

# Impacts of Compost APT01 Addition to Fruit Quality of Apple Crops

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**ABSTRACT---** *Objective of this experimental study was determining effects of compost APT01 addition on fruit quality of apple crop. The addition of compost APT01 as much as 10 and 20 kg per tree was applied one day after defoliation. Observations were conducted during the fruit production 3 and 4 months after composting (SR3 and SR4) and at harvest (SPN). Treatment addition of compost and the same observations in period-1 and period-2. Results were analyzed variance, two-way ANOVA with interaction ( $\alpha = 0.05$ ), using Microsoft Excel 2007. The analysis showed that the addition of compost APT01 as much as 10 and 20 kg per tree increasing the production weight and the average number of fruit per tree from initially 2.38 kg (35.36 fruits) to 3.97 kg (46.08 fruits) and 4.91 kg (51.33 fruits) respectively. Furthermore, average fruit produced from 10.45 to 11.61 fruit/kg can be categorized into grade quality of AB.*

**Keywords ---** compost, APT01, defoliation, apple.

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## 1. INTRODUCTION

Partially, nutrients in inorganic fertilizers contained in the form of available and unavailable substances absorbed plants roots. This statement is supported by data from research conducted by Krey et al. which concluded that about 85-90% inorganic phosphates cannot be absorbed well by plants. This is as a result of the reaction of phosphorus with a number of iron and aluminum cations present in the soil to form a compound  $\text{Fe}(\text{PO}_4)$  and  $\text{Al}(\text{PO}_4)$  which is difficult to dissolve. The insoluble phosphates cause nutrient phosphorus cannot be absorbed by plants roots. The addition of a number of composted organic material cause the amount of soil phosphate easily absorbed by plants (Krey et al, 2013).

Some nutrients such as potassium cations and nitrate anions in the soil solution is initially available becomes unavailable to plants because these elements have undergone leaching. The addition of organic matter to the soil plays an important role in improving the soil ecosystem, not only as a source of nutrients, binders of nutrients from the soil, dissolving of soil nutrients unavailable becomes available to plants but also as a substrate for growth of soil microorganisms.

Results of previous studies on chemical analysis tests showed that the average content of the soil organic matter in Bumiaji Batu less than 1%. Ideally, organic matter contained in the soil should be more than 3%. To solve this problem, addition of organic matter to the soil every completed reap rewards of production. The process of composting organic materials can be accelerated by the addition of *Trichoderma viride* APT01 biocatalyst that can decrease the C: N and total organic carbon which was originally 26.8 and 37.6% to 14.6 and 22.7% (Budiono et al, 2015). This is supported by the addition of organic matter such as manure into the soil to improve the quality of physical and chemical impact on improving soil porosity, pH, soil organic carbon and nitrogen as well as capable of maintaining soil fertility (Eche et al, 2013).

Another result of previous study reported that the compost contains some nutrients such as phosphorus and potassium, which contribute to increase harvest. Besides the organic matter present in compost can change the original nutrients in the form unavailable to a form available to plants. This is supported by the results of chemical analysis of the mud cake by Cifuentes et al (2013) contents of 1.83% N, 3.69%  $\text{P}_2\text{O}_5$ , 0.76%  $\text{K}_2\text{O}$  and 7.80% CaO.

The addition of compost significantly cause improving the content of nutrients such as nitrogen, potassium and phosphorus as well as the number of microorganisms in the soil. This nutrient content has accelerated the growth of the plant tissue (Liu et al, 2013). The results of a similar study reported that the addition of potassium and phosphorus availability influences the amount and weight of the fruit produced per plant (Al-Obeed et al, 2013).

Previous research on the use of compost in apple plantations was also carried out in Himachal Pradesh, India. The addition of compost as much as 5-15 kg per tree once a year. The study concluded that the quantity and quality of

apples has increased in terms of fruit size, storage time of apple fruits, and soil quality (Vineet, 2012). Improvement on fruit size will have an impact on increasing the value of rupiah. It is known in the market in Batu, Indonesia that the apple grades currently are A, AA, AB and C. Grade A contains 6-7, AA 8-9, AB 10-11 and C 12-15 fruits per kg. The price of grade A > AA > AB > C.

## 2. METHODS

The experiment was carried out according to completely randomized factorial design with the amount of compost and the season time of production. The amount of compost APT01 as much as 10 and 20 kg per tree was applied a day after defoliation. The study was conducted in an apple crop of 400 square meters in the area of Batu, Indonesia. The age of the plant approximately 4.0-4.5 years, with a distance between plants 2-3 meters. Implementation of field research began in February-December 2012 (period-1) and in January-June 2013 (period-2). Observations made during fruit growth 3 and 4 months after giving compost (SR3 and SR4) and at harvest (SPN). The parameters measured were the number and weight of fruit per tree. Results were analyzed variance, two-way ANOVA with interaction ( $\alpha = 0.05$ ), using Microsoft Excel 2007.

## 3. RESULTS AND DISCUSSION

The observation of the number and weight of fruit per plant by adding compost APT01 made during 3 and 4 months after giving compost (SR3 and SR4) and at harvest (SPN) for period-1 and period-2 are shown in Table 1, Figure 1 and Figure 2.

Table1. The outcome of the compost on the fruit of period-1 and period-2.

	Number of fruit						Weight of fruit					
	SR3		SR4		SPN		SR3		SR4		SPN	
	1	2	1	2	1	2	1	2	1	2	1	2
TK	34.67	45.00	29.33	38.33	23.33	35.33	0.66	1.05	1.09	1.35	1.86	2.39
ATP10	44.33	56.33	40.33	50.33	37.00	46.00	1.06	1.25	1.90	2.22	3.24	3.97
ATP20	46.67	59.33	43.00	55.00	39.00	51.33	1.26	1.43	2.42	2.81	4.22	4.91

Descriptions:

1 = period-1 and 2 = period-2.

TK = non compost, ATP10 = 10 kg Compost APT01 and ATP20 = 20 kg Compost APT01.

SR3 = after 3 months composting, SR4 = after 4 months composting, SPN = the time of harvest.

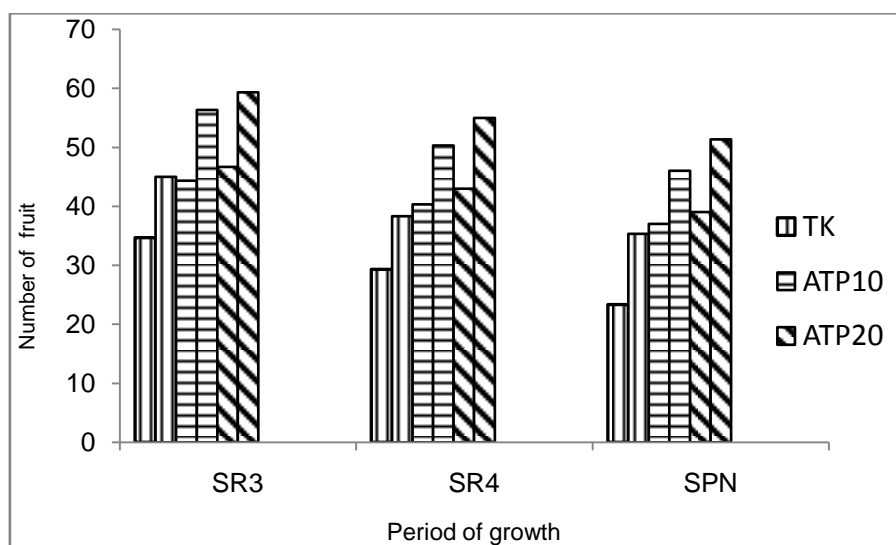


Figure 1. The period of growth on the number of fruit

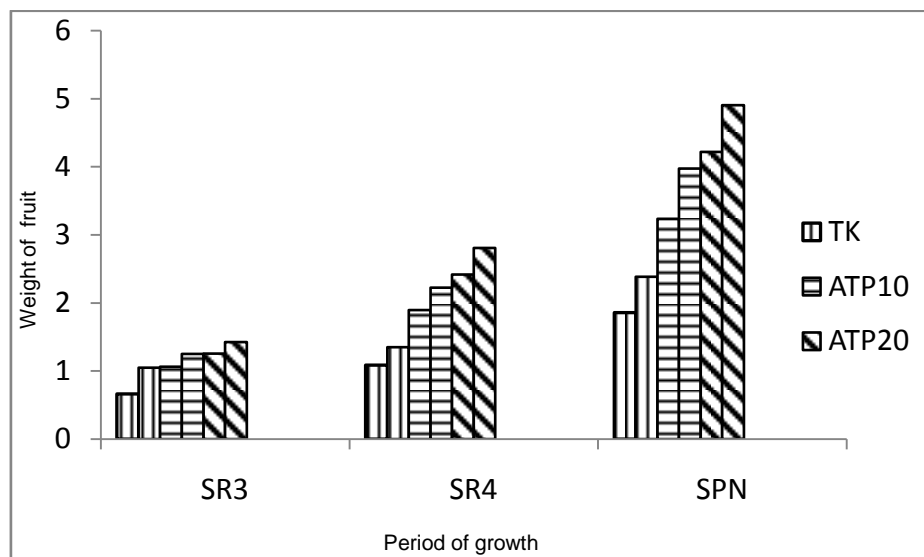


Figure 2. The period of growth on the weight of fruit

Data on Table 1 shows reduction in the number of falling fruit on SPN compared to SR3. At period-1, addition of compost APT01 reducing the value of the original fruit to fall 32.78% to 16.48-16.49%. Application compost APT01 directly into the soil cannot be well absorbed by plant roots. This is shown by the growing strength of the fruit stalk during 4 months of composting than during 3 months. Strengthening the fruit stalk as a result of absorption of potassium and calcium those can be absorbed by plants. Potassium and calcium in the form of positive ions tend to be bound by negatively charged organic compounds to form compounds available to plants. These elements play a role in strengthening elements of plants such as flower and fruit so it does not easily fall out (Budiono et al, 2013).

Whereas in period-2, the value of the original loss was 21.56% to 13.49-18.29%. Addition of compost continuously to the period-2 was able to suppress the value of the loss of fruit up to 13.49%. Results of this study is strengthened by Liu et al (2013) who reported that the addition of compost significantly improving the content of nutrients such as nitrogen, potassium and phosphorus as well as the number of microorganisms in the soil. Increasing of nutrient content has resulted in accelerating growth and strengthening the plant tissue. Similar conclusions presented by Colpan et al (2013) which states that the addition of the element potassium in the plant was able to strengthen and enlarge the plant tissue.

The element potassium contained in the soil is easily leached from the land. Only a small proportion of potassium elements that could be absorbed by the roots of plants in poor organic matter soil. Usually, potassium fertilizer in the form of potassium chloride or potassium nitrate are added to that kind of soil. The potassium fertilizers mostly passes and leaches from the soil that makes only a small proportion of potassium elements are available and can be absorbed by plant roots. As for soil with rich in organic matter, potassium elements will be absorbed by organic compounds. Potassium ions react with the carboxyl group, hydroxyl group, or other anions contained in the organic material causing the availability of potassium to a maximum.

In period-1, production of fruit weight per plant by the addition of compost APT01 ranging from 3.24-4.22 kg, while on period-2 of 3.97-4.91 kg/plant. The addition of compost APT01 at period-1 is able to increase production 74.51-135.91% significantly ( $\alpha = 0.05$ ) compared with no addition of compost (Budiono et al, 2013). The addition of compost to the same treatment as period-1 for the next season (period 2) increasing production 16.35-22,53% compared to the period-1. The magnitude of the increase in the percentage of period-1 nutrient expected to remain high in the soil mainly nitrogen, potassium and phosphorus in the form of unavailable become available by adding compost APT01. The element phosphorus which was originally located in a molecular form that is unavailable to available form by the addition of compost. Examples of phosphorus that is not available to plants is calcium phosphate  $\text{Ca}_3(\text{PO}_4)_2$  which has the small solubility values. The addition of compost resulted in increased dissolution of phosphate compounds.

Meanwhile, organic acids contained in the compost have ability to dissolve the phosphate compound. Hydrogen ions produced by organic acids react with  $\text{Ca}_3(\text{PO}_4)_2$  to form calcium diphosphate  $\text{CaH}(\text{PO}_4)$  and calcium monophosphate  $\text{Ca}_2\text{H}_2(\text{PO}_4)_2$  which is easily soluble. The soluble forms of these compounds have an impact on the quantity of elements available and can be absorbed by plants. Therefore, the addition of compost increases the availability of phosphorus that contributes to increase the crop production.

In the period-2, the addition of compost APT01 as much as 10 and 20 kg per tree increases the percentage of fruit on SR3 between 25.22-31.93%, SR4 31.36-43.65% and SPN 30.32-45.16%. The age of plant is about 4.5-5.0 years which usually produce around 45.00 fruits per plant. The amount of fruit in the period-1 per plant is 44.33-46.67 and 56.35-59.37 in the period-2. An increase per plant of 11.35-14.37 fruits by addition of compost. The land capacity has a

1,600 trees/ha with the plant distance between 2.0-3.0 meters. The production of fruit can reach 2-3 ton/ha by the addition of compost APT01 20 kg per tree. At the harvest, total production of the original apple increase from 7-9 to 9-12 tons.

Each addition of compost APT01 into the soil increasing nutrients availability and improving the physical and biological properties of the soil. At the period-2, physical and biological properties of the soil has been running either as a result of the period-1. The period-2 affects more effectively to product on the soil and plants. The addition of compost in a sustainable manner proved to be an impact on increasing the quantity and quality of fruit production.

The addition of compost APT01 as much as 10 and 20 kg per tree impact to increase in a weight and a number of fruit was originally 2.38 kg (35.36 fruits) to 3.97 kg (46.08 fruits) and 4.91 kg (51.33 fruits). When it made the quality grade, the average fruit produced from 10.45- 11.61 fruits/kg can be categorized into Grade AB. It is known in the market that the apple grade is a Grade A, AA, AB and C. Grade A contains 6-7, AA 8-9, AB 10-11 and C 12-15 fruits per kg. At this time in October 2015, the price of apples at the farm level to Grade A Rp.10,000/kg, Grade AA Rp.8,000/kg, Grade AB Rp.6,500/kg and Grade C Rp. 4,000/kg. The research Previously by Caione et al (2015) which states that the use of compost of mud cake of 7.5 tonnes / ha can increase the content of phosphorus in the soil, leaves and stalks and crop productivity (Caione et al, 2015).

Previous research by Adebayo et al (2013) found that the addition of compost on Okra plants were able to increase significantly the number and weight of fruit production. Similar studies had been reported by Khan and Ishaq (2011) that the addition of compost made from the remains of plants and livestock manure into the soil can improve nutrient of potassium, nitrate, and phosphorus in the form available to plants. The availability of plant nutrients accelerated growth and increased sustainability in production.

The addition of compost in the next season potentially maintains while increases nutrient availability to plants. This is supported by research results of Jusoh et al (2013) that raw material agricultural waste composting with manure by adding biocatalyst capable of increasing the content of nitrogen, potassium and phosphorus significantly at alpha <0.05. The addition of compost APT01 is also improving sustainability production by increasing availability of the main of nutrient elements nitrogen, potassium and phosphorus to plants. While similar studies reported that a potassium and phosphorus nutrients plays an important role in the formation of flowers and fruits to increase crop production (Devi et al, 2012; Idowu et al, 2013).

#### 4. CONCLUSION

The addition of compost APT01 as much as 10 and 20 kg per tree increasing the weight and number of fruit from initially 2.38 kg (35.36 fruits) to 3.97 kg (46.08 fruits) and 4.91 kg (51.33 fruits) respectively. Moreover, it also improves quality grade in terms of the average fruit produced from 10.45-11.61 fruits/kg which categorized as Grade AB.

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