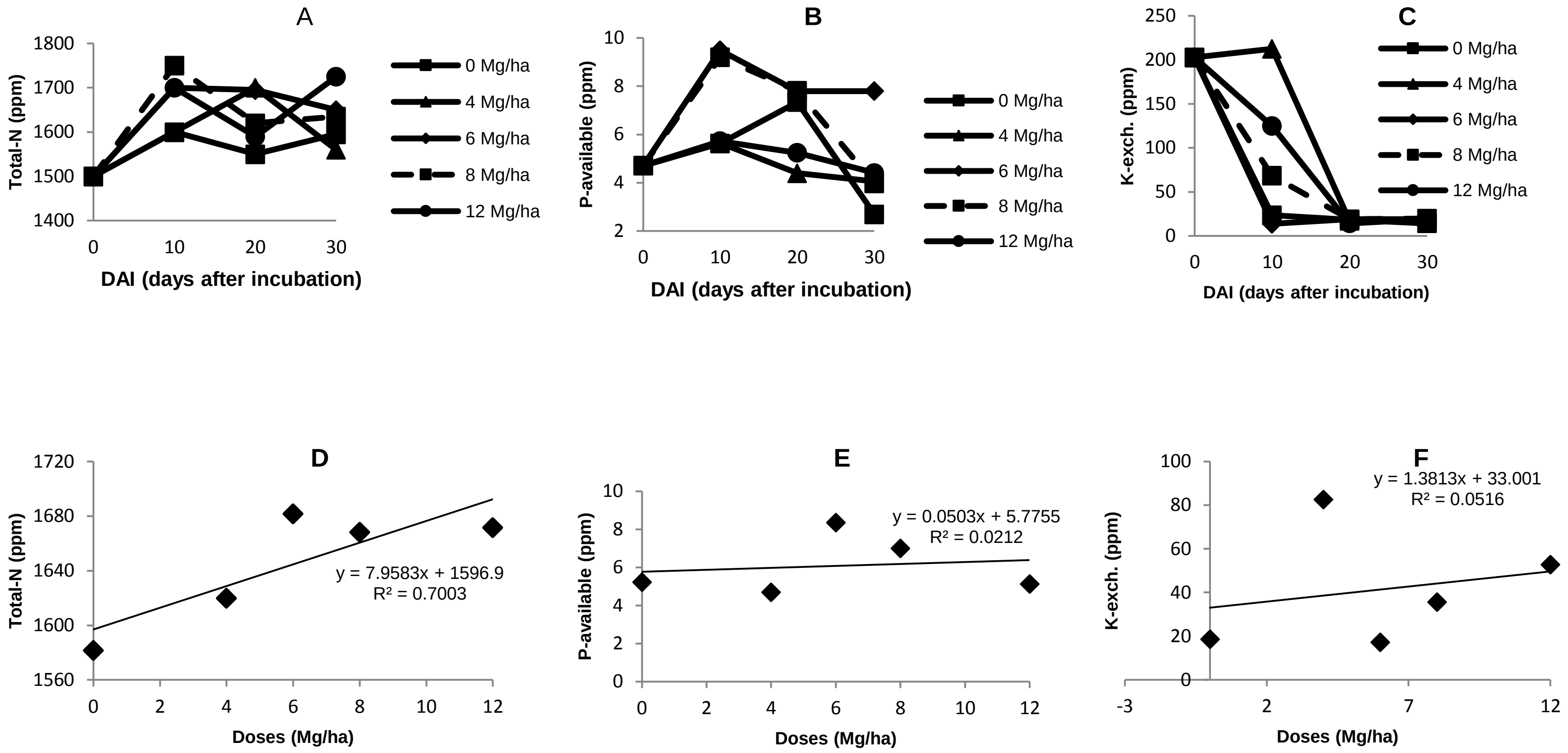

Figure 1. Effect of enriched granular-compost(EGC) fertilization in total-N, P-, and K-exchangeable in incubation experiment for along 30 days

Table 1. Effect of granular enriched-compost, inorganic fertilizer, and their combination on plant height, leaf number, tillers number per hill and shoot biomass

Treatment	**Plant height (cm)**		**Leaf number plant^{-1}**		**Tillers number hill^{-1}**			**Shoot Biomass (g.m^{-2})**
	60 DAT	**90 DAT**	**15 DAT**	**30 DAT**	**30 DAT**	**75 DAT**	**90 DAT**	**30 DAT**
C (control)	64.67 a	98.30 bc	3.44 a	25.11 ab	10.00 ab	53.10ab	37.60 ab	2.28 ab
A (IF alone)	69.67 ab	86.76 a	6.33 ab	38.11abc	12.40 b	51.60ab	26.20 a	2.71 ab
B(25% EGC+75%IF)	66.67 ab	90.13 ab	8.67 ab	47.89 c	13.30 b	44.40 a	30.60 ab	2.80 b
D(50% EGC+50%IF)	69.67 ab	90.06 ab	8.33 ab	43.89 bc	13.10 b	44.00 a	27.90 ab	2.71 ab
E(75% EGC+25%IF)	66.67 ab	88.04 ab	10.67 b	35.22 abc	10.40 ab	38.80 a	32.30 ab	2.04 ab
F(100% EGC+100IF)	74.67 b	104.41 c	3.22 a	18.33 a	6.40 a	73.60 c	36.30 ab	1.39 a
G(EGC alone)	66.67 ab	96.56 abc	3.89 a	25.56 ab	9.70 ab	64.20bc	43.30 b	1.73 ab
HSD(P< 0.05)	**9.51**	**11.29**	**5.67**	**20.92**	**5.96**	**17.81**	**16.09**	**1.40**

Remarks: HSD= honestly significance difference; different letters in the same column indicate a statistically significant difference (P < 0.05) IF= Inorganic Fertilizer ; EGC= enriched granular-compost

The highest number of productive tillers per plant wasfound in control plots (C treatment) and EGC (G treatment) (Table 2). Although both treatments had the highest panicle per plant compared to inorganic fertilizer or combination of granular enriched-compost and inorganic fertilizer, it cannot be justified whether it was influenced by the different condition of soil fertility or inefficiency of fertilization treatment, since fertilization treatment increased plant growth. Inorganic fertilizer applied singly (A) had the lowest of 1000-grain weight (g) compared to the others. It indicated that integration of EGC and IF was better than inorganic fertilizer alone because inorganic fertilizer released nutrient fast but easily lost.

Inorganic fertilizer treatment (Urea, SP-36, and KCl in doses of 92 kg N ha^{-1} + 11.35 kg P ha^{-1}+ 41.5 kg K ha^{-1}, respectively) combined with EGC (79.2 kg N ha^{-1}+ 44.6 kg P ha^{-1}+ 70.2 kg K ha^{-1}) in ratio of 1:1 (F treatment) tends to obtain the highest yield (6.13 Mg ha^{-1}), but that did not significantly increase the yield compared to the other treatments. The application of inorganic fertilizer without compost (A treatment) produced a similar yield as that with treatments where inorganic fertilizer was reduced and substituted with EGC. Reducing inorganic fertilizers of 25 kg N, 2.8 kg P, and 10.4 kg P (B treatment) did not significantly decrease the yields compared to optimum dose of inorganic fertilizer (A treatment) because those nutrient were substituted with 500 kg ha^{-1} EGC (Table 2). This result means that the application of EGC on rice farming system can reduce inorganic fertilizer application. Gorttappech *et al*. (2000) explained that combination of enriched compost with chemical fertilizer not only improves the efficiency of the chemical fertilizer but also reduces the use of chemical fertilizers.

The F treatment (1:1 proportion) commonly gave more output than the other fertilization treatments because increasing soil organic matter gave numerous benefits to rice quality, soil, and environment (Singh *et al*., 2004; Lin *et al.,* 2011). Kushwaha *et al.,* (1992) reported that the application of 60 kg N ha^{-1}, 60 kg N ha^{-1}+40 kg P ha^{-1}, 60 kg N ha^{-1}+40 kg P ha^{-1}+15 kg K ha^{-1}, and 60 kg N ha^{-1}+40 kg P ha^{-1}+15 kg K ha^{-1}+ 25 kg $ZnSO_4$ ha^{-1} obtain the average grain yield of 3.16, 3.60, 3.79 and 3.98 Mg ha^{-1} respectively.

Table 2. Effect of fertilization treatments on grain yield and components

Treatment	Number of panicles m^{-2}	Number of productive panicles $plant^{-1}$	Number of filled grain $panicle^{-1}$	Percent of filled grains $panicle^{-1}$ (%)	1000-grain weight (g)	Grain yield ($Mg\ ha^{-1}$)
C (control)	206.67	33.00 b	83.33	75.86	25.67 b	5.44
A (IF alone)	170.67	21.00 ab	122.67	80.08	20.37 a	5.60
B(25%EGC+75%IF)	205.33	22.00 ab	114.67	76.55	25.87 b	5.44
D(50%EGC+50%IF)	186.67	17.00 a	122.67	78.63	26.33 b	5.21
E(75%EGC+25%IF)	164.33	18.00 a	114.33	76.94	25.00 b	4.67
F(100%EGC+100IF)	186.67	31.00 ab	124.00	82.24	24.93 b	6.13
G (EGC alone)	178.67	35.00 b	126.33	78.12	25.73 b	5.35
HSD (P<0.05)	**ns**	**15.02**	**Ns**	**Ns**	**4.13**	**Ns**

Remarks: HSD = honestly significance difference; different letters in the same column indicate a statistically significant difference (P < 0.05). IF = Inorganic Fertilizer ; EGC= enriched granular–compost; ns = non significant

Table 3. Coefficient correlation among yield components

Variable	Grain yield ($Mgha^{-1}$)	Number of panicle m^{-2}	Number of productive tillers $plant^{-1}$	Number of filled grain $panicle^{-1}$	Percent of filled grains $panicle^{-1}$ (%)	1000 grain weight (g)
Grain yield ($Mg\ ha^{-1}$)	1.000	0.357	0.507*	0.135	0.685*	-0.225
Number of panicle m^{-2}	0.357	1.000	0.350	-0.580*	-0.362	0.492
Number of productive tillers $plant^{-1}$	0.507*	0.350	1.000	-0.256	0.070	0.202
Number of filled grain $panicle^{-1}$	0.135	-0.580*	-0.256	1.000	0.645*	-0.213
Percent of filled grains $panicle^{-1}$ (%)	0.685*	-0.362	0.070	0.645*	1.000	-0.417
1000 grain weight (g)	-0.225	0.492	0.202	-0.213	-0.417	1.000

Remarks: significance correlation at 5%

Based on coefficient correlation, the productivity of rice was closely related to the number of productive tillers per plant and percent of filled grain (Table 3). It was similar to the previous research by Siavoshi *et al.* (2011) showed that the productivity of rice is greatly dependent on the number of productive tiller (tillers which bear panicles) rather than the total number of tillers. This research showed that the highest number of productive panicles was produced by the combined treatment of EGC and inorganic fertilizer.

Substitution of inorganic fertilizer with enriched granular-compost 25-75% from optimum dose had the same effect on the application of inorganic fertilizer alone (Table 2). It indicated that enriched granular-compost was potential to be applied in intensive rice farming system combined with inorganic fertilizer. Therefore, the excessive application of inorganic fertilizers to produce effective tiller is ineffective if the organic fertilizer can provide nutrients for plants (Miller, 2007; Rakshit *et al.,* 2008).

Nutrient uptake

At the end of vegetative phase, fertilization treatment affected significance on the total soil N content and N uptake, but soil P and K concentration and uptake by plant were similar. The highest N uptake at the end vegetative phase was observed in plot treated with treatment of A (inorganic fertilizer) (Table 4). It indicates that the increases of nutrient availability in soil will increase nutrient uptake.

Table 4. Nutrient content in plant and nutrient uptake at 60 DAT

Treatment	Total-N (%)	Total-P (%)	Total-K (%)	N-uptake (g plant^{-1})	P-uptake (g plant^{-1})	K-uptake (g plant^{-1})
C (control)	1.649 ab	0.484	1.553	0.727 ab	0.215	0.694
A (100%IF)	2.039 b	0.506	1.083	1.099 b	0.273	0.597
B (25% EGC+75% IF)	1.894 b	0.467	0.988	0.788 ab	0.194	0.413
D (50% EGC+50% IF)	1.700 ab	0.507	0.966	0.758 ab	0.222	0.447
E (75% EGC+25% IF)	1.846 ab	0.644	1.066	0.719 a	0.249	0.419
F (100% EGC+100 IF)	1.866 ab	0.605	0.991	1.032 ab	0.356	0.477
G (100% EGC)	1.491 a	0.495	0.901	0.718 a	0.255	0.391
HSD (P< 0.05)	**0.40**	**ns**	**ns**	**0.38**	**ns**	**ns**

Remarks: HSD= honestly significance difference; different letters in the same column indicate a statistically significant difference (P < 0.05) IF= Inorganic Fertilizer ; EGC= enriched granular –compost ns= non significant

Based on this study, it is suggested that enriched granular-compost from campus organic waste is potential to increase nutrient availability in soil for supporting plant growth and yields. This fertilizer is predominance because not only does it contain higher nutrients than compost but it also holds organic matters which are beneficial in improving physical and biological of soil quality. From the practical view point, farmers can use the combination of enriched granular-compost and are recommended to reduce the dose of inorganic fertilizer to increase the grain yields as well as to maintain and improve soil fertility.

CONCLUSIONS

The application of enriched granular-compost (EGC) in various level tends to increase total N and P-available at 10 days after incubation in the average value 12.5% and 33% respectively. The combination of EGC and inorganic fertilizer with various compositions significantly affected plant growth and shoot biomass.

The application of EGC alone gave the best effect on number of productive tillers per plant and 1000 grain weight, but the highest rice grain yields (6.13 Mg ha^{-1}) was reached by combination between 100% of optimum doses of EGC (2 Mg ha^{-1}) and 100% of optimum doses of inorganic fertilizer (200 kg Urea ha^{-1}, 100 kg SP-36 ha^{-1}, and 100 kg KCl ha^{-1}) (F treatment). The grain yield is closely related to the number of productive tillers per plant and percent of filled grain.

The application of 25-75% of EGC (500-1500 kg ha^{-1}) will be potentially reduce 25-75% of inorganic fertilizer doses (50-150 kg Urea ha^{-1}, 25-75 kg SP-36 ha^{-1}, and 25-75 kg KCl ha^{-1}) for intensive rice farming system.

ACKNOWLEDGEMENTS

The author thanks to the Directorate General of Higher Education for the funding given through the Competitive Grant Research Program by DIPA of Brawijaya University, with the contract number: 0636/023-04.2.16/15/2012 December 9, 2011and based on the Rector's Decree No.058/SK/2012 February 8, 2012

REFERENCES

Cho, J.Y. 2003. Seasonal run off estimation of N and P in a paddy field of Central Korea. Nutrient Cycling in Agroeco-systems 65: 43-52.

Cho, J.Y., J.G. Son, C.H.Song, S.A. Hwang, Y.M. Lee, S.Y. Jeong and B.Y. Chung. 2008. Integrated nutrient management for environmental-friendly rice product-ion in salt affected rice paddy fields of Saemngeum reclaimed land of South Korea. Paddy Water Environment J. 6: 263-273.

Dobbelaere, S., J. Vanderleyden and Y.Okon. 2003. Plant growth promoting effects of diazotrophs in the rhizosphere. Critical Rev. Plant Sci. 22: 107 – 149.

Dobermann, A. and T. Fairhust. 2000. Rice : Nutrient management and nutrient disorders. PPI/PIC and IRRI. pp.162.

Food and Agriculture Organization (FAO). 2008. Current world fertilizer trends and outlook to 2011/12. FAO. pp.57.

Gomez, K.A. and A.A. Gomez. 2010. Statistical procedures for agricultural research,. 2nd edition (in Indonesian). University of Indonesia. pp.698.

Gorttappech, A.H., A. Ghalavand, M.R. Ahmady and S.K. Mirnia. 2000. Effect of inorganic and organicfertilizer on quantitative and qualitative traits of different cultivars of sunflower (*Hellianthus annus* L.). Iran J. Agri. Sci. 6(2): 85-104.

Hairiah, K., Widianto, S.R.Utami, D.Suprayogo, Sunaryo, S.M.Sitompul, B.Lusiana, R. Mulia, M.van Noordwijk and G. Cadish. 2000. Biological management of soil fertility on acid soils (In Indonesian). International Centre for Research in Agroforestry. Bogor. ISBN 9799553776. pp.187.

Indonesian Agricultural Ministry Regulation No.40/Permentan/OT.140/04/2007.2007. Fertilizer recommendation of N, P, and K on Paddy field based on specific location (In Indonesian). Agriculture Dept. pp.18.

Islam, M.S., F. Rahman and A.T.M.S. Hossain. 2011. Effects of NPK briquette on rice (*Oryza sativa*) in tidal flooded ecosystem. The Agriculturists: A Scientific J. of Krishi Foundation 9 (1 and 2): 37-43.

Khalid, M., F.M. Chaudry, and H.Abid. 2003. Effect of different levels of NPK on the yield and quality of rice cv. IR-6. J. of Research (Science) 14(1): 11 – 15.

Kushwaha, H.S., M.K. Mishra and R.A.S. Tomer.1992. Response of rice to NPK and Zn on farmer field. Agric. Science Digest (Kernel 12, 4 – 6), (Rice Absts, 1993, 6, 2455).

Lin, X., D. Zu and X.Lin. 2011. Effects of water management and organic fertilization with SRI crop practices on hybrid rice performance and rhizosphere dynamics. J. of Paddy Water Environment 9: 33-39. Springer.

Miller, H.B. 2007. Poultry litter induces tillering in rice. J. Sustain. Agriculture 31: 1-12.

Muhammad, I. 2008. Response of wheat growth and yield to various levels of compost and organic manure. Pak. J.Botany. 40 (5): 2135-2141.

Naher, U.A., M.A. Saleque, Q.A. Panhwar, O. Radziah, and S. Jusop. 2011. Techniques of efficient fertilizer management for wetland rice- a review. Australian J. of Crop Science 5(12): 1661-1669.

Ndaeyo, N.U., K.U. Iboko, G.I. Harry and S.O. Edem. 2008. Growth and yield performances of some upland rice (*Oryza sativa L*) cultivars as influenced by varied rates of NPK (15:15:15) on an Ultisol. J. of Tropical Agriculture, Food, Environment, and Extension 7(3): 249-255.

Rakshit, A., N.C. Sarkar and S. Debashish. 2008. Influence of organic manures on productivity of two varieties of rice. J. Cent. Eur. Agriculture 9(4): 629-634.

Rochayati, S. and Husnain. 2010. Fertilizer management for improving lowland sawah productivity in Indonesia: Integrated plant nutrient management system. Paper presented on Inter-national Conference of “Balanced Nutrient Management for Tropical Agriculture”, 12-16 April 2010, Pahang-Malaysia. pp.7.

Siavoshi, M., A. Nasiri and S.L.Laware. 2011. Effect of organic fertilizer on growth and yield components in rice (*Oryza sativa* L.). J. Agric.Sci. 3(3): 217-224.

Singh, Y., B. Singh, J.K. Ladha, C.S. Khind, R.K. Gupta, O.P. Meelu and E. Pasuquin. 2004. Long term effects of organic inputs on yield and soil fertility in the rice-wheat rotation. Soil Sci Soc Am J. 68: 845-853.

Soil Survey Staff. 2010. Keys to soil taxonomy. Eleventh ed. United States Department of Agriculture, Natural Resources Conservation Service. pp.34.

Wurjandari, D. dan M.Syam. 2007. Important data of paddy on the world and many countries in Asia (In Indonesia). In http: //pustaka.litbang.deptan.go.id/bppi/lengkap/bpp07001.pdf. pp.90.

Zai, A.K.E., T. Horiuchi and T. Matsui. 2008. Effects of compost and green manure of pea and their combinations with chicken manure and rape seed oil residue on soil fertility and nutrient uptake in wheat-rice cropping system. African J. of Agricultural Research 3(9): 633-639.

Zahir, Z.A., M. Naveed, M. Zobair, A. Khalid and M. Arsyad. 2007. Enrichment of composted wastes for improving rice production. J. Chem.Soc.Pak 5(29): 514-519.