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Effects of Different Animal Manure Combined with Carbonized Rice Hull on the Growth and Yield Performance of Tomato (Solanum lycopersicum)

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Abstract

This study was conducted to evaluate the effects of different animal manure to tomato production. The study adapted the Randomized Complete Block Design (RCBD) of experiment having five (5) treatments which were; Treatment A- 40% Horse manure with 10% carbonized rice hull and 50% Garden soil; Treatment B- 40% Cattle manure with 10% carbonized rice hull and 50% Garden soil; Treatment C- 40% Goat manure with 10% carbonized rice hull and 50% garden soil; Treatment D- 40% Vermicast with 10% carbonized rice hull and 50% Garden soil; Treatment E- 100% Garden soil Control and were replicated three (3) times. It appeared that the application of cattle manure & carbonized rice hull combination and goat manure & carbonized rice hull combination had significantly influenced the total weight harvested, weight of yield per harvest and number of fruits per harvest of tomato. The fruit diameter was significantly affected by the application of horse manure and carbonized rice hull combination. The growth increment, average number of days from flowering to first harvest and fruit length of tomato were not directly influenced by the different organic fertilizer and soil enhancer applied. Therefore, the different animal manure mixed with carbonized rice hull applied as fertilizer gave uniform response to the tomatoes in its vegetative stage. Combining or mixing all the treatments (animal manure) and carbonized rice hull applied in the study would give significant results to the organic production of tomatoes.

Keywords: Tomato, Organic fertilizer, Animal manure, Carbonized rice hull (CRH), Vermi cast

Introduction

Tomato is belonging to solanaceae family. Locally known as “kamatis” in the Philippines, it is an edible fruit of a nightshade family. Fruits are high round, firm with excellent transportability and storability. Tomatoes is the second most important agricultural crops cultivated worldwide (Villanueva, 2018). Its importance could be ascribed to the nutritional benefits it provides. Every 100g of fresh tomato fruits could offers 735mg of vitamin A, 266mg of potassium and 29mg of vitamin C. (Puwastein et al., 2000, Kimeu, 2012). Moreover, it is high in lycopene, known to have anti carcinogenic property and helps lower the risk of a heart attack (Kirankumar et al., 2008). Tomato is also known sources of vitamins and pro-vitamins like vitamin C, pro-vitamins A, B carotene, folate, and minerals such as potassium, and secondary metabolites such as lycopene, flavonoids, phytosterols, and polyphenols (Luthria, et al., 2006). Besides, tomato is considered a model organism for research of the Solanaceae family and therefore still a major crop subject of studies both in the indoor and under farm conditions (Villanueva, 2018).

Tomato (Solanum lycopersicum L) is an important food constituent and the second-largest vegetable in terms of production and consumption worldwide (Food and Agriculture Organization [FAO], 2016). Successful farming of tomato is based basically upon the choice of right varieties for a particular location and condition (Chaerani, 2006). Tomato is one of the most popular cultivated

vegetables worldwide. There are about 10,000 tomato varieties of all over the world and it has a wide range of colors, from orange, reddish, purple to pink, yellow to white, and sometimes even as dark or as black. There are tomatoes that can be striped or spotted as well. Tomatoes have been farmed by humans for centuries. They are very appreciated fruit from the past markets and current markets. Yet tomatoes have been produced extensively, there are still unique traditional varieties that always turn heads at farmer's markets. The farmers select tomato variety to grow depending on a number of factors which include production potentiality, demand in the market, regional adaptability, resistance in pest and disease, and the end use of the product (Orzolek et al., 2006). Nutrients requirements of the tomato crop also depend on variety, yield and cultural practices in the farm (Sainju et.al., 2003).

The manure in general is an organic matter that is used to fertilize the soil, it generally consist of the feces and urine of domestic livestock (cattle, horse, goat, sheep and pigs) and poultry, with or without association of litter such as rice straw, hay, cobs or bedding. Animals the farms negated most of the nitrogen, phosphorus, and potassium that is present in the their diet, and this creates an enormous fertilizer source. In many countries, excrement of human is also being used in the farms. Manure form livestock is having lower in nitrogen, potash, and phosphorus than the synthetic fertilizers and with this it must be applied in much bigger quantities. A ton of manure from hogs, cattle, or horses typically contains approximately with 4.5 kilogram of nitrogen, 2.3 of phosphorus pentoxide, and 4.5 kilogram of potash. Nevertheless manure has huge organic matter, or humus, and so it improves the soil's capacity to absorb and store the water, it also prevent the erosion. More amount of the nitrogen and potassium in the manure usually lost through leaching if the material is exposed to rainfall before being applied to the farms. The losses of nutrients may be avoided if manure stacked with cover or placed in pits to prevent spreading or leaching it on the fields as soon as it is practicable, and distributing protective materials in the constant. The use of fertilizer manure date back from the beginnings of agriculture. On today's modern farms the manure is regularly applied by a manure spreader, a two-wheeled or four wheeled drive tractor drawn with wagon or four-wheeled self-propelled. Vegetable gardeners more likely to use decomposed manure, since it is odor less, less weight, more easily to spread, and will not to burn the plants (Britannica, T. Editors of Encyclopaedia., n.d.).

Organic farming is a system in agricultural that utilized ecologically created pest controls and biological fertilizers made mostly from animal waste and crop residues and nitrogen-fixing cover crops. At present, of organic plants was developed as a key practice to the environmental destruction caused by excessive use of farming chemical pesticides and synthetic fertilizers in conventional farming system, and it has several ecological benefits. Comparing it to the conventional farming, organic agriculture uses less pesticides, prevent soil erosion, reduce nitrate leaching into surface water and groundwater, it also reuses animal wastes back into the farm. These advantages are compensated by higher costs of food for consumers and hence organic farming generally have lower yields. Definitely, harvests of organic crops have been found to be about 25 percent lower overall than the conventionally produced crops, while this can vary significantly depending on the type of crop. Maintain its environmental benefits is still a challenge for future organic agriculture, increasing the yields, and reduce cost of crops while responding to the challenges of climate change and population increasing in the world (Adamchak, R., n.d).

The growth and vigor of the plant increase more rapidly with the use chemical fertilizer, it therefore meets the world's demands for food, however the plants harvested in this way do not grow with good plant characteristics primarily the good sprouts, good root system, nutritional content and

don't have longer time to grow and matured properly (Liu et al., 2005). The chemical fertilizers have harmful effects, the thing starts with the chemical processing of those products and by-products are positively a destructive chemicals or gases that cause pollution in the air, such as ammonia, methane and carbon dioxide. It causes pollution in water when the waste from manufacturing is disposed of untreated in nearby streams, creek and lakes. Fertilizers have most damaging effect of the buildup of chemical waste in the water bodies like harmful algal blooms, dead zones, and fish kills. Excessive use of synthetic fertilizer to the soil, destroys the health and quality of the soil, thus producing soil pollution. Therefore, the crop production decades ago depleted the climate and biodiversity. Constant use this fertilizer without making any corrective action to reduce or cautious use will deplete all the natural resources in the coming days and destroy the entire life on the earth. Health humans and the environment are harmfully affected of these synthetic chemicals, however this can be reduced or eliminated by accepting new agricultural practices and technological advancement, including the use of organic fertilizers such as biofertilizers, biopesticides, manure, slow-release fertilizers and nano-fertilizers, etc. Shifting away from farming system that greatly use synthetic fertilizers and embrace the organic farming (Bisht et al., 2020).

The soil is a home of many creatures which are a mechanism for the nutrient recovery, and it provided many advantages to the environmental resources. The over usage of chemical fertilizer can contribute to soil acidification and soil crusting, thereby reducing the content, beneficial organisms, stunting plant growth, altering the pH of the soil, present of pests, and even resulting to the release of greenhouse gases. The soil acidity reduces plant phosphate intake, it increases the concentration of destructive ions in the soil and hinders crop growth (Chandini et al., 2019). The common problem farmers mostly experienced in planting tomato are blossom-end rot, flower drop and fruit cracking. Blossom end rot and cracking of fruits cracking are among the soil moisture related physiological disorders that cause yield losses and quality in tomato production (Maboko, 2006). Organic fertilizer can be also made from occurring natural mineral deposits and organic material, such as bone or decayed plant or dead animals. Organic fertilizer is best because it's stimulated beneficial soil microorganisms and improve the soil structure. Soil organism plays an important character in changing the organic fertilizer into dissolved nutrients that can be absorb immediately by your plants. Organic fertilizer and compost provide all the micronutrients and secondary nutrients important to the plants. Increasing the amount of soil organic matter, the organic farming can restore the natural fertility of the damage soil, and will lead to the improvement of crop productivity to feed the increasing world population. It enhances the soil natural processes, which have long-standing effects on the fertility of soil.

The objective of the study was to evaluate the effect of different animal manure combined with carbonized rice hull in growth and yield of tomato. Specifically, it aimed to: evaluate the plant height, number of days from flowering up to first harvesting, weight of fruits, number of fruits and size of fruits length (cm) and diameter (mm). The study was conducted off-season from May 2021 to July 2021 at the Crop Science experimental area, DEBESMSCAT, Mandaon, Masbate Philippines.

Materials and Methods

Research Design

The study used the Randomized Complete Block Design (RCBD) for experimental design with five (5) treatments and three (3) replications. The treatments used in the study were the following: Treatment A - 40% Horse manure (HM) + 10% Carbonized rice hull (CRH) + 50% Garden soil

(GS); Treatment B- 40% Cattle manure (CM) +10% carbonized rice hull + 50% GS; Treatment C - 40% Goat manure (GM) + 10% carbonized rice hull + 50% GS; Treatment D - 40% Vermicast (VC) +10% carbonized rice hull + 50% GS; Treatment E - 100% Garden soil (control). The study was conducted at Crop Science experimental area in DEBESMSCAT, Masbate, Philippines.

Materials and Procedure of the Study

The materials and equipment that were used in the study are different animal manure for the treatment and carbonized rice hull as soil conditioner, garden tools for the plot preparation and cultivation, sprinkling cans for the watering of plant, polyethylene bag for seedling preparations, meter stick and calliper for measuring the parameters observed, marker pens and record book for data gathering and recording, bamboo stick/slat were also used to support the plants to stand and weighing scale to measure the weight of fruits.

Land Preparation and Plot Layout

The experimental area was properly ploughed and harrowed to remove the weeds and break the soil clods into smaller piece. The plots were layout according to statistical design and plot requirements. Fifteen (15) plots were constructed with 3.0 m length and 3.0 m width for the 5 treatments and 3 replications. A canal of 50 cm width and 20 cm deep which served as drainage and passageway was also built. Overall, a total of 198 square meter was used in the experimental area. Each plot was applied with treatment from different animal manure.

Seed Sowing and Seedling Preparation

The seeds were procured at organic farm procured via online at reliable seed company. Seeds were sown in directly polyethylene bags containing the mixture of the soil media. The seedlings were cared in 24 days and were hardened in 6 days. Regular water was also applied to maintain the soil moisture and temperature.

Treatment Preparation and Application

After the gathering and drying, the different animal manure was pulverized. The rice hull gathered from nearby rice mill was then carbonized using locally made carbonizer. Together with carbonized rice hull were mixed thoroughly following the recommended proportion of the treatments and applied to plots per hill. A mixture of 40% horse manure +10% carbonized rice hull + 50% garden soil was used for treatment A, treatment B used the 40% cattle manure + 10% carbonized rice hull + 50% garden soil, the treatment C used 40% goat manure + 10% carbonized rice hull + 50% garden soil, treatment D used 40% vermi cast+ 10% carbonized rice hull + 50% garden soil and treatment E used garden soil (control) no mixture. All the treatments were applied 1 week before transplanting.

Transplanting of Tomato Seedling

Thirty days after sowing (DAS), the seedlings were transplanted in the plots to a required depth and distance of 60 cm per row and 60 cm per hill. Each hill was planted with one seedling ranging from 15-20cm in height. A total of 300 seedlings were transplanted in 15 plots and cared for the study.

Care and Management

After the transplanting regular irrigation was applied in the early morning and in the afternoon to maintain the required soil moisture. Irrigation was done using a sprinkler. Pest management was also done in the study. Regular monitoring of pest population was made and the control method was done through handpicking and the use of portable sprayer. Fourteen (14) days after transplanting, all the tomato plants were provided with bamboo stick to support its stem and to keep it in

standing position, since the tomato branch and leaves became heavier as it grows bigger fall down when there is heavy rain and wind.

Data Gathering

The following were gathered during the study:

Plant height. Increase in plant height was measured 7 days after transplanting (DAT) from the base up to the tip of the plants using a meter stick and was expressed in centimetre (cm). Plant height were measured from 10 plants randomly selected in every plot sample in 7 days interval.

Number of days flowering to first harvest. Number of days from flower development were counted up to the first harvesting. The counting was done in 10 randomly selected samples per plot.

Weight of fruits. The weight of fruits was measured using standard weighing scale to determine the weight of harvested fruits per treatment and was expressed in kilograms (kg).

Total yield per harvest. The total yield was determined after weighing all the fruits per treatment every after harvesting.

Number of fruits. The number of fruits per treatment were counted every after harvesting.

Size of fruits (length and diameter). The sizes of fruits were measured per treatment using calliper. The length of the fruits was expressed centimetres (cm) and the diameter was expressed in millimetres (mm).

Data Analysis

Randomized Complete Block Design (RCBD) was used in the study to describe the effects of different animal manure mixed with carbonized rice hull blended with garden soil in growth and yield performance of tomato under DEBESMSCAT, Mandaon, Masbate, Philippine condition. Significant results were further analyzed in Least Significant Difference (LSD). The growth and yield response of tomato was analyzed using univariate analysis in SPSS version 25.

Results and Discussions

Increase in Plant Height

The results of study on the growth increment as shown in table 1, found that the average growth increment ranges from 9.18 to 9.88 cm. The treatment C had the highest increased in height among other treatment that has 9.88cm followed by treatment D with 9.37cm, treatment E with 9.35cm, treatment B with 9.22cm and the last was treatment A with only have 9.18 cm increased. The result of analysis on growth increment revealed no significant differences among other treatment. Based from the data gathered, plants in treatment A and B showed shorter increase in height with only have 9.18 cm and 9.22 cm respectively, compared to those plants treated with goat manure and vermi cast combined with carbonized rice hull that has 9.37 cm and 9.88 cm and control were slightly taller. This may be due to the NPK content of goat manure that contains 4.9% total nitrogen, 1.9% potassium, 4.1% phosphorus, 0.9% magnesium and 1.0% calcium (Ansa, 2021). Horse manure tends to have low scoring at around 0.7-0.3-0.60. However, it contains large amounts of organic matter that feed and build the soil as well (NZlife, 2022). Cow manure is a time-tested fertilizer and has been in use since ages. Cow manure is a composite package for plant nutrients with typical NPK ratio of 0.5-0.2-0.5 (Ecotika, 2021). The NPK in vermi cast runs at a minimum of 0.50-0.70-0.40 (Mike, 2017). These different scales of NPK may results to different effect in plants growth. Based from the results, it appeared that the goat manure and carbonized rice hull combination aided the slight improvement in increase in plant height compared to other treatments. Results can be similar to the findings (Mowa et al., 2017), that the organic manure formulated from the goat manure positively improved the plant growth of tomato crop. This indicates that the application of goat manure

and carbonized rice hull combination could slightly improve the height of tomato plants however, not to a significant level.

Table 1. Growth increment of tomato applied with different animal manure.

Treatment	Replication			Total	Mean
	I	II	III		
A	8.75	10.09	8.71	27.55	9.18
B	9.05	9.4	9.21	27.66	9.22
C	9.24	11.18	9.21	29.63	9.88
D	9.34	8.13	10.63	28.10	9.37
E	9.75	8.45	9.84	28.04	9.35
Grand Total	46.1	47.3	47.6		
Grand Mean				140.98	

LSD at 5% = 0.881; R Squared = 0.102 (Adjusted R Squared = -0.257)

Number of Days from Flowering to Harvesting

The result of the study number of days from flowering to harvesting found that the average of days from flowering to first harvest ranges from 25.83 days to 27.83 days. Treatment B had the greatest number of days among other treatment that has 27.83 days. Second was treatment D with the average of 27.70 days. Third is treatment A with 27.60 days, followed by treatment C with 27.40 days and shortest was the treatment E with the of 25.83 days. The table 2 shows the graph of number of days flowering to harvesting.

The results of analysis in the days from flowering to first harvest revealed that the application of different animal manure had no significant effects on tomato plants in terms of number of days from flower until first harvest. Based from the results it was observed that those plants in Treatment E (control) were slightly earlier in terms of average number of days to flower with only 25.83 days, this was followed by those tomato plants applied with goat manure and carbonized rice hull with 27.40 days. The next are those plants with horse manure and carbonized rice hull with 27.60 days, this due to the amount of organic matter. The next with longer number of days to harvesting was observed in tomatoes applied with vermicast and carbonized rice hull combination. The lengthiest period (number of days) from flowering up to first harvest was exhibited by those tomatoes applied with combination of cattle manure and carbonized rice hull that has 27.83 days.

Table 2. Number days from flowering to first harvest.

Treatment	Replication			Total	Mean
	I	II	III		
A	27.60	26.30	28.90	82.80	27.60
B	27.30	28.90	27.30	83.50	27.83
C	28.40	25.70	28.10	82.20	27.40
D	28.90	28.10	26.10	83.10	27.70
E	24.40	27.90	25.20	77.50	25.83
Grand Total				**409.10**	
Grand Mean					27.27

LSD at 5% = 0.455; R Squared = 0.284 (Adjusted R Squared = -0.002)

This finding in this study was comparable to the 'Athena' variety earliest to bear flower at 23 days after transplanting, and 'Astig' variety, 'Makapuno', and 'Apollo' variety, which has 28-30 days to flowering of tomato. The results also significantly earlier than, 'Diamante Max','Malakas', and 'Victory' flower at 38-40 days to flowering varieties produced in conventional cultivation in the semi-temperate conditions of Benguet, Philippines (Kimeu, 2021). Additionally, the tomato in this study was more significantly earlier in days to flower than tomato varieties that has between 38 to 49 days (Meseret et al. 2012). Based from the findings, the flower formation of different varieties was affected by genetic composition of the plants and very important for the fruit formation. Other finding was observed, that the delays in flowering usually results to the delays in fruit production.

Weight of Fruits

The result of the study on weight of fruits found that the total weight of fruits harvested per treatment ranges from 3.78 to 7.23 kilograms. Treatment C had the highest weight of fruits harvested among other treatment that has 7.23 kilograms. Followed by treatment B with the average of 6.82 kilograms. Then, treatment D with 5.07 kilograms next was the treatment A with 3.87 kilograms and the last was the treatment E (control) with only have 3.78 kilograms. The figure 3 shows the graph of harvested tomato fruits in terms of weight. The result of analysis on total weight of fruits harvested it revealed that those tomato plants applied with combination of cattle manure and carbonized rice hull and goat manure and carbonized rice hull gave significantly higher total yield of 6.82 and 7.23 kilograms respectively. While the other treatments were not statistically different from each other. Plants applied with horse manure and carbonized rice hull, vermi cast and carbonized rice hull and those in the control gave lower yields of 5.07, 3.87 and 3.78 respectively.

Table 3. Total weight of tomato fruits harvested

Treatment	Replication			Total	Mean
	I	II	III		
A	2.80	5.00	3.80	11.60	3.87^{b}
B	7.10	8.30	5.05	20.45	6.82^{a}
C	8.10	8.40	5.20	21.70	7.23^{a}
D	5.80	4.70	4.70	15.20	5.07^{b}
E	3.75	3.70	3.90	11.35	3.78^{b}
Grand Total				**80.30**	
Grand Mean					**5.35**

Means with different letter is significantly different by LSD at $P \leq 0.05$.
LSD at 5% = 0.015; R Squared = 0.667(Adjusted R Squared = -0.548)

The results on weight of fruits in this study far larger than the highest weight of fruits that used different organic matter with 1.5426kg per plant (Mehdizadeh et al., 2013). The results were confirmed from report of (Gichaba, 2019) that the application of goat manure based vermicompost fertilizer resulted into significantly higher, bulb diameter, bulb length, bulb fresh weight, number of cloves per bulb, bulb dry weight and yield of bulb per hectare than the control treatment. Report also found out that the application of increasing levels of cattle manure significantly improved the growth and yield attributes of crop, which might have been due to the balance availability of nutrients to the plants that resulted in a favorable soil environment (Eleduma, 2020). These favorable conditions increase the nutrient availability and water holding capacity of the soil resulted to the improvements in growth and yield. This result implied that the application of cattle manure and car-

bonized rice hull, and goat manure and carbonized rice hull combinations will significantly influence the yield of tomatoes compared to other treatments used in the study.

Number of Fruits

The result of the study on the number of fruits found that the average number of fruits harvested ranges from 36 to 63 pieces. Treatment C had the highest means among other treatment with the average of 63 pieces. Then, treatment B with 61 pieces followed by treatment D with the average of 45 pieces then treatment E with 38 pieces. Least number fruits harvested was found in treatment A with 36 pieces. The figure 4 shows the graph of number of tomato fruits harvested. Results showed that the application of cattle manure and carbonized rice hull, and goat manure and carbonized rice hull combinations significantly affected the yield of tomato plants in terms of average number of fruits per harvest. It was observed that plants in these two treatments had significant difference in terms of number of fruits compared to other treatments. The number of fruits obtained from plants applied with Vermicast and carbonized rice hull combined also significantly different compared to those plants applied with horse manure and carbonized rice hull and those in the control with 35.89 and 37.67 pieces respectively. The results indicated that those treatment with higher yield were due to their significant difference in terms of number of fruits. This due to the NPK contents and type of organic matter of different manure and improvements made by carbonized rice hull application in the soil. The result in number of fruits in this study to was higher than the number of tomato fruits produced using different organic fertilizers with an average of 26 fruits reported (Mehdizadeh et al., 2013) and cumulative fruits harvested using organic fertilizer with 16.20 fruits (Taiwo et al., 2020). These results might be due to the sources and composition of organic manure used in the different studies.

Table 4. Number of tomato fruits harvested

Treatment	Replication			Total	Mean
	I	II	III		
A	24.67	43.00	40.00	107.67	35.89[c]
B	66.33	74.00	43.67	184.00	61.33[a]
C	74.67	66.67	49.00	190.34	63.44[a]
D	52.00	40.33	44.00	136.33	45.44[b]
E	37.67	35.00	40.33	113.00	37.67[c]
Grand Total				731.34	
Grand Mean					48.76

Means with different letter is significantly different by LSD at $P \leq 0.05$.
LSD at 5% = 0.023; R Squared = 0.647 (Adjusted R Squared = -0.505)

Fruit Length

The result of the study on the fruit length found that the average of fruit length ranges from 4.23 to 4.33 cm. It was observed from the results of plants applied with horse manure and carbonized rice hull. The fruits were slightly bigger in terms of length with 4.33cm compared to fruits of plants from other treatments. This was followed by those fruits applied with cattle manure and carbonized rice hull with 4.30 cm, next was plants applied with goat manure and carbonized rice hull with 4.27 cm, 4.24 cm from the control and last was from plants applied with vermicast and carbonized rice hull with only have 4.23 cm length. The figure 5 shows the graph of length of tomato fruit harvest. The result of analysis on fruit length harvested revealed no significant differences among

treatment means. Although not statistically different, result implied that applying horse manure to tomato plants will slightly give better results in terms of fruit length but not to a significant level.

Table 5. Length of tomato fruits harvested

Treatment	Replication			Total	Mean
	I	II	III		
A	4.29	4.26	4.43	12.98	4.33
B	4.30	4.33	4.27	12.90	4.30
C	4.27	4.29	4.25	12.81	4.27
D	4.24	4.27	4.19	12.70	4.23
E	4.17	4.26	4.28	12.71	4.24
Grand Total				64.10	
Grand Mean					4.27

LSD at 5% = 0.232; R Squared = 0.401 (Adjusted R Squared = -0.161)

This finding in fruit length this study was significantly longer that the fruit produced by 'Marvel' variety with 3.70cm, 'Diamante Max' with 3.71cm, 'Athena' with 3.27cm, and 'Makapuno' variety with 3.86cm and the shortest from 'Apollo' which has 3.13cm fruit length. Comparable to the fruits produced from variety 'Kalpana' with 4.58cm, 'Rocky 1' with 4.23cm, the 'Malakas 'with 4.33cm and 'Victory' that has 4.11cm fruit length. However, significantly shorter than 'Discovery' with 7.18cm length, 'Astig F1' with 5.33cm, 'Victory New' with 4.64cm, 'TM 03' variety with 4.87cm and 'Marimax' with 4.96cm variety. All produced in conventional cultivation in the semi-temperate conditions of Benguet, Philippines (Kimeu, 2021).

Fruit Diameter

The result of the study on fruit diameter found that the average of fruit diameter ranges from 40.40 to 46.99 mm. Treatment A had the highest mean among other treatments with 46.99 mm. Followed by treatment E with 40.75 mm. next was treatment B and D with 40.59 mm. The smallest diameter recorded was found in treatment C with only have 40.40 mm. The figure 6 shows the graph of tomato fruit diameter. The result of the analysis revealed that the application of horse manure and carbonized rice hull combined significantly affect the fruit diameter of tomato. As observed from the data, the fruits harvested from plants applied with this treatment had larger diameter compared to the fruits of other treatments (B to E) that has an average of 40.59, 40.40, 40.59 and 40.75 mm, respectively. The results indicated that tomato plants applied with horse manure and carbonized rice hull mixed resulted to larger fruits. As to the results in fruit length that plants applied with this treatment had slightly longer fruit compared to other treatments. Noticeably, based from the data most of the fruits harvested from plants applied this treatment were bigger in sizes compared to fruits harvested from other treatment. However, their weights were not that better as compared to those applied with cattle and goat manure both mixed with carbonized rice hull.

Table 6. Average fruit diameter of tomatoes harvested

Treatment	Replication			Total	Mean
	I	II	III		
A	40.97	50.13	49.88	140.98	46.99[a]
B	40.49	40.76	40.53	121.78	40.59[b]

Treatment	Replication			Total	Mean
C	40.47	40.46	40.27	121.20	40.40[b]
D	40.34	40.60	40.82	121.76	40.59[b]
E	40.93	40.65	40.66	122.24	40.75[b]
Grand Total				627.96	
Grand Mean					41.86

Means with different letter is significantly different by LSD at $P \leq 0.05$.
LSD at 5% = 0.024; R Squared = 0.644 (Adjusted R Squared = -0.501)

The fruit diameter in this study in was slightly smaller than the fruit produced by 'Rocky 1' with 5.05cm and 'Victory ' variety with 5.05 and the largest 'Discovery' variety that has 5.17cm. The diameter was also comparable to the fruits produced from variety 'Kalpana' with 4.11cm, 'Marvel' with 4.12cm, the 'Victory New' with 4.11 and 'TM 03' with 4.18cm fruit length. However, significantly larger than 'Astig F1' with 3.41cm diameter, 'Diamante Max' with 3.52cm, 'Marimax' with 3.42cm, ' Malakas' variety with 3,63cm 'Makapuno' with 3.57cm and 'Apollo' variety with 3.37cm variety (Kimeu, 2021).

Conclusion

The study it aimed to evaluate the plant height, number of days from flowering up to first harvesting, weight of fruits, number of fruits and size of fruits length (cm) and diameter (mm). The study was conducted off-season from May 2021 to July 2021 at the Crop Science experimental area, DEBESMSCAT, Mandaon, Masbate Philippines. A total of 300 seedlings was transplanted and arranged for treatments and replications. The study used 5 treatments with 3 replications and arranged in Randomized Complete Block Design. The treatments used in the study were the following: 40% HM + 10%Carbonized rice hull + 50%GS; 40%CM+10% carbonized rice hull + 50% GS; Treatment C - 40%GM+ 10% carbonized rice hull+50% GS; Treatment D - 40%VC +10% carbonized rice hull + 50% GS; Treatment E - 100% GS (control). Based on the results of the study the cattle manure and carbonized rice hull combination and goat manure and carbonized rice hull combination significantly affect yield of tomatoes in terms of weight and number of fruits. The application of horse manure in tomato plants slightly improved its fruit length and gave significantly bigger fruits in terms of diameter compared to other treatments. The average growth increment, average number of days from flowering to first harvest and average fruit length were not significantly affected by the different organic fertilizers and soil enhancer applied. Therefore, the different animal manure mixed with carbonized rice hull applied as fertilizer gave uniform response to the tomatoes in its vegetative stage. Combining or mixing all the treatments (animal manure) and carbonized rice hull applied in the study would give significant results to the organic production of tomatoes.

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