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Application of liquid organic fertilizer from city waste on reduce urea application on Chinese mustard (*Brassica juncea* L) cultivation

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Abstract. Chinese mustard (*Brassica juncea* L) was grown on Andisol Soil with low pH (5.1), very low total N 0.67 %, medium P_2O_5 concentration (7.0 ppm), and very high K content (134.8 ppm) to evaluate the best concentration of liquid organic fertilizer (LOF) from city waste on reduce urea application. Eleven urea and liquid organic fertilizer combination (1 = 100 % Urea + 0 LOF, 2 = 100 % Urea + 25 ml l^{-1} LOF, 3 = 75 % Urea + 25 ml l^{-1} LOF, 4 = 50 % Urea + 25 ml l^{-1} LOF, 5 = 100 % Urea + 50 ml l^{-1} LOF, 6 = 75 % Urea + 50 ml l^{-1} LOF, 7 = 50 % Urea + 50 ml l^{-1} LOF, 8 = 100 % Urea + 75 ml l^{-1} LOF, 9 = 75 % Urea + 75 ml l^{-1} LOF, 10 = 50 % Urea + 75 ml l^{-1} LOF, and 11 = 0 % Urea + 50 ml l^{-1} LOF) were arranged in a randomized completely block design with three replications. The results showed that combination of liquid organic fertilizer and urea increased Chinese mustard growth and yield in low N soil. The best treatment is the combination of 50 % Urea + 75 ml^{-1} but not significantly different than others combination. Liquid organic fertilizers from city waste reduce 50 % Urea application, and 25 ml l^{-1} concentration of LOF is efficient on Chinese mustard cultivation as an alternative nutrition source.
Key Words: Liquid organic fertilizer, city waste, urea, *Brassica juncea* L.

Introduction. Chinese mustard (*Brassica juncea* L) is consumed as a leafy vegetables and consumer demand on healthy vegetables makes this product face to organic farming. Although, pure organic farming is difficult to apply in the field but organic matters application is direction for healthy food (O'Doherty Jensen 2000). Inorganic residue on the field and pollutants in irrigation water are examples of factor which contradictive with pure organic farming. Beside that, uptake nutrition overdue from organic fertilizer made plant production not maximal. The relative availability of nutrients is lower in organic compared to inorganic fertilizer, which can result in significantly lower yield in plant (Tétard-Jones et al 2013). Low exchange input sustainable agriculture was improved to solve those problems. Minimum inorganic input and maximum organic input practice make the cultivation synergy with nature and maintain high production. Low exchange input sustainable agriculture of Chinese mustard cultivation used bokashi and EM application gave higher yield and higher R/C ratio than conventional cultivation (Faqih 2006).

Organic fertilizer could be made from domestic material compost (Karim & Ali 2001), example city waste. City waste as a compact (city garbage) and as a liquid (water pollutants) can be used as a nutrient source of the plant. Although these material can maintain and improve land fertility, but there are some problems of city garbage used as a fertilizer, *i.e.* to collect the material, to separate the material which can not coated by biologically, variety of material, and low N content. The problem of liquid waste is the metal contamination (Power & Papendick 1997). Composting and application of EM in organic material give good effect on plant growth (Nuraini & Adi 2003) and application of liquid waste give not bad effect on soil water quality (Manik 2000). In composting process decomposition by microorganisms transform undissolved organic nutrients in dissolved nutrients and can be used easily by plants (Leithold 1996; Murbandono 1998).

Compact organic material such as mature, compost, or green mature are usually used in agriculture systems, but they have some disadvantage as their bulk density and

low nutrient content (Sutanto 2002). Organic material rapidly faces to hormone materials and liquid organic fertilizer (Nugroho et al 1996). Liquid organic fertilizers application leads to faster nutrient supply than compact organic fertilizers do. But, high concentration on liquid fertilizer could delay nutrient uptake by the plant (Rohmiyat et al 2006). To solve the problem watery mix can be applied. Higher concentration will delay nutrient uptake, lower concentration of nutrients will uptake rapidly, but by smaller nutrient uptake content for each time (Prawiranata et al 1995).

Urea was used as main N sources for leafy vegetables. Application of liquid organic fertilizer can substitute urea application as nutrient sources. The research objective is to find out the effect of liquid organic fertilizer from city waste on Chinese mustard growth and yield, to show the effect on urea application and also to elucidate the best concentration of liquid organic fertilizer for Chinese mustard cultivation. It is assumed that liquid organic application can reduce urea application and give good effect on plant growth and yield.

Material and Method. Liquid organic fertilizer (LOF) made from: 50 g dedak (mixture of rice and bran), 20 l liquid waste, 100 ml EM4, 500 g city garbage, 50 g a fish-preserves and 100 g sugar. With nutrient content *i.e.* C – organic (0.65 %), N total (0.15 %), C/N ratio (4), P2O5 (0.01 %), K2O (0.22 %), Fe (5.4 ppm), Mn (0.8 ppm), Cu (0.8 ppm), Zn (0.5 ppm), B (2.5 ppm), Pb (0.088 ppm) and metal content *i.e.* Co (0.16 ppm) and Cd (0.060 ppm).

The experiment was conducted in a green house at Indonesian Vegetable Research Institute's (IVEGRI) Experiment Field (Lembang Jawa Barat Indonesia, 1200 m abs) from November to December 2008. Type of soil is Andisol with low pH (5.1), very low total N 0.67 %, medium P_2O_5 concentration (7.0 ppm), and very high K content (134.8 ppm). Randomized Block Design with eleven treatments and three replications was used. The eleven treatments were: (1) A = 100 % Urea + 0 LOF, (2) B = 100 % Urea + 25 ml l^{-1} LOF, (3) C = 75 % Urea + 25 ml l^{-1} LOF, (4) D = 50 % Urea + 25 ml l^{-1} LOF, (5) E = 100 % Urea + 50 ml l^{-1} LOF, (6) F = 75 % Urea + 50 ml l^{-1} LOF, (7) G = 50 % Urea + 50 ml l^{-1} LOF, (8) H = 100 % Urea + 75 ml l^{-1} LOF, (9) I = 75 % Urea + 75 ml l^{-1} LOF, (10) J = 50 % Urea + 75 ml l^{-1} LOF, and (11) K = 0 % Urea + 50 ml l^{-1} LOF.

Recommended urea (46 % N) dosage was 130 kg/ha equal with 0.5 g per plot. Treatments used 5 kg per plot, where each pot was planted with 1-2 seedlings, age 2 weeks after sowing. Plant media was Andisol soil with mixture with horse manure with 5:1 composition. Treatments were given in secondary fertilizer, on 2 weeks after planting and just once application. Parameters observed: plant height, leaves number, plant diameter and yield per plant.

Results and Discussion. Nutrient uptake from organic fertilizer is slower than from inorganic fertilizer. It shows in plant height and plant diameter (Table 1). In 50 % urea + 50 ml l^{-1} organic (G) treatment plant height was significantly lower than control (A) in 28 dap (days after plant). But, there is no significantly different in 35 dap. Liquid organic fertilizer is slow release, that's meant that nutrient content in liquid fertilizer can not been uptake directly, but need time for decomposition. Application of EM4 in liquid organic fertilizer from city waste hopes has faster decomposition time. Iskandar (2003) said that EM4 application in organic material mixture could achieve a faster decomposition time and increase the fertilizer quality. Using nitrogen fertilizer and organic compost on potato has a significant effect on plant height (Changiz-Dalivand et al 2012). Same effect can be found on plant diameter parameter. Plant diameter at 21 dap of 100 % urea + 25 ml l^{-1} (B), 50 % urea + 25 ml l^{-1} (D) and 100 % organic (K) treatments is significantly lower than control, but at 28 and 35 dap there's no significantly differences with control. It also proves that liquid organic fertilizer application is a slow release technique which needs time for decomposition.

Liquid organic application can give good effect on plant growth. Watery organic material increase dissolved nutrients because of the perfect decomposition process (Parnata 2004). Another beneficial effect of watery organic material is increase of humic acid production which can improve dissolved phosphor on the ground (Rohmiyat et al

2006). And also uptake of humic acid by the plant can improve protein exchange and increase pest resistance (Arbiwati 2000). Watering regimes significantly affected plant N-concentration and yield (Tétard-Jones et al 2013).

Table 1

Effect of urea and organic liquid fertilizer on plant height and diameter

Treatment	Plant height (cm)			Plant diameter (cm)		
	21 dap	28 dap	35 dap	21 dap	28 dap	35 dap
A	23.3	28.4 a	31.4	29.3 ab	30.8	38.2 ab
B	20.3	25.0 ab	30.4	23.0 cd	28.4	35.0 ab
C	24.5	28.7 a	34.2	28.2 abc	34.2	40.3 ab
D	21.3	26.3 ab	31.6	23.7 cd	32.9	37.7 ab
E	22.6	26.0 ab	31.5	27.0 abc	32.5	38.4 ab
F	21.0	25.3 ab	30.9	25.2 bcd	30.9	39.7 ab
G	19.7	23.0 b	27.1	24.6 bcd	29.2	33.0 b
H	22.3	26.5 ab	31.8	26.5 abc	29.4	36.8 ab
I	21.8	26.5 ab	34.5	25.6 abcd	29.8	40.1 ab
J	24.3	28.7 a	34.6	30.9 a	33.9	43.4 a
K	19.0	23.9 b	29.0	20.7 d	27.2	31.8 b
CV (%)	9.94	7.33	8.36	9.35	9.06	9.81

dap – days after planting, A – 100 % Urea + 0 ml l^{-1} LOF, B – 100 % Urea + 25 ml l^{-1} LOF, C – 75 % Urea + 25 ml l^{-1} LOF, D – 50 % Urea + 25 ml l^{-1} LOF, E – 100 % Urea + 50 ml l^{-1} LOF, F – 75 % Urea + 50 ml l^{-1} LOF, G – 50 % Urea + 50 ml l^{-1} LOF, H – 100 % Urea + 75 ml l^{-1} LOF, I – 75 % Urea + 75 ml l^{-1} LOF, J – 50 % Urea + 75 ml l^{-1} LOF, K – 0 % Urea + 50 ml l^{-1} LOF.

Organic acid from organic decomposition could dissolve undissolved P and phosphate stone (Hoffand 1992), organic application could increase P-potential content (Hartatik et al 1993) and also could decrease aluminum dissolve (Yusuf et al 2004), increase total C-organic content and C-organic fraction (Pujiyanto et al 2003) and with cation and micro unsure made kelat as a micro nutrient source (Indrasari & Syukur 2006).

Available nitrogen could increase vegetative growth and give good effect on the yield. Leafy vegetables need high concentration of nitrogen for vegetative growth, like growth of leaves, stem and root and will effect on leaf area meter, leaves number and fresh weight of plant. Leaves number at 21, 28 and 29 dap shows not significantly differences between all treatments (Table 2).

Table 2

Effect of urea and liquid organic fertilizer on leaves number and yield per plant

Treatment	Leaves number			Yield per plant (g)
	21 dap	28 dap	35 dap	
A	5.2	6.0	7.2	44.56 abc
B	4.8	5.0	6.9	37.30 bc
C	5.2	5.7	7.3	49.86 ab
D	5.4	5.8	7.3	50.09 ab
E	4.8	5.8	7.3	43.81 abc
F	4.2	5.7	6.6	36.89 bc
G	4.3	5.3	6.8	33.82 bc
H	4.7	5.9	7.3	45.13 abc
I	4.8	5.9	7.2	45.30 abc
J	5.1	6.0	8.2	61.75 a
K	3.9	4.2	6.1	30.43 c
CV	12.31	11.3	11.94	22.88

dap – days after planting, A – 100 % Urea + 0 ml l^{-1} LOF, B – 100 % Urea + 25 ml l^{-1} LOF, C – 75 % Urea + 25 ml l^{-1} LOF, D – 50 % Urea + 25 ml l^{-1} LOF, E – 100 % Urea + 50 ml l^{-1} LOF, F – 75 % Urea + 50 ml l^{-1} LOF, G – 50 % Urea + 50 ml l^{-1} LOF, H – 100 % Urea + 75 ml l^{-1} LOF, I – 75 % Urea + 75 ml l^{-1} LOF, J – 50 % Urea + 75 ml l^{-1} LOF, K – 0 % Urea + 50 ml l^{-1} LOF.

Same results were found on phoenix palm with a mix of inorganic fertilizer and organic extract, with no increase number of leaves (Wanderley et al 2012).

Yield of all treatments not differ significantly with control (A). Therefore, the best yield can reached by 50 % urea + 75 ml l^{-1} organic (J) with significantly differences toward 100 % organic (K). Farneselli et al (2013) reported organic tomato and maize yielded less than conventional low input cropping system. Application of liquid organic fertilizer plus 100 % urea (B, E, H treatments) do not increase plant yield significantly, but application of liquid organic fertilizer with reducing urea application give high yield.

Best treatment shows on 50 % urea + 25 ml l^{-1} and 75 ml l^{-1} LOF which have higher yield, and also liquid organic fertilizer can reduce urea application until 50 %. On shallot, liquid organic fertilizer could reduce inorganic fertilizer (Urea, SP-36 and KCl) until 50 % (Londra 2008), and on paddy organic fertilizer (compost straw and biofertilizer) can reduce inorganic fertilizer (N, P and K) about 20 % (Turmuktini et al 2012). This is show that liquid organic fertilizer can use as an alternative plant nutrition source. Application of liquid organic fertilizer with 25 ml l^{-1} concentration is more efficient than 75 ml l^{-1} concentration although had lower yield but not significantly different yield. Besides as an alternative nutrition source, organic material application can improve soil physics by decrease soil weight volumen and increase soil organic material content (Dharmawati 2003), improve soil chemics by increase nutrition, cation exchange capacity (Arbiwati 2000) and could control iron toxicity (Hakim et al 2012), and not at least improve soil biology by increase useful microorganisms (Arbiwati 2000). A mixture of organic and inorganic fertilizer farming could be more economically viable, beneficial for farmers livelihoods and environmentally friendly than inorganic fertilizer farming by himself (Vetayasuporn 2012).

Conclusions. Liquid organic fertilizers from city waste gives good effect on growth and yield of Chinese mustard, and can reduce urea application until 50 %. Concentration of 25 ml l^{-1} liquid organic fertilizer is efficient as an alternative and environmental friendly nutrition source for the plant.

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