Application of Compost APT01 on Apple Crop (10.0-10.5 years)

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Abstract— *Production of apple tends to decrease because of soil degradation. Objectives of this study are to determine the addition of compostAPT01 to increase fruit production in apple crop.This study aims to analyze the effect of the type and amount of compost APT01 as the soil organic matter to the apple crop production at 3 and 4 months of a day after defoliation and at harvest time (SR3, SR4 and SPN). The experiment was carried out according to completely randomized factorial design with the amount of compost APT01 and the season time of production. The experiment was conducted in 600 square meters. Organic materials of mud cake was fermented for 3 weeks. The amount of compost APT01 as much as 40, 60, and 80 kg per tree was applied a day after defoliation. A total of 27 apple trees aged about 10.0 - 10.5 years with a distance between trees 2-3 meters were randomly selected. 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. The addition of compost APT01 as much as 40, 60 and 80 kg per tree increasing the number and weight of fruit from initially 5.71 kg (58.84 fruits) to 9.99 kg (95.46 fruits) and 12.12 kg (104.06 fruits) respectively. Moreover, it also improves quality grade in terms of the average fruit produced from 9.56-10.22 fruits/kg (grade AB) to 8.59 fruits/kg (grade AA).*

Keywords— organic; apple; APT01; compost; defoliation.

I. INTRODUCTION

The land of apple plantation centers used to produce crops usually have a much greater erosion of land with natural vegetation. Increasing of erosion causes by the replacement of the structure of forest plant 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 and likely increases 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 being damaged and production declines [2]. Such these conditions force us to constantly seek new breakthroughs for land use that can meet the needs of the community while helping to conserve resources and minimize the impact of external land. One form of such breakthrough was the addition of organic fertilizer such as compost given twice a year. Some of the literature mentioned that the content of organic matter in Java agricultural land is less than 1% which is ideally should be more than 2% [3]. The carbon organic deficiency is an indicator in the excess of chemical fertilizer.

Based on the test results, the number of organic fertilizer needed by the apple plant which have 0.79% organic content in soil is 30 – 50 kg per tree [4]. 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 generated by the sugar mills are dirty, brownish watery and smelled which disturb the surrounding community, therefore need to be composted to become organic fertilizer.

Basic principles of composting procedures has been widely discussed in the literature [5]. Aerobic composting of organic material is a humification process of unstable organic matter (C/N ratio >25) to become stable, characterized by the release of heat and gas from composted substrates. Composting duration varies from 2 to 7 weeks, depending on the type of

decomposers and composting techniques used [6]. Level of maturity and stability in compost determine compost quality shown by the various changes in the physical, chemical and biological compost substrate.

The interest of public to improve soil fertility is by applying compost as an organic filler. 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 [7]. Previous research [8] showed that raw materials which have a C/N ratio > 60:1 will produce poor quality compost. Therefore, organic material with high carbon content is required to be mixed with low-carbon organic material, in addition to high levels of nitrogen.

The mud cake containing cellulose about 3.8% of milled cane. Organic matter content in the mud cake about 75-80% which is mainly in the form of cellulose. The mud cake waste is largely taken by farmers for ground fill or dumped in open fields which can cause air pollution and unpleasant smell around the area [9].

Processing of organic material into compost can be considered as a sustainable technology because it is in accordance with conservation of environment. In addition, the use of compost (organic fertilizer) can reduce chemical fertilizers application [10].

Results of previous studies on chemical analysis tests showed that the average content of the soil organic matter in Bumiaji Batu is less than 1%. Ideally, organic matter contained in the soil should be more than 3%. The process of composting organic materials can be accelerated by the addition of *Trichoderma viride* APT01 as 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% [11].

II. METHODS

Implementation of field research began February to October 2022 in an apple crop "Anna" of 600 square meters located in the area of Tulungrejo, Bumiaji, Batu, Indonesia. The age of the plant approximately 10.0-10.5 years, with a distance between plants 2-3 meters. The experiment was conducted in 600 square meters. Organic materials of mude cake was fermented by *Trichoderma Viride* APT01 for 3 weeks. The amount of compost APT01 as much as 40, 60, and 80 kg per tree was applied a day after defoliation. A total of 27 apple trees aged about 10.0 - 10.5 years with a distance between trees 2-3 meters were randomly selected. 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.

III. 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.

TABLE 1
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
C40	70.23	75.35	60.37	67.56	58.44	58.23	3.23	3.11	3.78	4.01	5.36	6.05
C60	**107.88**	**112.82**	**96.57**	**98.44**	**94.57**	**96.35**	**3.82**	**4.17**	**6.55**	**7.18**	**9.79**	**10.18**
C80	**112.33**	**120.02**	**107.95**	**110.23**	**103.45**	**104.66**	**4.47**	**4.31**	**7.84**	**7.72**	**12.06**	**12.17**

Descriptions:
1 = period-1 and 2 = period-2. C40 = 40 kg Compost APT01, C60 = 60 kg Compost APT01 and C80 = 80 kg Compost APT01. SR3 = after 3 months composting,
SR4 = after 4 months composting, SPN = the time of harvest.

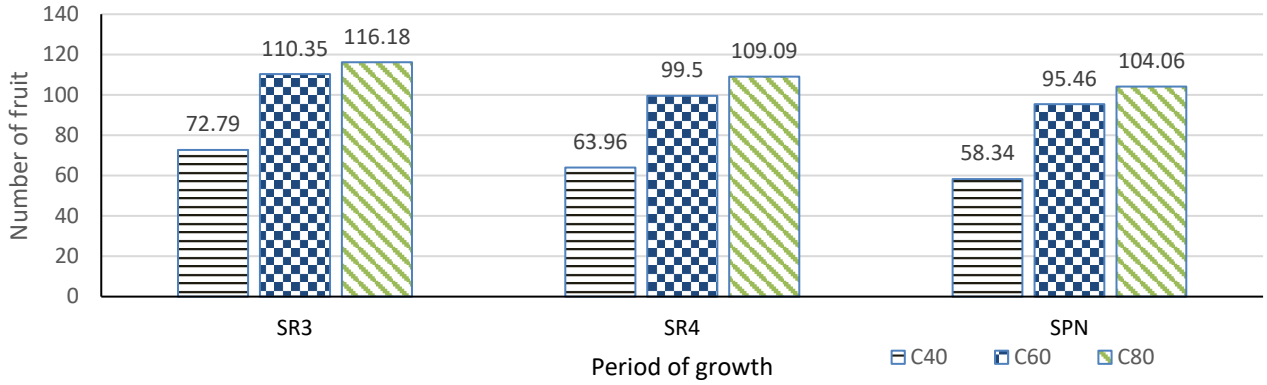

FIGURE 1: The period of growth on the number of fruit

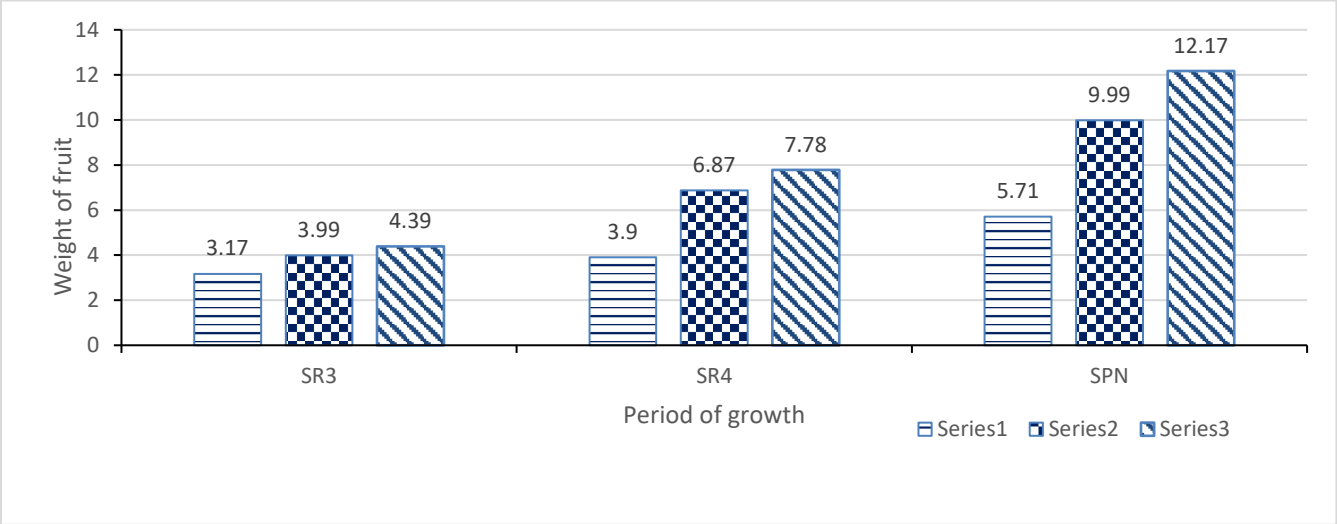

FIGURE 2: The period of growth on the weight of fruit

Data on Table 1 shows reduction in the number of falling fruit on SPN compared to SR3. At SR3, addition of compost APT01 C40, C60, and C80 reducing the amount of the original fruit to fall respectively 19.85%, 13.49%, and 10.43%.

Addition of compost APT01 reducing the amount of the original fruit to fall 16.48-16.49%. Application of 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. Stronger fruit stalk as a result of absorption of potassium and calcium that 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 [12]. 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% [13].

The significant addition of compost improves 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 [14]. The results of a similar study reported that the addition of potassium and phosphorus influences the amount and weight of the fruit produced per plant [15].

Data on Table 1 shows the apple production of the 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 C40, C60 and C80 respectively 5.71, 9.99, and 12.12 kg. Improvement on fruit size for C40, C60 and C80 respectively 10.22 (grade AB), 9.56 (grade AB) and 8.59 (grade AA).

Production of fruit 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 [12].

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 [16]. 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 [13].

The addition of compost APT01 as much as 20 and 30 kg per tree increases the weight and number of fruits was originally 5.3-5.9 kg (62-71 fruits) to 9.0-9.3 kg (89-90 fruits). When it come to the quality grade, the average fruit produced decrease from 12-13 to 10-11 fruits/kg, and can be categorized into Grade C to AB. 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 [17]. The research data of Budiono *et al.* (2015), showed that: (1) Addition of compost APT01 with fermentation time F1, F2 or F3 did not differ significantly ($\alpha = 0.05$) to total fruit production on SR3, SR4, and SPN. This shows that the time required to ferment into compost APT01 by Bio-catalyst was 1 week, (2) The addition of 20, 30, and 40 kg of compost per tree, respectively for F1, F2, and F3 show a significant differences ($\alpha = 0.05$) on the amount of fruit production on SR3, SR4, and SPN, (3) The addition of 30 and 40 kg of compostAPT01 has an impact on increasing the number of fruits from 19 to 29, fruit weight increase from 3.3 to 3.9 kg per tree, and the quality of fruit from grade C (12-13 fruits per kg) to grade AB (10-11 fruits per kg) [18].

IV. CONCLUSION

The addition of compost APT01 as much as 40, 60 and 80 kg per tree increases the number and weight of fruits from 5.71 kg (58.84 fruits) to 9.99 kg (95.46 fruits) and 12.12 kg (104.06 fruits) respectively. Moreover, it also improves quality grade in terms of the average fruit produced from 9.56-10.22 fruits/kg (grade AB) to 8.59 fruits/kg (grade AA).

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