

Impact of an APT01 Compost on Quality Improving of the Anna Apple (Age of the Plant 8.0-8.5 Years)

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Abstract— This study aims to analyze the effect of the APT01 compost as the soil organic matter to the apple crop production (*Malus sylvestris*) at harvest time (SPN). The experiment was carried out according to completely randomized factorial design with the amount of mud cake that was fermented for two weeks by APT01 as bio-catalyst. The experiment was conducted in a treeation area of 400 square meters. The amount of the APT01 compost as much as 20, 30, and 40 kg per tree was applied a day after defoliation. A total of 48 apple trees aged about 8.0-8.5 years with a distance between trees 2-3 meters were randomly selected. Observations made during fruit growth took 5-6 months after giving the APT01 compost 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. The results of variance analysis concluded that : (1) The addition of 20, 30, and 40 kg of APT01 compost per tree, shows significant differences ($\alpha = 0.05$) on the amount of fruit production on SPN, (2) The addition of 30 and 40 kg of APT01 compost has an impact on increasing the quality of fruit from grade C (12-15 fruits per kg) to grade AB (10-11 fruits per kg).

Keywords— APT01; mud cake; compost; apple; fermentation.

I. INTRODUCTION

Apple treeation centers is currently located in Batu, East Java, Indonesia. The village is very fertile with society's diverse style, which is still productive agroecologically (soil and climate). However, the lands used to produce crops usually have a much greater erosion of land with natural vegetation. The increase of erosion is caused by the replacement of the structure of forest tree roots which bind the soil strongly with a weaker root structure of agricultural crops^[1]. This is reinforced by the application of farming system that uses high fertilizers and chemical pesticides that is increased from year to year, both in quality and quantity, which in turn exceeds the carrying capacity of the land. As a result, the land is damaged and the production is declined^[2].

Such these conditions force us to constantly conserve the resources and minimize the external impact. One form of such breakthrough was the addition of organic matter such as mud cake given twice a year. Some literatures mentioned that the content of organic matter in Java agricultural land is less than 1% which is ideally should be more than 3%. The interest of public to improve soil fertility is by applying compost as an organic matter. Farming communities are encouraged to convert agricultural waste such as corn stalks and grasses used as raw material to make compost. Quality of compost produced depends on the raw materials and the treatment of the composting process^[3].

The organic fertilizer can be derived from agriculture waste and manure, household waste, or even from the sugar cane industry known as mud cake. Mud cake waste which is generated by the sugar mills are dirty, brownish watery, and smelly. Therefore, it needs to be composted to become organic fertilizer.

The process of composting organic materials can be accelerated by the addition of *T. viride* APT01 as bio-catalyst that could decrease the C:N and total organic carbon which was originally 26.8 and 37.6% to 14.6 and 22.7%^[4]. This is supported by the addition of organic matter into the soil to improve the quality of physical and chemical impact on improving soil porosity, soil organic carbon and nitrogen, as well as the ability to maintain soil fertility^[5].

Some minerals such as potassium and calcium presence in the soil organic matter tend to join and give rise to the production^[6]. Encourage increased soil organic matter and cation exchange capacity to respond to 90% adsorption strength of the soil. Cations such as potassium and calcium will be generated during the decomposition^[7].

The amount of fruit during four months after defoliation (SR4) increased from 39.08% to 48.28% by the addition of compost APT as much as 10 and 20 kg per tree while the percentage of the number of fruit increases at harvest (SPN) ranging between 58.57% and 67.14%. Age tends to reinforce the fruit on the stem of the tree resulting in fruit loss reduction. The trees network systems become stronger as a result of nutrients such as K and Ca which can be absorbed by trees. These elements are presented in the compost of organic matter APT01. Potassium and calcium is in the form of positive ions that tend to be bound by the negatively charged organic matter to form compounds available to trees. K and Ca play a role in strengthening and toughen tree tissues such as flowers and fruit so it does not easily fall out^[8].

Application of mud cake for apple tree should be conducted continuously, because mud cake is well known as source of organic materials and is available continuously in large quantity. Our previous research shows that the first application of mud cake composting by *Trichoderma viride* APT01 after defoliation can improve the number of fruit (58.57- 67.14%) and weight of fruit per tree (74.51-135.91%) compared to controls ^[8]. The addition of APT01compost as much as 20 kg was significantly able to further increase number and weight of apple (51 fruits and 4.91 kg) than other compost addition ($\alpha = 0.05$). In the second period, we knew that the number and weight of apple in 10 kg compost APT01addition was similar with Bokashi compost addition ($\alpha = 0.05$), but it has different amount of compost^[9]. Those productivity still need to be increased. So, the second application of mud cake should be conducted to get more information about the effect of mud cake composting on productivity (quantity and quality) of apple trees in apple farm area, Batu, East Java, Indonesia.

Previous research on the use of compost in apple treeations 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 ^[10]. 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 current grades 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 ^[11].

II. MATERIALS AND METHODS

The experiment was carried out according to completely randomized factorial design with the amount of mud cake that was fermented for two weeks by APT01 as bio-catalyst. The experiment was conducted in a treeation area of 400 square meters. The amount of the APT01 compost as much as 20, 30, and 40 kg per tree was applied a day after defoliation. A total of 48 apple trees aged about 8.0 to 8.5 years with a distance between trees 2-3 meters randomly selected. Observations made during fruit growth 5-6 months after giving the APT01compost 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.

III. RESULTS AND DISCUSSION

Observation of fruit growth per period was conducted for 5-6 months from composting to harvesting (SPN). Tree observations were undertaken at a day after defoliation in February 2020 until fruit production was harvested in June 2020. The parameters observed were generative growth (total number and weight of fruit per tree) as shown in Table 1, Figure 1 and Figure 2.

TABLE 1
THE RESULT OF FRUIT PRODUCTION BY A APT01 COMPOST AT 2 WEEKS FERMENTATION

| APT01Compost (kg) per tree | Number of Fruit | | | Weight of Fruit (kg) | | |
|-------------------------------|-----------------|-----|-----|----------------------|------|------|
| | SPN | | | SPN | | |
| 20 | 112 | 107 | 109 | 8.7 | 7.9 | 8.3 |
| 30 | 141 | 134 | 139 | 14.4 | 13.2 | 13.8 |
| 40 | 145 | 147 | 143 | 14.0 | 14.8 | 13.6 |

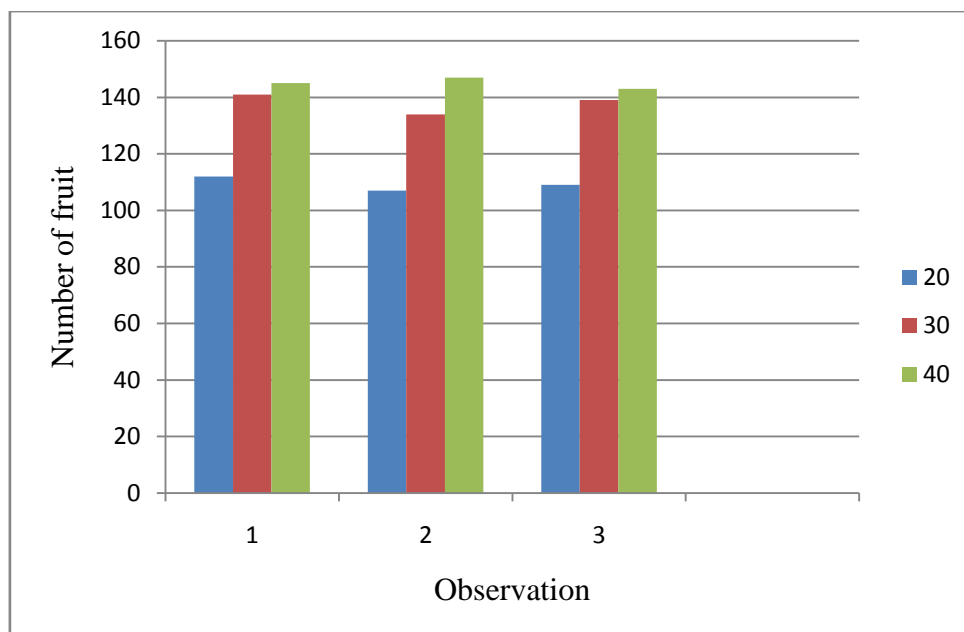


FIGURE 1: Number of fruit production

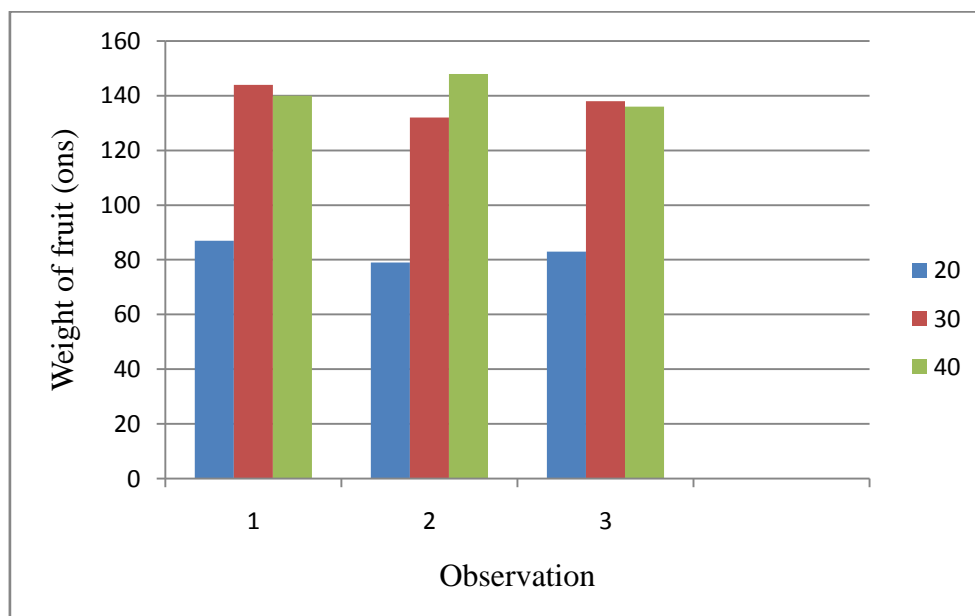


FIGURE 2: Weight of fruit production

The amount of fruit produced by the addition of APT01 compost 30 and 40 kg increases the range between 26.85 and 33.33% compared to 20 kg per tree as control. To determine the effect of addition of APT01 compost 30 and 40 kg against statistically performed using two-way anova with the following results. Hypothesis column in Table 1. show the p value less than 0.05, then the decision to accept H_1 and reject H_0 . Furthermore, it appears the value of F is higher than F_{crit} . In other words, $F_{calculated} > F_{table}$. It means that there is a significant difference between the average value calculated from categories of addition of 30 and 40 kg APT01 compost. Each addition of 30 and 40 kg compost would make the difference in number and weight of fruit of apple crop production. The results of this study reinforce the research data conducted by Asio ^[12], that the addition of organic matter can improve soil fertility either physically, biologically or chemically.

Addition 30 and 40 kg of APT01 compost reduces the value of the original fruit to fall from 3.57% to 2.04-2.84%. The value of the fruit loss tends to decrease by increasing the APT01 compost to the soil. This is evidenced by the addition of compost as much as 20, 30, and 40 kg for each apple tree aged 8.0 to 8.5 years which have an impact on the reduction of fruit loss value. Application of APT01 compost directly into the soil cannot be well absorbed by tree roots. This is shown by the growing strength of the fruit stalk during 4 months of composting than during 3 months. Strength of the fruit stalk as a result

of absorption of potassium and calcium which can be absorbed by trees. Potassium and calcium in the form of positive ions tend to be bound by negatively charged organic compounds to form compounds available to trees. These elements play a role in strengthening elements of trees such as flower and fruit so it does not easily fall out ^[8].

At this time the apple treeation land in Batu, East Java, Indonesia has likely degraded. Land degradation in the uplands is mainly because of erosion, lack of organic matter, and loss of nutrient due to conversion of forest to agricultural land. The percentage increased in the amount of fruit as a result of the addition of organic matter such as APT01compost. The impact of land degradation resulting in yield reduction amount of fruit produced.

Observations weight of fruit per tree from various compost treatments mentioned that the addition of APT01compost can enlarge apple production. The largest increase in yield is 71.08% on the addition of APT01compost as much as 30 and 40 kg per tree.

Previous research by Adebayo^[13], found that the addition of compost on Okra trees were able to increase the number and weight of fruit production significantly. Similar studies had been reported by Khan and Ishaq ^[14], that the addition of compost made from the remains of trees and livestock manure into the soil can improve nutrient of potassium, nitrate, and phosphorus in the form available to trees. The availability of tree nutrients accelerated growth and increased sustainability in production. The addition of composted organic material has been done by previous research on apple crop varieties "Galaxy" were able to increase production more than 10% ^[15].

Based on previous research in period-1, the production of fruit weight per tree by the addition of APT01 compost ranging from 3.24-4.22 kg, while on period-2 of 3.97-4.91 kg/tree. The addition of APT01 compost at period-1 is able to increase production 74.51-135.91% significantly ($\alpha = 0.05$) compared with no addition of compost ^[8]. The addition of APT01 compost to the same treatment as period-1 for the next season (period-2) increases 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 APT01 compost^[11].

The number of apple trees per hectare is 1,500-1,700 trees. Composting per season of production per hectare is 30-50 tons per hectare. For apple trees that are productive (10-20 years), the amount of compost added can reach 50-60 tons per hectare per season. The addition of the compost is expected to affect the increase of flower and fruit production. The results of the research of the productivity of apple trees by the addition of APT01compost showed an increase in the number of fruits as a result of the addition of compost.

The addition of APT01compost as much as 30 and 40 kg per tree impact to increase in a weight and a number of fruit that was originally 7.9-8.7 kg (107-112 fruits) to 13.6-14.8 kg (134-147 fruits). When it made the quality grade, the average fruit produced from 12-13 to 10-11 fruits/kg, and can be categorized into Grade C to AB. The previous research by Caione^[16], 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, stalks and crop productivity. 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 ^[11]. The research data of Budiono^[9], showed that a 20 kg APT01compost addition gave the best result to improve quality and quantity productivity of apple trees than Bokashi compost in SPN. The 20 kg APT01compost addition suppressed the fruit loss until 13.85% and improved fruit weight until 49.11% .

IV. CONCLUSION

The results of ANOVA variance analysis concluded that: (1). The amount of fruit produced by the addition of 30 and 40 kg APT01 compost increases ranged between 26.85 and 33.33% compared to 20 kg per tree as control. It means that there was a significant difference ($\alpha = 0.05$) between the average value calculated from categories of addition of 30 and 40 to 20 kg APT01compost. Each addition of 30 and 40 kg of APT01 compost those were different number and weight of apple production., (2) The addition of 30 and 40 kg of APT01 compost has an impact on increasing the quality of fruit from grade C (12-13 fruits per kg) to grade AB (10-11 fruits per kg).

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