International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 5, No. 5, p. 53-58, 2014

INNSPUB

RESEARCH PAPER OPEN ACCESS

The effect of bio and liquid organic fertilizer on weight and quality of apple

Amin Setyo Leksono*, Bagyo Yanuwiadi

Department of Biology, Faculty of Sciences, University of Brawijaya, Jl. Veteran Malang, 65145, Indonesia

Article published on November 04, 2014

Key words: Biofertilizer, insect abundance, liquid organic fertilizer.

Abstract

This research aimed to analyse the effect of biopesticide and organic liquid fertilizer on weight and quality of apple. The study was carried out in Bumiaji, Batu, East Java (8°05'S, 112°80'E, 1400 m in altitude) on July - December 2013. The liquid organic fertilizer (LOF) was produced from water mixed with nitrogen source such as manure, urin, legume leaves, phosphoric powder and an energy source such as molasses or sugar juice This mixture was fermented with local microorganism. Biopesticide was extracted from Mahogany seed powder and Sour sop leaves and mix with LOF to get a combination (CB) treatment. Two treatments and a control were applied in different fields. First treatment consisted of application of the liquid organic fertilizer (LOF), while the second consisted of combination of the liquid organic fertilizer and biopesticide (CB). Five trees were selected per field for data collection. Application of LOF and CB were conducted every two weeks untill fruit harvest. Control was conducted in a field with regular cultivation. Result showed that both treatments increase the weight of apple production. Mean of individual apple weight with CB treatment is slightly higher (115.56 ± 29.99 gr/ind) than that with LOF treatment (112.72 ± 9.09 gr/ind). The effect of both of treatments by applying liquid organic fertilizer (LOF) and combination (CB) has increased the apple weight (29.8% and 33.1% respectively). In general both treatments have shown to increase glucose content, Vitamin C and Calcium content in apple fruits.

* **Corresponding Author:** Amin Setyo Leksono ✉ amin28@ub.ac.id

Introduction

Apple is the main fruit of in Batu region, accounting for 92% of total fruit production. However, during the last four years, the production of apple per trees has decreased 2% per year in spite of increased effort to apple cultivation (Leksono *et al.*, 2012). Several efforts have been conducted to increase the apple production, including application of organic farming system. In organic farming system, practices for fruit production must avoid applications of synthetic fertilizers and pesticides, rely on organic inputs and recycling for nutrient supply, and emphasize cropping system design and biological processes for pest management (Araujo, 2008). Biopesticide and organic liquid fertilizer or biofertilizers are an important option for organic farming system, as they are conducive for long-term beneficial effects on the physical, chemical and biological aspects of soils (Méndez and Viteri, 2007). Other study showed that the levels of N, P and K in the plant tissues of soybeans, and the availability of P and K in soil were significantly improved by the application of composted rice chaff (Son *et al.*, 2008).

The effect of biofertilizers has been studied in many agricultural crops such as sugarleaf, fennel, lettuce Summer squash and cabbage (Das *et al.*, 2007; Mahfouz and Sharaf-Eldin, 2007; Criollo *et al.*, 2011, Sarhan *et al.*, 2011). Application of organic farming system has shown to increase yield values and most physical and chemical properties of fruit such as fruit weight, fruit firmness, peel thickness, TSS, Vitamin C and lowest in acidity (Alaa El-Din and Belal, 2007) as well as fruit yield (El-Boray *et al.*, 2006). However research on the effect of biopesticide and organic liquid fertilizer on weight and quality of apple is few. This research aimed to analyse the effect of biopesticide and organic liquid fertilizer on weight and quality of apple.

Material and method

The study was carried out in Bumiaji, Batu, East Java (8°05'S, 112°80'E, 1400 m in altitude) on July - December 2013. Apple (*Malus sylvestris* var. Anna) is the most important crop in this area. The liquid organic fertilizer (LOF) was produced from water mixed with nitrogen source such as manure, urin, legume leaves, phosphoric powder and an energy source such as molasses or sugar juice This mixture was fermented with local microorganism. Biopesticide was extracted from Mahogany seed powder and Sour sop leaves and mix with LOF to get a combination treatment.Two treatments and a control were applied in different fields. Five trees were selected per field for designed treatment. First treatment consisted of application of the liquid organic fertilizer (LOF), while the second consisted of combination of the liquid organic fertilizer and biopesticide (CB). Application of LOF and CB were conducted every two weeks untill fruit harvest. Control was conducted in a field with regular cultivation. Apple production and quality was measured. The 15 fruits per treatment were randomly selected from respective field. Variables measured are consisted of weight of fruit, glucose content, vitamin C content and Calcium content. The abundance of canopy insect was collected by using modified window traps. In this research insects were counted and identified to family level, but community analysis was not performed. Data analysis was performed to compare mean of variable measures. Because data were not normally distributed, analyses were performed by using Kruskall Wallis and Mann Whitney non parametric test.

Result and discussion

Result showed that both treatments had significant effect on the weight of apple production. Mean of individual apple weight with CB treatment is the highest (115.56 ± 29.99 gr/ind) than that with LOF treatment (112.72 ± 9.09 gr/ind) and control (86.81 ± 5.69 gr/ind). Statistically, mean of individual apple weight with both LOF and CB was significantly different with that in control (Fig. 1). But, mean individual apple weight of LOF and CB was not significantly differing.

This study showed the changing in the soil properties before and after treatment. Total Nitrogen content in soil has increased both of application with LOF and

CB. The former treatment has increased 0.02%, while the latter 0.018%. Change in of Carbon content in soil with LOF (0.710%) treatment was highest than those in control (0.613%) and with CB treatment (0.628%). Change in of total Calcium in soil with LOF (0.5 mg/gr) treatment was highest than those in control (0.3 mg/gr) and with CB treatment (0. 4 mg/gr) (Table 1).

Table 1. Variation of Change (Margin) of Soil Properties Content (Before and After Application) following Treatment Using of Liquid Organic Fertilizer (LOF) and Combination (CB).

Treatments	*C (%)*	*Org. material (%)*	*N (%)*	*C/N ratio*	*Ca (mg/g)*
Control	0.613	0.796	-0.010	1.215	0.3
LOF	0.710	0.922	0.020	1.151	0.5
CB	0.628	0.816	0.018	1.599	0.4

Both treatments had significant effect on the fruit glucose content. Averages of fruit glucose content with both treatments were significantly different compare to that of control. Average of glucose content of apple with LOF treatment is even higher (12.12 ± 0.08 %) than that with CB treatment (11.93 ± 0.33%) (Fig. 2).

The effect of both treatments had also significant to the fruit vitamin C content. Averages of vitamin C content with both treatments were significantly different compare to that of control. Average of vitamin C content with LOF treatment was even higher (14.98 ± 0.31 mg/100gr) than that with CB treatment (13.81 ± 0.64 mg/100gr) (Fig. 3).

Table 2. Canopy Insect Abundance and Family Richness in Control and Treatment Fields.

Treatments	*Individuals*		*Families*	
	FlS	FrS	FlS	FrS
Control	26 ± 10	46 ± 18	9 ± 2	6 ± 2
LOF	32 ± 9	70 ± 40	10 ± 2	6 ± 2
CB	35 ± 15	48 ± 11	10 ± 2	7 ± 2

The same trend was also found in total calcium content. The effects of both treatments were significant to the total calcium content. Averages of total calcium content with both treatments were significantly different compare to that of control. Average of total calcium content with LOF treatment was also higher (8.17 ± 0.06 mg/100gr) than that with CB treatment (8 ± 0.06 mg/100gr) (Fig. 4).

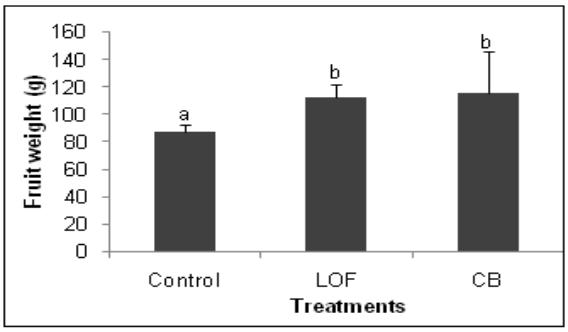

Fig. 1. The Effect of Liquid Organic Fertilizer and Combination on Apple Weight. Different alphabet above the graph columns indicate a significant different with $p<0.05$.

The number of individuals and families of canopy insect from trees with CB treatment was highest than that in control and with LOF treatment in flowering season. The number of individual from trees with LOF treatment was highest than that in control and with CB treatment in fruiting season.

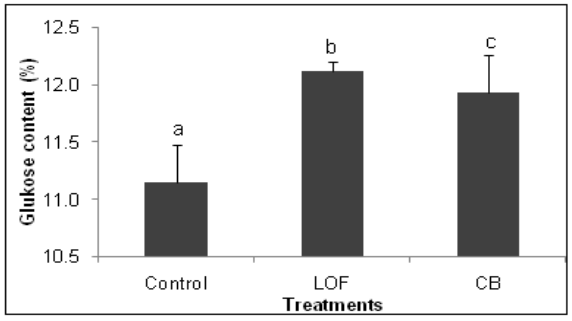

Fig. 2. The Effect of Liquid Organic Fertilizer and Combination on Apple Glucose Content. Different alphabet above the graph columns indicate a significant different with $p<0.05$.

This study showed that the effect of treatments by

applying liquid organic fertilizer (LOF) on the apple production and quality was consistent, except for the apple weight. The effect of both of treatments by applying liquid organic fertilizer (LOF) and combination (CB) has increased the apple weight (29.8% and 33.1% respectively).

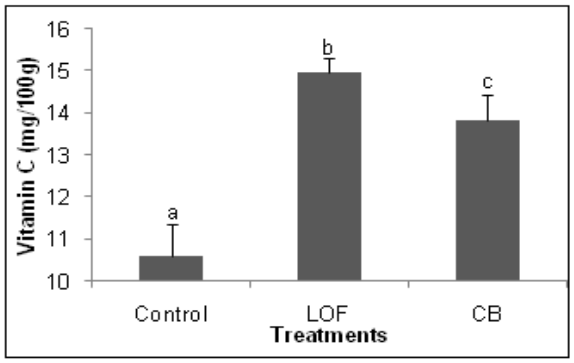

Fig. 3. The Effect of Liquid Organic Fertilizer and Combination on Vitamin C of Apple. Different alphabet above the graph columns indicate a significant different with $p<0.05$.

The effect of LOF treatment has increased glucose content, Vitamin C and Calcium content. Basically, the weight of apple depend on plant nutrition such as Nitrogen (Raese *et al.*, 1997), seasonal variation (McCann, 2000) and other environmental factors. In this study, application of liquid organic fertilizer solely or in combination with biopesticide has increased nitrogent content. Availabiliy of total Nitogen has even higher after used by plant (Table 1). This indicates that the nitrogen availability is sufficient for apple growth and production. Generally, organic fertilizer enhance soil biological activity, which improves nutrient mobilization from organic and chemical sources and decomposition of toxic substances. This fertilizer releases nutrients slowly and contribute to the residual pool of organic N and P in the soil, reducing N leaching loss and P fixation; they can also supply micro nutrients. This may increase of root growth, improve the exchange capacity of nutrients, increase soil water retention, promote soil aggregates (Chen, 2006). Microbial activity in biofertilizer has shown to increased the nutritional assimilation of plant (total N, P and K) and improved soil properties, such as organic matter content and total N in soil (Wu *et al.*, 2005). This study indicates that application of both treatment has significant effect on the apple weight. Treatment by using combination has produced highest weight but, the effect was not significant. this implies that the effect of nitrogen content may be supported by other factor such as pollinator. Apple is one of the fruit that depend on pollinator. The effect of the abundance was substantial if the insect success to pollinate ovules of apple flower. Previous study showed that pollination of apple flower strongly depends on insect pollinator (Leksono *et al.*, 2013).

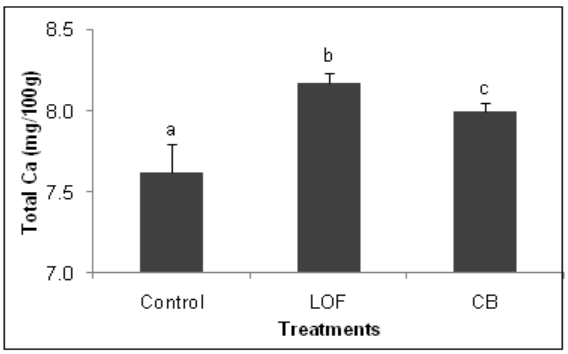

Fig. 4. The Effect of Liquid Organic Fertilizer and Combination on Total Calcium Content of Apple. Different alphabet above the graph columns indicate a significant different with $p<0.05$.

The glucose content was highest in apples with liquid organic fertilizer application. The similar trend was observed on the Vitamin C and Calcium content. Both variables were highest in apple with this treatment. The quality of glucose decrease seasonally. This was higher in early fruit than later fruit ripening (Sturm and Stampar, 1999). Previous study showed that higher glucose content associated with weight of apple (Leksono *et al.*, 2013). In this study, glucose content in apples with LOF application was higher than that with CB treatment altough the weight of apple in former was lower than the latter. This was because the weight of apple with both treatments was not significantly different.

Acknowledgement

The author would like to thank to Head of Institute for Research and Public Service, University of Brawijaya. We are in debt to Dean of Faculty of Mathematic and Natural Sciences, Head of Department of Biology, and local farmers in the study site. We thank to Zainal Abidin and M. Fathoni for

technical effort in the field. This project was supported by the University Outstanding Research Grant, Directorate of Research and Public Service, Directorate General of Higher Education, Ministry of Education and Culture.

References

Alaa El-Din KHO, Belal EBA. 2007. Effect of organic, inorganic and bio-fertilizer application on fruit yield and quality of mango trees *(Mangifera indica* L.) cv. Sukari in Balteem, Kafr El Sheikh. Egypt Journal of Agricultural Research **33(4),** 857-872.

Araujo ASF, Santos VB, Monteiro RTR. 2008. Responses of soil microbial biomass and activity for practices of organic and conventional farming systems in Piaui state, Brazil. European Journal of Soil Biology **44,** 225-230. http://dx.doi.org/10.1016/j.ejsobi.2007.06.001.

Chen ZS. 2006. The advantages and disadvantages of using chemical and organic fertilizers for crop growth and soil fertility. International Workshop on Sustained Management of the Soil-Rhizosphere System for Efficient Crop Production and Fertilizer Use. 25-28.

Criollo H, Lagos T, Piarpuezan E, Pérez R. 2011. The effect of three liquid bio-fertilizers in the production of lettuce (*Lactuca sativa* L.) and cabbage (*Brassica oleracea* L. var. capitata). Agronomía Colombiana **29(3),** 415-421.

Das K, Dang R, Shivananda T, Sekeroglu N. 2007. Influence of bio-fertilizers on the biomass yield and nutrient content in *Stevia rebaudiana* Bert. grown in Indian subtropics. Journal of Medicinal Plants Research **1(1),** 5-8. http://dx.doi.org/10.5897/JMPR.

El-Boray MS, Mostafa MF, Iraqi MA, Mohamed AA. 2006. Some recent trends of apple trees fertilization. World Journal of Agricultural Sciences **2(4),** 403–411.

Leksono AS, Yanuwiadi B, Hasyim MA, Apituley FL. 2013. Impact of insect pollinator of apple tree on the production and quality of apple in Poncokusumo, Malang and Bumiaji, Batu. Proceeding of The Third Basic Science International Conference **B14,** 1-4.

Leksono AS, Yanuwiadi B, Hasyim MA, Purwantiningsih B, Apituley FL. 2012. Composition of insect visitors in apple crop in Malang and Batu, East Java, Indonesia. Trends in Entomology **8,** 75 – 83.

Mahfouz S, Sharaf-Eldin M. 2007. Effect of mineral vs. biofertilizer on growth, yield, and essential oil content of fennel (*Foeniculum vulgare* Mill.). International Agrophysics **21(4),** 361-366.

McCann KS. 2000. The diversity-stability debate. Nature **405,** 228–233. http://dx.doi.org/10. 1038/35012234.

Méndez M, Viteri S. 2007. Alternativas de biofertilización para la producción sostenible de cebolla de bulbo (*Allium cepa*) en Cucaita, Boyacá. Agronomía Colombiana **25(1),** 168-175.

Raese JT, Drake SR. 1997. Nitrogen fertilization and elemental composition affects fruit quality of 'Fuji' apples. Journal of Plant Nutrition **20(12),** 1797-1809. http://dx.doi.org/10.1080/0190416 9709365375.

Sarhan TZ, Mohamed GH, Teli JA. 2011. Effect of bio and organic fertilizer on growth, yield and fruit quality of summer squash. Sarhad Journal of Agriculture **27(3),** 377-383.

Son TN, Man LH, Diep CN, Thu TA, Ngoc N. 2008. Bioconversion of paddy straw and biofertilizer for sustainable rice based cropping systems. Omonrice **16,** 57-70.

Sturm K, Stampar F. 1999. Seasonal variation of sugars and organic acids in apple (*Malus domestica*

Borkh.*)* in different growing systems. Phyton Australia **39(3),** 91-96.

Wu SC, Cao ZH, Li ZG, Cheung KC, Wong MH. 2005. Effects of biofertilizer containing N-fixer, P and K solubilizers and AM fungi on maize growth: a greenhouse trial. Geoderma **125(1-2),** 155–166. http://dx.doi.org/10.1016/j.geoderma.2004.07.003.