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Combined organic fertilizer application improved growth and yield of cherry tomato (*Solanum lycopersicum L.*)

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Abstract
A field experiment was conducted at the Cebu Technological University-Barili Campus compound from April-June. The study determine the effect of combined organic fertilizer application on the growth and yield of cherry tomato (*Solanum lycopersicum*) as to height, days to flowering, number of flowers, days to first harvest, fruit per plant, and fruit weight. The study was laid out in a Randomized Complete Block Design (RCBD) with three replications. The results showed that the combined bat guano and fermented seaweed fertilizer produced the tallest plants at, 55.06±3.81SE cm. The earliest plants to produce flower were those treated with combined bat guano and fermented plant juice at 28.17±0.27SE days after transplanting. Also, combined bat guano and fermented plant juice significantly produced 11.33 ±0.57SE more flower per plant gathered after 45 days from transplanting. Moreover, these plants had the highest number of fruits 9.39 ±0.51SE at first harvest. Furthermore, yield parameters of cherry tomato plants treated with combined bat guano and fermented seaweed is doubled 509±0.20SE g total yield compared to the recommended rate of inorganic fertilizer (229±0.68). Based on the study's findings, the combined bat guano and fermented seaweed seem to promote growth at 55.06±3.81SE cm tall compared to the recommended rate fertilizer 39.61±3.6 SE cm. Furthermore, the combined bat guano and fermented seaweed improved the yield of cherry tomato at 509±0.20SEg two times heavier compared to the recommended rate of inorganic fertilizer 229±0.68SE g. Thus, 500kg/ha of bat guano and 500L/ha of fermented seaweed is recommended for growers of cherry tomatoes.

Keywords: cherry tomato, bat guano, chicken dung, fermented seaweed, fermented plant juice

Introduction
Cherry tomato (Solanum *lycopersicum* L.) is among the world's major vegetable crop and a good source of nutritive value. It is rich in vitamins specifically vitamin C and other minerals like phosphorus, iron, and calcium (Bhowmik *et al.*, 2012) [6]. Consumers demand and competition imposed by the market have the provision of a high standard of nutritional value of cherry tomatoes. (Rahul *et al.*, 2018) [22].

Inorganic fertilizer is usually immediately and fast containing all necessary nutrients that are ready for plants (Roba, 2018) [23]. But, in recent years consumption of fertilizer exponentially increased throughout the world, results from serious environmental problems. Fertilization may affect the soil and plant system. Plants consume the fertilizer throughout the soil, they can penetrate the food chain. Then, fertilization leads to soil acidity and water contamination (Savci, 2012) [24].

Though synthetic fertilizers are most frequently applied, organic forms such as bat guano, compost, livestock manure, etc. are broadly used throughout the world (Sothearen *et al.*, 2014). Compared to inorganic fertilizers organic fertilizers have more benefits in the long run (Roba, 2018) [23]. Developing nations used organic fertilizer to avoid environmental pollution by doses of synthetic in the soil (Thirumaran *et al.*, 2009) [30].

Bat Guano carried essential nutrients macro and microelements (Misra *et al.*, 2019) [17]. Also, chicken manure carried excellent fertilizer and released nutrients uptake after mineralize in the soil (Masarirambi *et al.*, 2012) [16]. Regarding the expansion source of manures, seaweed fertilizers are useful in enriching the soil and achieving higher production. Compared to commercial seaweed organic fermented seaweed extract have a beneficial effect to the plant height (Pascual *et al.*, 2020) [21]. Moreover, applying fermented plant juice (FPJ) to vegetable

crops will promote good plant growth and vitality (Tagotong & Corpuz, 2020) [28].

Organic fertilizer had proven longevity benefits including enhanced soil quality, improve biodiversity, increase farm incomes and reduced pollution. The effect of combining organic fertilizer application could affect the growth and yield of cherry tomato. Moreover, it is important to determine which combination of organic fertilizer shows promising effect in cultivating cherry tomato. Hence, this study

Materials and Methods

Collection of chicken dung and bat guano

Chicken dung and bat guano was hauled from Brgy. Mayana, Barili, Cebu and was air-dried and pulverized and mix into the soil based on the treatment. Chicken dung and bat guano were applied one month before planting.

Collection of seaweed

Seaweed was collected at sayao beach. Washing the seaweed three times with tap water and then blending the washed seaweed, mixed with molasses with the ratio of 1:1. Seaweed was fermented for seven days. Then ready to apply.

Application of Treatments

Treatments were applied to the plant 7 days interval after planting which was done on the 7th day, second 14th day, third at 21st day, and the fourth on 28th day, fifth at 35th day, six at 42nd day, seventh 49th day. The recommended rate of inorganic fertilizer (10ml/L) was followed and the recommended rate.

Data gathered

Data was taken from 6 sample plants per plot. Sample plants were labeled to avoid confusion. The following data were gathered: Plant Height (cm) – was done by measuring the height of the sample plants from the ground to the tip of the plant. A measuring tape will be used every 15 days from planting until the first harvest. Number of days to flowering - was determined by counting the number of days to flowering from transplanting; number of flowers per sample plant. Number of days to first harvest - was determined by counting the number of days to first harvest from transplanting. Number of fruits/sample/harvest- this was determined by counting the presence of the fruits from 6 sample plants collected in every block during harvest. Fruit weight (g) - was done by the total weight of the fruits per sample plant by using a digital weighing scale.

Data Analysis

For statistical results, STAR Program was used for statistical analysis. Means were tested using Analysis of Variance (ANOVA) for Randomized Complete Block Design, in analyzing significant differences of all parameters gathered. To determine the specific significant differences, comparisons among treatments using Turkey's HSD was used.

Result and Discussion

Towards the entire period of the study, it showed that the combined bat guano and fermented seaweed fertilizer produced the tallest plant at 55.06±3.81SE cm (Figure 1) However, other treatments whereabouts the combined bat guano and fermented plant juice produced 42.28±3.29SE cm tall. At the same time, the combined chicken dung and fermented seaweed produced 53.44±1.82SE cm tall. On the other hand, combined chicken dung and fermented plant juice produced 43.28±1.87SE cm. While the recommended rate fertilizer produced plant height at 39.61±3.6 SE cm. The study stated that the combined bat guano and fermented seaweed have better effects compared to the recommended rate of fertilizer. Fermented seaweed contains cytokinin, auxin, and polyamines like putrescine and spermine to promote the height of tomato plants (Almohammedi *et al.*, 2014) [1]. Moreover, it was reported as well that fermented liquid seaweed promotes the weekly plant height of lettuce and has a better effect than commercial seaweed (Pascual *et al.*, 2020) [21]. Bat guano contains macro-elements and micro-elements to enhance plant growth and have more significant weekly increments in plant height than synthetic fertilizer (Karimou et. al., 2020) [12].

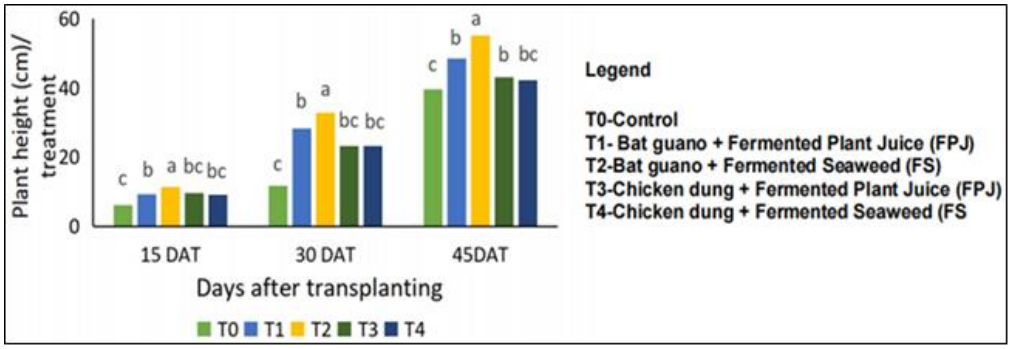

Fig 1: The effects of combined organic fertilizer on the plant height at 15 days intervals from transplanting of cherry tomato (*Solanum lycopersicum*) Different small subscript specifies significant differences (Tukey HSD, α = 0.05)

Number of days from transplanting to flowering

The treatment with bat guano and fermented plant juice produced flowers 28.17±0.27SE days after transplanting, while the treatment with bat guano and fermented seaweed fertilizer took 29.390.46 SE days to bloom (Figure 2). On the other hand, those plants treated with combined chicken dung and fermented seaweed produced 32.11±0.73SE days to flower compared to those treated with combined chicken dung and fermented plant juice produced 32.06±0.57SE days to flower but compared to the recommended rate of fertilizer produced 33.06±0.98SE days to flower. Therefore, the plants treated with combined bat guano and fermented plant juice flowered six days earlier more than those applied with the recommended inorganic fertilizer rate corresponds to the study of (Lado *et al.*, 2020) [34] bat guano influences the flowering duration by early flowering. Furthermore, it is significantly improving the mineral absorption and physiological characteristics of plants. Fermented plant juice contains auxin and essential nutrients to enhance the production of pineapple plants and produced early flowers compared to untreated plants (Sakimin *et al.*, 2017) [35].

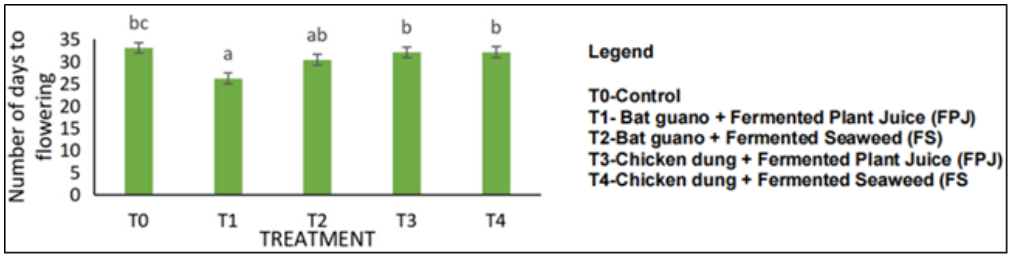

Fig 2: The outcomes of combined organic fertilizer on the number of days to flowering from transplanting on cherry tomato *(Solanum lycopersicum)* Different small subscript specify significant differences (Tukey HSD, α = 0.05)

Number of first flower per plant

The results clearly shows that combined bat guano and fermented plant juice produced the highest number of flowers per plant at 11.33 ±0.57SE flowers (Figure 3.) Compared to the application of recommended rate of inorganic fertilizer has 5.17±0.47SE flowers per plant.

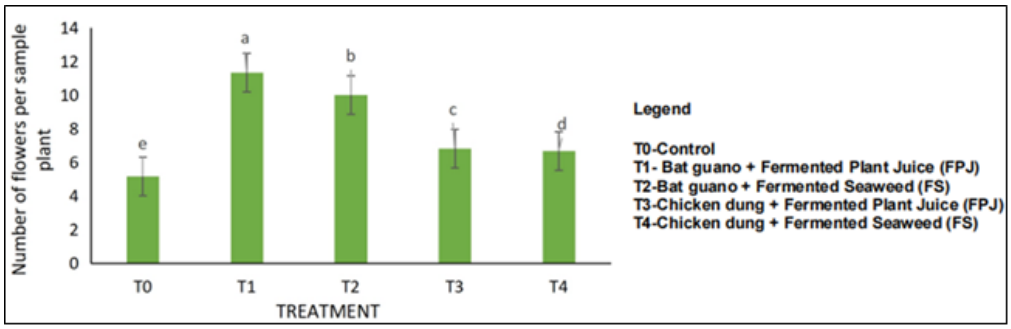

Fig 3: The effect of combined organic fertilizer on number of first flowers per sample plant on cherry tomato *(Solanum lycopersicum)* Different small subscript specify significant differences (Tukey HSD, α = 0.05)

It was corresponding with the study of (Lado *et al.*, 2020) [34]. The use of Bat guano can enhance the number of flowers in particular by significantly promote the radical part of the plants and vegetative. On the other hand, it was stated that fermented plant juice influences and increases the number of flowers (Sakimin *et al.*, 2017) [35] of tomato plants.

Number of fruits per sample plant

The cherry tomato plants application with combined bat guano and fermented seaweed fertilizer produce two times larger at 10.28±0.51SE fruits per plant (figure 4). Compared to the recommended rate of synthetic fertilizer produced at 5.15±0.39SE fruits per plant. While, the other treatments where the combined bat guano and fermented plant juice have 7.89±0.54SE fruits per plant, the combined chicken dung and fermented plant juice have 5.5±0.54SE fruits per plant, and on the other hand, the combined chicken dung and fermented seaweed produced 5.5±0.61SE fruits per plant

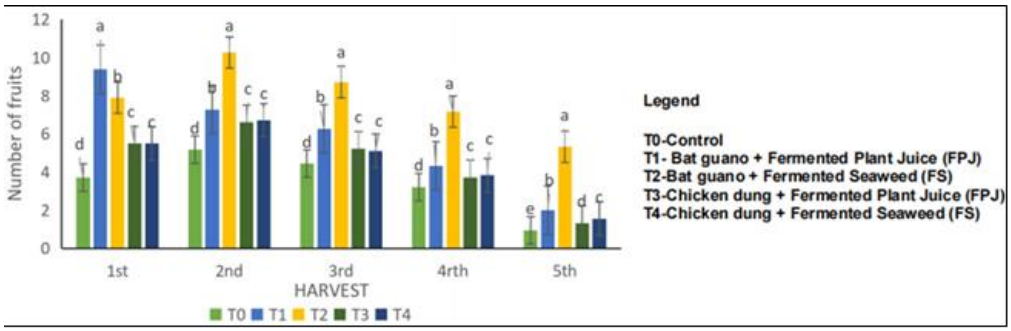

Fig 4: The outcomes of combined organic fertilizer on the number of fruits per sample plant on cherry tomato *(Solanum lycopersicum)* Different small subscript specify significant differences (Tukey HSD, α = 0.05)

As a result, the research indicates that combined bat guano and fermented seaweed enhanced the number of fruits from the second harvest compared to plants that received the appropriate rate of inorganic fertilizer. It is consistent with the findings of (Afa 2016) [36] and (Karimou *et al.*, 2020) [12] that the used of bat guano enhanced the number of fruits on the berries plant attributed to the macro elements and microelements found in bat guano. Fermented seaweed enhanced the number of fruits due to plant cytokinin, gibberellin, trace elements, vitamins and microelements in the seaweed (Shah *et al.*, 2013) [37].

Fruit weight (g) per fruit

The result showed that the combined bat guano and fermented seaweed extract produced heavier at 6.94 ±0.23SE g/fruit compared with the application of recommended rate of inorganic fertilizer produced at 3.28±0.21SE g/fruit (Figure 5.).

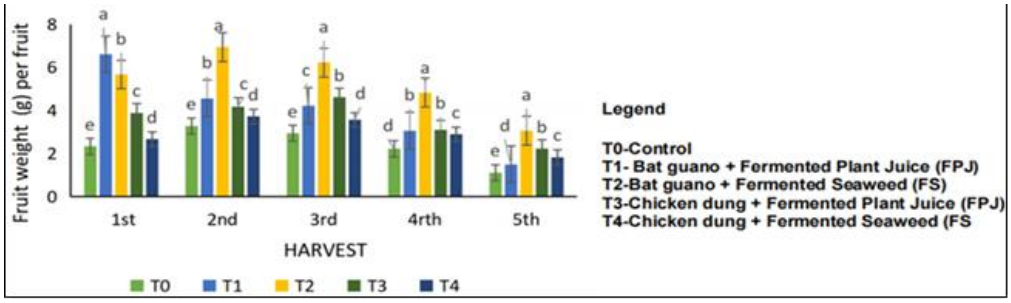

Fig 5: The outcomes of combined organic fertilizer on fruit weight (g) of the first harvest on cherry tomato (*Solanum lycopersicum*) Different small subscript specify significant differences (Tukey HSD, α = 0.05)

This is supported by the study of (Shetty *et al.*, 2013) and (Almohammedi *et al.*, 2014) [1] bat guano contain nutrients macro elements and microelements which needed the plants to improve the fruit weight.

Total fruit weight

Figure 6. Showed the application of combined bat guano and fermented seaweed produced more than two times heavier at 509±0.72SE g total weight compared to the recommended rate of inorganic fertilizer produced at 229±0.68SE g total weight. According to the study of (Karimou *et al.*, 2020) [12] the plants treated with bat guano recorded a higher yield than inorganic fertilizer. This study stated that the combined bat guano and fermented seaweed improved the yield of cherry tomato. This is related to the study of (Bhat *et al.*, 2013) [5]. Seaweed was found have better effects in all the parameters in the berries cultivation. Due to the present of cytokinin and auxin. Guano contains a powerful decomposing microbes, which help to promote the yield of plants due to the present of macro elements and microelements (Bharambe, C.M., Kakde, 2017) [4], (Zodape *et al.*, 2008) [33] and (Dobromilska *et al.*, 2008) [9].

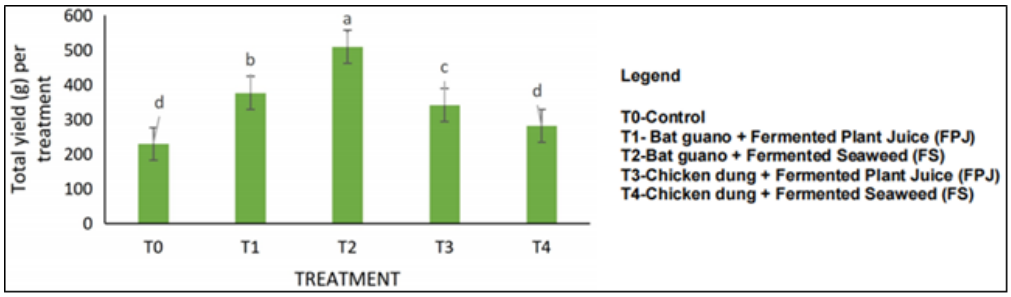

Fig 6: The outcomes of combined organic fertilizer on the yield (g) of cherry tomato *(Solanum lycopersicum)* Different small subscript specify significant differences (Tukey HSD, α = 0.05)

Conclusion

This study showed that combined bat guano and fermented seaweed effectively substitute synthetic fertilizer. Bat guano in basal-based and fermented seaweed in liquid form. Furthermore, bat guano and fermented seaweed improved the yield of cherry tomato two times heavier than the recommended rate of inorganic fertilizer. Moreover, the plants treated with combined bat guano and fermented plant juice produced flowers earlier than other treatments, significantly improving the mineral absorption and characteristic physiological parameters of the plants.

Recommendation

The study recommends that organic fertilizer be practiced in farming methods generally with a lessened reliance, especially for farmers with limited resources and also organic fertilizer reduce the environmental impacts of farming and safeguard surrounding ecosystem. Organic fertilizer such as bat guano, chicken dung, fermented seaweed, and fermented plant juice has no side effect to the consumers. Those organic fertilizer can improve the soil structure and fertility. Through organic, farmers can prevent soil erosion and soil compaction. Furthermore, based on the study, the researcher recommends using the combined bat guano and fermented seaweed. Thus, 500kg/ha of bat guano and 500L/ha of fermented seaweed should be recommended for growers of cherry tomatoes.

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