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Leek (*Allium fistulosum*, L.) Growth and Yield as Affected by Cow Manure and Guava Waste Liquid Organic Fertilizer

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Abstract. Fruit waste can be a good source of liquid organic fertilizer (LOF) because it contains macro and micronutrients needed by plants. This study aims to determine the type and concentration of LOF for the growth and yield of leek (*Allium fistulosum*, L.). This research was conducted from June to August 2019, in Pematang Gubernur, Muara Bangkahulu, Bengkulu City, Indonesia. Treatment consist of types of Liquid Organic Fertilizer (LOF) which were cow manure (CM) and guava waste (GW) at concentrations of 25%, 50%, and 75%. Experimental treatment included; without LOF, CM LOF (25%), CM LOF (50%), CM LOF (75%), GW LOF (25%), GW LOF (50%), GW LOF (75%), CM LOF + GW LOF (25%), CM LOF + GW LOF (50%) and CM LOF + GW LOF (75%). The study used a completely randomized design (CRD), one factor, repeated five times. Differences in LOF concentration and source significantly affected the number of leaves and tiller diameter. Nonetheless, it did not affect the number of tillers, plant height, and fresh weight. Cow manure liquid organic fertilizer at a 50 % concentration raised the number of leaves by 35 %, whereas guava waste increased the leaves numbers by 25%. With the application of guava waste liquid organic fertilizer at a concentration of 75%, so the number of tillers increased by 23%.

Keywords: leek; liquid organic fertilizer; organic fertilizer

INTRODUCTION

Fertilization aims to meet the soil nutrients needed to increase leek yields. On the other hand, excessive and continuous use of synthetic fertilizers harms the environment. The application of organic fertilizers can replace synthetic fertilizers because they are environmentally friendly and contain nutrients needed for plants (Muktamar et al., 2016).

Organic fertilizers consist of solid organic fertilizers and liquid organic fertilizers (LOF). Liquid organic fertilizers consist of essential plant nutrients and beneficial microorganisms, which recycle organic matter such as plant waste and animal litter. Fruit waste may be used as a source of LOF because it contains organic materials in carbohydrates, proteins, and fats (Latifah et al., 2012). Liquid organic fertilizers provide nutrients and are often applied to overcome nutrient deficiencies. In addition, the application of LOF does not harm either the soil or plants despite frequent use. The quality of the LOF is determined mainly by the composition and source of organic matter (Indrianasari, 2017). Sources of LOF organic matter include agricultural, livestock, municipal waste, and others.

Cow manure is one of the livestock wastes used as the primary material for LOF. Converting cow manure into LOF aims to increase the efficiency of nutrient absorption by plants. Liquid organic fertilizers derived from organic materials contain low nitrogen (N). Thus, LOF applications require additional N nutrients. Fruit waste containing N elements can be used as a source of LOF (Utaminingsih., 2013).

Tropical fruit waste has many potential usages. Extracted compounds of fruit and vegetable waste can be used in food, pharmaceuticals, cosmetic, and chemical industries, food research, and functional foods (Sagar et al., 2018). Tropical organic fruit waste has potential as a medium for microalgae (Tan et al., 2021), and bio-briquettes (Brunerová et al., 2017). Papaya waste contains valuable medicinal properties, while durian peels are being mainly utilized as bio-sorbent (Cheok et al., 2018). Guava leaves and neem seeds extract waste can be utilized as organic fertilizer (Arifin et al., 2017).

Fruits, such as guava have the potential as a source of LOF. If not stored at the proper temperature, guava rots soon after harvest. The

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decaying guava fruit is thrown away as garbage or waste. We can find guava waste in fruit plantations and fruit shops. Application of guava waste containing nutrients and various decomposing bacteria can increase soil fertility. Guava waste can be mixed with other LOF resources to make LOF (Anwar et al., 2008). This study aims to determine the type and concentration of LOF for the growth and yield of leek.

METHODS

The research was carried out from June to August 2019 in Bengkulu City, Indonesia, at an altitude of ± 10 m above sea level. The study was conducted in 30 cm x 35 cm (width x height) polybags using a completely randomized design (CRD), 1 factor, repeated five times. Types of Liquid Organic Fertilizer (LOF) were Cow Manure (CM) and Guava Waste (GW) at concentrations of 25%, 50%, and 75%. The following is the procedure for generating LOF. The first phase was to dissolve 10 mL of EM-4 and 1 kg of granulated sugar in 10 L of water and let it stand for 24 hours. Next, 10 kg of cow dung + 2.5 kg of topsoil + 10 L of coconut water is mixed and put into a plastic barrel. The EM-4 solution was then poured into a barrel and refilled to a volume of 100 L with water. The plastic barrel was then closed and incubated for one month. Every three days, the LOF mixture in the barrel was stirred, and after one month, the solution was filtered, and the LOF was ready to use.

Experimental treatment consisted of:

P_0 = without LOF
P_1 = CM LOF (25%)
P_2 = CM LOF (50%)
P_3 = CM LOF (75%)
P_4 = GW LOF (25%)
P_5 = GW LOF (50%)
P_6 = GW LOF (75%)
P_7 = CM LOF + GW LOF (25%)
P_8 = CM LOF + GW LOF (50%)
P_9 = CM LOF + GW LOF (75%)

The planting medium was topsoil Histosol mixed with cow manure at a dose of 15 tons/ha or 37.5 g/polybag. Polybags were arranged with a distance between plants of 30 cm x 30 cm. The leek seedlings planted were two months old with an average fresh weight of 15-20 g. The planting of leek seedlings was carried out in the afternoon, one plant per polybag.

LOF was applied to the soil surface around the roots for six weeks, starting one week after planting (WAP). From the first to the sixth week, each plant received 80 ml, 100 ml, 100 ml, 100 ml, 125 ml, and 125 ml of LOF, respectively (Muktamar et al., 2016 with modification).

Synthetic N fertilizer was applied twice, 21 and 42 days after planting (DAP) at a dose of 200 kg/Ha urea (50% recommended dose), while SP-36 fertilizer as much as 50 kg/Ha and KCl 75 kg/Ha applied at 21 DAP (Setiawati et al., 2007). Weeding and pest control were done manually. Leeks were harvested at 60 DAP.

The variables observed included the number of tillers, number of leaves, plant height, tiller diameter, and plant fresh weight.

Data analysis

The data were analyzed statistically by Analysis of Variance (ANOVA) using the F-test at the 5% level. Further tested of the significant effect was conducted with the Duncan Multiple Range Test (DMRT) test.

RESULTS AND DISCUSSION

The difference in concentration and source of LOF significantly affected the number of leaves and tiller diameter. Still, it did not significantly affect the number of tillers, plant height, and fresh weight (Table 1).

The number of tillers was between 2.6 – 4.2; plant height 42.9 cm – 45.1 cm, and plant fresh weight between 113.65 g – 140.3 g. The number of leeks fertilized with LOF of CM (50%) and GW (50%) was higher than that of the control treatment. On the other hand, the tiller diameter fertilized with LOF GW (75%) was higher than that of the control treatment (Table 1).

Figures 1 and 2 demonstrate the trend of the type and concentration of LOF on the number of tillers and leaves.

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Table 1. Effect of liquid organic fertilizer type and concentrations on leek growth and yield

LOF type and concentration	Tiller number	Leaf number	Plant height (cm)	Tiller diameter (mm)	Fresh weight (g)
Control (no LOF)	3.20	25.20bc	42.90	12.68b	118.98
Cow manure (25%)	4.00	28.40abc	43.60	12.36b	122.96
Cow manure (50%)	4.20	34.00a	43.70	12.86b	134.10
Cow manure (75%)	3.60	28.60abc	43.40	12.16b	113.65
Guava waste (25%)	3.60	32.20ab	44.30	13.96ab	140.30
Guava waste (50%)	4.20	32.40a	43.20	12.43b	128.68
Guava waste (75%)	2.60	24.80bc	43.80	15.60a	118.18
Cow manure + Guava waste (25%)	3.00	23.40c	44.20	14.20ab	114.72
Cow manure + Guava waste (50%)	3.60	28.20abc	44.50	13.08b	124.50
Cow manure + Guava waste (75%)	4.00	30.80abc	45.10	12.32b	135.40

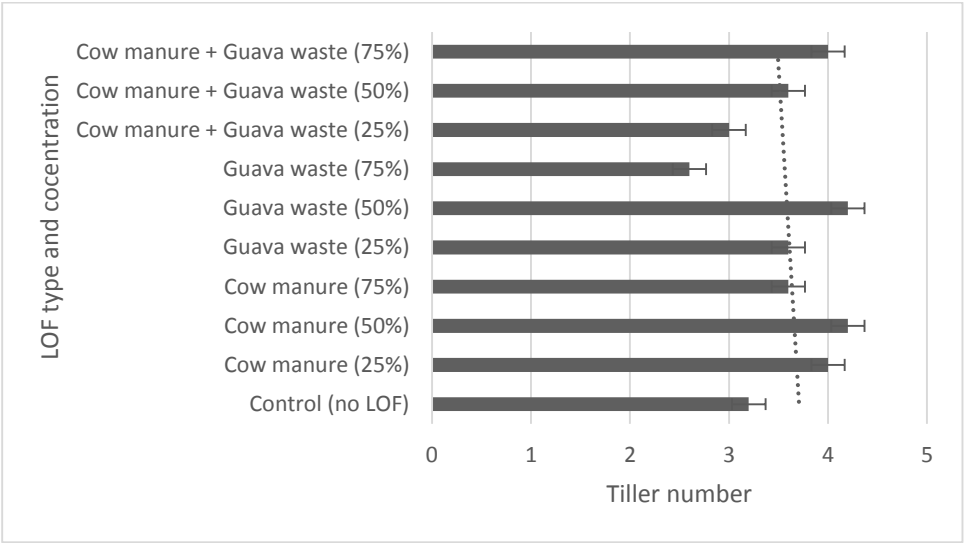

Figure 1. Effect of type and concentration of LOF on tiller number

The number of leek tillers was between 2.6 (GW 75%) – 4.2 (CM 50%). The control treatment produced 3.2 tillers. The effect of LOF application on the number of leek tillers showed inconsistent results. GW (75%) application resulted in only 2.6 tillers, while a mixture of (CM + GW) 25% resulted in as much as 3.0 tillers, smaller than the control treatment, which was 3.2. The application of CM, GW, or a mixture of the two LOF did not show an increasing trend in the number of tillers (Figure 1).

As with the number of tillers, the application of LOF also did not show a consistent effect on the number of leaves. However, the application of CM (50%) and GW (50%) resulted in a higher number of leaves than the control treatment (Figure 2).

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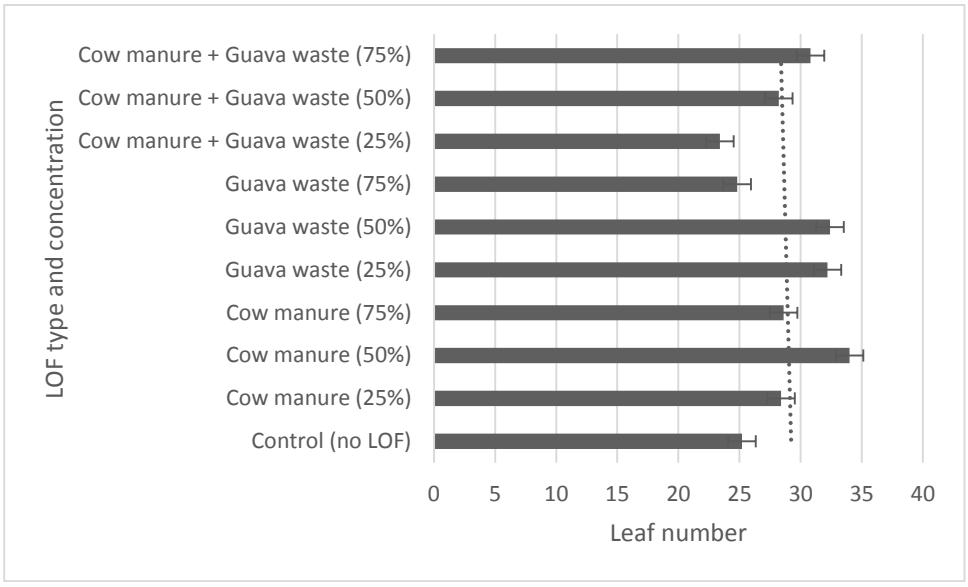

Figure 2. Effect of type and concentration of LOF on number of leaves.

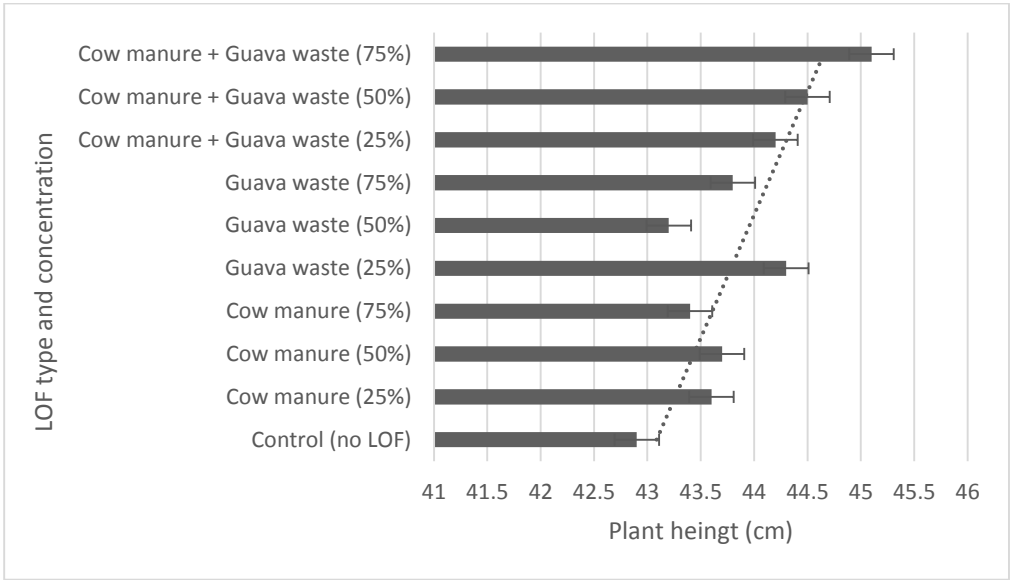

Figure 3. Effect of type and concentration of LOF on plant height.

Figure 3 shows that although CM and GW LOF applications did not produce significantly different plant heights, the increase in LOF concentration showed a positive trend towards plant height. A mixture of (CM + GW) LOF at a concentration of 75% produced a plant height of 45.1 cm, higher than the control treatment, which was 42.9 cm.

Although LOF application at various concentrations showed inconsistent results to tiller diameter, the GW LOF (75%) resulted in a larger tiller diameter than the control treatment. The LOF application showed a trend of increasing tiller diameter (Figure 4).

The experiment results showed that the application of CM, GW, or a mixture of both LOF at various concentrations did not affect plant fresh weight. Plant fresh weight ranged from 113.65 g – 140.3 g per plant (Figure 5)

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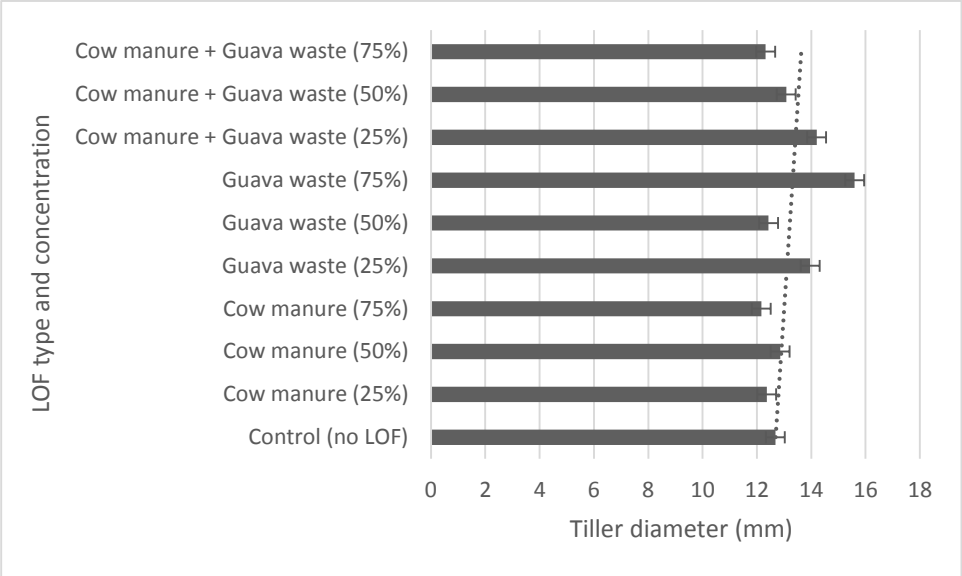

Figure 4. Effect of type and concentration of LOF on tiller diameter.

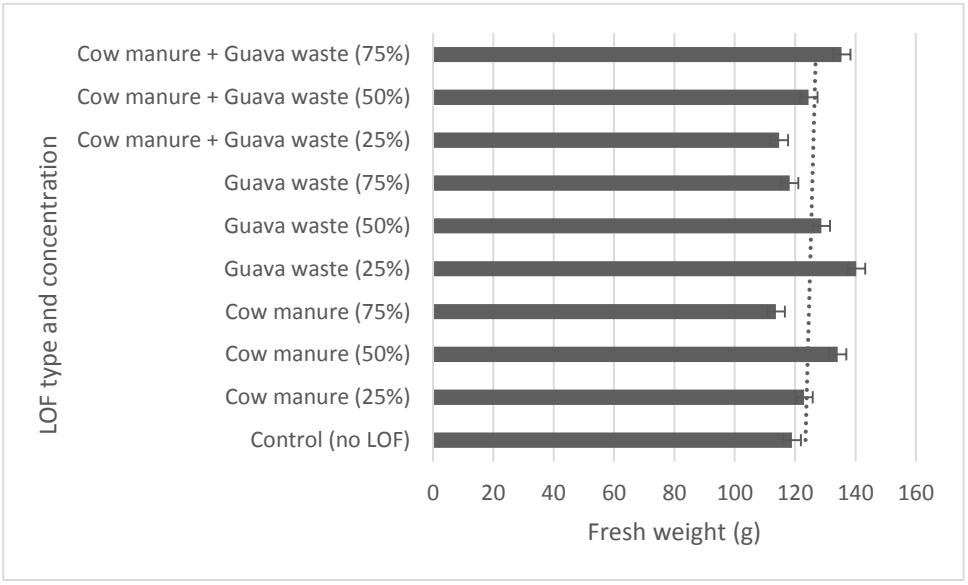

Figure 5. Effect of type and concentration of LOF on plant fresh weight.

The effect of organic fertilizer application on plants is determined by factors including the environment, source of organic matter, application method, concentration, and others. This study showed that the concentration of CM, GW, and the combination of (CM + GW) LOF showed an inconsistent effect on the growth and yield of leeks. LOF application did not affect tiller number and plant height, but it could increase the number of leaves and tiller diameter at particular types and doses.

Plants need nutrients to grow and develop, and LOF contains such nutrients. As reported by Guerrero et al. (2005), several plant nutritional elements were determined in LOF, such as nitrogen (N), phosphorous (P), potassium (K), calcium (Ca), iron (Fe), copper (Cu), and zinc (Zn). The nutrient content of LOF is determined by the source of organic matter, as reported by Fahrurrozi et al. (2017), where LOF *Tithonia diversifolia* and *Ageratum conyzoides* had the highest N content compared to other biomasses. *A. conyzoides* had the highest P content, followed by *T. diversifolia*. *A. conyzoides* had the highest K content, followed by *Gliricidia sepium*. Banana pseudo-

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stems have high nitrogen, phosphorus, and potassium content around 0.3-2.8, 0.2-0.5, and 4.0-4.6%, respectively (Saraiva et al., 2012). Analysis proved a suitable ratio of C:N (±25-30:1) in Dragon fruit and Duku fruit, which indicated their suitability as a natural fertilizer in the form of compost (Brunerová et al., 2021). Mango peels and seeds are rich, invaluable bioactive compounds such as polyphenols, carotenoids, dietary fibers, enzymes, phytosterols, and tocopherol (Ravani & Joshi, 2013). Organic matter, K, H^+, Al, Fe, and Zn increased more as a function of guava by-product dose than in the absence of fertilization. The results demonstrate the potential of using guava waste material in the cycling and supply of nutrients (Rozane et al., 2013).

In general, LOFs improved soil conditions by improving soil physical and biological qualities. LOFs application improved soil biological while also enhancing soil physical condition. LOFs improved aggregate stability, hydrophobicity, and overall porosity while lowering bulk density and resistance to soil penetration (Moridi et al., 2020).

The pH of the soil was more acidic with Commercial Fertilizer (CF) than with OF, and the electrical conductivity (EC) was also higher with CF than with OF. While organic fertilizer served to keep the NO_3-N content steady throughout the growing season, CF fertilization caused the concentration to fluctuate up and down rapidly. In the field, organic fertilizer enhanced the population of soil microorganisms (Lee, 2010). According to Muktamar et al. (2016), the sweet corn genotype substantially impacted nitrogen uptake. The dry weight of the plant, weight yield, chlorophyll content, and nutrient uptake of nitrogen, phosphorous, and potassium absorbed in cauliflower leaves were all significantly affected by applying solid and LOF (Mahmood *et al*., 2019). The application of LOF in soybean plants can reduce chemical fertilizers (Herawati et al., 2021).

The application of organic fertilizer affects the growth and yield of plants. These results showed that the number of leaves and tiller diameter were affected by the type and dose of LOF applied (Table 1). The increasing number of leaves and tiller number due to the nutrients availability release by LOF. (Nurofik & Utomo, 2018) also reported that Urea and Petroganik fertilizer application affects the growth and onion yield. The more Urea and Petroganic doses, the growth and the yield of the onion were also increased. The application of Petroganik 8 ton.ha^{-1} increased watermelon yield by 32.24% compared to the control treatment (without fertilization) (Parmila et al., 2019). Organic fertilizer treatment affects plant height, leaf number, canopy width, crop diameter, and cabbage yield (Sugiono & Krismawati, 2020). Applying 15 g of goat manure per plant to the White variety also increased the leaf area of the pakcoy (Afitra et al., 2021).

Although LOF application affected the number of leaves and tiller diameter, it did not affect tiller number, leaves number, or plant fresh weight (Table 1). These findings suggest that the LOF concentration needs to be increased further to achieve optimal growth and yields. In line with this study's results, others also reported similar findings. As reported by Andrian et al., (2019), the different dosage of LOF applied to kangkung (*Ipomoea aquatica*) has no significant effect on the plant's height, leaf number, leaf color, leaf area, or fresh weight. The treatment of oil palm LOF also had no significant effect on plant growth and yield (Kurniawan et al., 2020). Tuber length, tuber diameter, tuber fresh weight, shoot-tuber ratio, and the number of tubers per plot were not affected by tithonia-enriched LOF (Fahrurrozi et al., 2017).

CONCLUSIONS

Cow manure LOF (50%) increased the number of leaves while LOF of guava waste (75%) increased stem diameter. The number of tillers and plant height was not affected by the LOF application.

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