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The Effects of Aerobic Bokashi in the Production of Sweet 16-F1 Watermelon (*Citrullus lunatus*)

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Abstract

The study aimed to determine the effects of aerobic bokashi on the growth and yield of watermelon (Citrullus lunatus). Specifically, it was intended to determine the response of watermelon in terms of length of vine, girth of vine, days to flowering, weight of fruits, and yield per plot. The study also performed cost and return analysis. The study used a Randomized Complete Block Design (RCBD). The study used 12 experimental plots with 4 treatments and 3 replications. The treatments were the following; Treatment 1: 500 grams (g) of aerobic bokashi per hill, Treatment 2: 1000 grams, Treatment 3 - 1500 grams, and Treatment 4: control. The study was conducted off-season at Dr. Emilio B. Espinosa Memorial State College of Agriculture and Technology (DEBESMSCAT), Mandaon, Masbate, Philippines, from January to March 2021. The result of the study on levels of aerobic bokashi has no significant effect on vine length, vine diameter, days to flower, fruit diameter, and weight of fruits. However, in terms of fruit length and yield, the aerobic bokashi gave significant results. The fruit length and yield per plot were significantly different among the other treatments. This implied that the different levels of boskashi applied will give a different response in terms of fruit length and yield. The most viable result of the cost and return analysis was treatment A. The use of aerobic bokashi in watermelon cost PhP 1,391.00, this investment gave a net income of PhP 1,651.00 and a 118.69 % return on investment.

Keywords: Aerobic bokashi, Basal fertilizer, Fruit length, Organic matter, Watermelon

Introduction

In sustainable agricultural systems, managing soil fertility entails combining different techniques that enhance the chemical, physical, and biological qualities of the soil to maximize long-term crop production through the use of a system-wide strategy (Watson et al. 2002). Crop wastes, compost, vermicompost, or other organic residues have traditionally been added to the soil on a regular basis to add organic matter (Gong et al. 2009; Zucco et al. 2015).

Crop production initiatives must be synchronized with increased soil fertility primarily by the use of organic fertilizer. The utilizing organic fertilizers might aid in changing the microenvironment of the plant, which in turn can optimally increase crop output. Biological stuff can enhance fertility, structure, and will subtly maintain soil aggregation and porosity, thus it will keep the soil's ability to hold water intact. The use of organic fertilizers is also extremely common, reducing the use of synthetic fertilizers is crucial. The use of organic fertilizers the soil's biological, chemical, and physical characteristics, such as increasing soil cation and aeration exchange (Wijayanto et al., 2016).

Fertilizer availability frequently becomes a problem, bottleneck and in general, farmers' capacity to purchase of inorganic fertilizers is likewise quite low, particularly the availability and demand for organic fertilizer for the horticulture and the production of food crops are very important. If farmers simply use the manure from their animals, then it is undoubtedly insufficient, especially for agriculture that is largely widespread. Mostly, agricultural wastes that have been composted are being used as a plant growing medium or as fertilizer. Solid wastes from the agricultural production and rice industries can be gathered through time and can be broken down into compost or organic material that can be utilized as a medium fertilizer (Wijayanto et al., 2016).

The most frequent nutrient issue for the production of watermelon is a nitrogen (N) deficit. Nitrogen deficiency can negatively impact crop output and quality at any point throughout the growing season, but it can be particularly harmful when fruit sizes range from 4 to 6 inches in diameter. Producing watermelons for a particular market requires attention to fruit quality. Organic nitrogen sources used in soil amendments have been shown to improve soil quality and promote plant development by replenishing soil nitrogen (Audi et al., 2013).

Dr. Teuro Higa, a professor at the University of Ryukyus in Okinawa, Japan, created bokashi in the early 1980s; the phrase is translated from Japanese as "fermented organic matter." Bokashi contributes to the soil with a variety of microorganisms, including fungi, bacteria, and actinomycetes, which can enhance the health of the soil. It also contains a high concentration of organic matter and nutrients needed for plants, as well as high porosity and a high water-holding capacity (Silva et al. 2014; Restrepo and Hensel 2015). In comparison to compost, bokashi has the advantage that the majority of the organic carbon is preserved (rather than being lost as CO2) and can be stored in the soil. Bokashi fermentate has a substantially greater C:N ratio than compost (made of the same material), which encourages microbial activity. The C:N ratio also determines how quickly compost mineralsizes (Boechat et al., 2013). Bokashi can thereby increase soil aggregate abundance and stability by promoting microbial, meso-, and macro-fauna activity (Amezketa, 1999, Olle, 2021). Particularly in heavy soils, increasing aggregate availability and stability will improve soil drainage and aeration; in more coarse soils, organic matter instead raises the soil's capacity to hold water. According to a study, using Bokashi increases soil fertility (Ginting, 2019).

Therefore, adding bokashi to the soil enhances its characteristics and increases its organic matter content, supplying nutrients and decreasing nutrient leaching (Murillo-Amador et al. 2015). As with the application of compost, which is a popular practice in sustainable agriculture, bokashi might therefore be used widely to help boost the efficiency of how well crops utilise nutrients. The Bokashi method uses low-cost, nutrient- and energy-saving, greenhouse gas-reduction, and environmentally safe technology to create the organic fertilizers for agriculture that are required, thereby promoting the circular economy. A revolutionary method for enhancing food quality, yield, and plant health is bokashi technology. The application of this technology in Europe has enormous promise, however the appropriate approach must be created based on the knowledge of temperature regimes for EM that will influence crop production (Olle, 2021).

Watermelon, (Citrullus lanatus), succulent fruit and vine plant from the gourd family (Cucurbitaceae), native to tropical Africa and cultivated all over the world. The fruit contains vitamin A and a small amount of vitamin C and is generally consumed raw. The crust is sometimes conserved as a pickle. The watermelon annual plant thrives in hot environments. Its vines contain branching tendrils, deeply cut leaves, and blooms that are produced individually in the leaf axil. These vines grow on the ground (e.g., where the leaf joins the stem). Each pale-yellow flower has a male or female counterpart that solely produces pollen or fruit, accordingly. Large, intensely sweet fruits with tender flesh and fewer seeds are the result of domestication and selective breeding. Some recent cultivars marketed as "seedless" have essentially no viable seeds (Britannica, n.d.). Watermelon is a popular summertime vegetable crop; watermelon is a significant cucurbitaceous vegetable farmed throughout Asian countries. The crop is often grown from November to April, depending on the water supply. A hot, dry climate with warm days and cool nights is necessary for the crop. Many farmers prefer to plant their seeds in November, and harvest them in February because most do not have access to enough water throughout the summer. Despite the introduction of numerous types, farmers favor hybrids because of their high yield and sweetness, which help them sell for more money. Watermelon is a great fruit for deserts, and the juice is a tasty, energizing drink. Fruit is 92 percent water, 0.2 percent protein, 0.3 percent minerals, and 7 % carbohydrates in an edible flesh.

The general objective of the study is to determine the effects of aerobic bokashi on the growth and yield of watermelon (Citrullus lunatus). Specifically, it aims to determine the growth response of watermelon in terms of length of vine, girth of vine and days to flowering. Further, this study will determine the yield response of watermelon using different levels of aerobic bokashi in terms of weight of fruits and yield per plot. The study also performed the simple cost and return analysis. This study was conducted off-season at the experimental area of Dr. Emilio B. Espinosa Memorial State College of Agriculture and Technology (DEBESMSCAT), Mandaon, Masbate, Philippines from January 2021 to March 2021. The parameters of the study were limited to the levels of application of aerobic bokashi to watermelon.

Materials and Methods

Research Design and Experimental Unit

The study was laid out in Randomized Complete Block Design (RCBD) with four (4) treatments and 3 replications. Overall, the study used 12 experimental plots. The study used 4 treatments, 3 different levels of bokashi mixture and 1 control. The treatments were the following; Treatment 1 - 500 grams (g) of aerobic bokashi per hill, Treatment 2 - 1000 grams of aerobic bokashi per hill, Treatment 3 - 1500 grams of aerobic bokashi per hill, and Treatment 4 - control (no application). The total area of the experimental site was 247.5 square meters. Each plot has a dimension of 3 meters (m) x 5 m and provided with 0.5 m size canal. Each plot was planted with 15 water melon seedlings. Every plant was planted with 1.0 m between hills and 1.0 m between rows. Overall, a total of 180 water melon seedlings were used in the study.

Materials and procedure

Cattle dung, molasses, fermented plant and fruit juice extract, as well as indigenous microorganisms (IMO) were used for the treatment preparation in the study. The seeds that were used in the study were procured from Agrivet supply in Cabitan, Mandaon, Masbate. Gardening tools were used to prepare the plots and cultivation. Sprinkling cans were used to water the plants. Plastic cups were used for seed sowing and prepare the seedlings. A meter stick and caliper were used to measure the parameters that were observed. Marker pens and a record book were used to collect and record the data. The bamboo sticks were also used to mark and label the plots.

Sowing of seeds and seedling preparation.

The seeds were soaked for 24 hours to ensure the possible highest germination rate of the seeds. After the soaking, the seeds were carefully sown in a plastic cup (one seed per cup). Three days after sowing (DAS), the seeds already germinated. Constant monitoring and regular watering were made to maintain the moisture content needed by watermelon seedlings. Ten DAS, the seedlings were hardened for 4 days before the transplanting.

Preparation of area

The experimental area was ploughed and harrowed twice to properly invert the soil and bury the grass. After the harrowing, the selected area was preparation for the lay-outing of plots for the study. This was done this was done by uprooting of newly germinated weeds and debris. After cleaning, the plots were laid out according to the research design. 12 plots were made with 3.0 m width and 5.0 m length. A 0.50 m canal was also constructed in between plots. The canal served as passageway during the care and maintenance and the same time served as drainage of experimental area.

Treatment preparation

Aerobic bokashi used two types of ingredients, the solid and liquid. The solid ingredients include the following: carbonized rice hull, rice bran and decomposed carabao manure, it should have 80:20 carbons to nitrogen ratio (the carbon to nitrogen ratio was based on the total weight of entire treatments to be used in terms of kilograms). The liquid ingredients include the following, fermented fruit juice, fermented plant juice, indigenous microorganism, and molasses. Each concoction was diluted in 60 liters unchlorinated water, 20 ml per liter dilution rate based on the Philippine National Standard on Organic Agriculture. The mixing area should be cleaned and if possible, the floor is concrete with roof covering for proper mixing, it should be away from direct sunlight and rain. Mixed the solid ingredients, while mixing gradually add the water diluted with different concoctions, make sure that the liquid ingredients were evenly distributed on the solid ingredients. Continue mixing the mixture, until its moisture content becomes 30 to 40 percent (the 30 to 40 percent moisture content is determined when you strongly squeeze the bokashi, there is no dripping water coming out between your fingers). When it is well mixed. Cover the mixture with gunny bags, plastic, sacks or any material that can protect the mixture while it's on fermentation stage. The mixture was fermented seven days, during the fermentation process the heat temperature of the mixture was increased, turn over the mixture if it exceeds 50-degree Celsius, once a day, every day for seven days until it cools down its temperature. After seven days, aerobic bokashi is ready to use when it has a sweet-sour smell and its temperature is stable. Dry without direct sunlight. Placed it in sacks, and store in a cool, shady and dry place. Aerobic bokashi can be kept for 6 months under good storage condition.

Application of treatments

Aerobic bokashi was applied one (1) week before transplanting for further decomposition as basal fertilizer. To stabilize the pH and the biological activity of the microorganisms at the level of the different bokashi. After it has fermented sufficiently, the finished bokashi should be buried in holes or trenches in the garden under at least 15-20 cm (6-8 in.) of soil to keep it from being disturbed. Mixing soil with the bokashi will help the speediness of final decomposition process (Houenou et al., 2021).

Transplanting

Fourteen days after sowing, the seedlings were transplanted in the plots laid out based on the research design. A hole dug and applied with treatment 7 days before the transplanting were inserted with watermelon seedlings and backfilled with garden soil. The transplanting was done in the late afternoon to avoid direct sunlight and plant stress. After the transplanting irrigation was done to provide the soil moisture needed by plants. One seedling was planted per hill. Overall, 180 seedlings were transplanted in the plots for 4 treatments and 3 replications.

Cultural management

Water management. Regular irrigation was employed in the watermelon on a daily basis (except during rainy days), early in the morning and late in the afternoon to maintain the soil moisture content viable for plant growth and development.

Weeding and cultivation. Watermelon has a shallow root system so weeding and cultivation were done manually using dull bolo to keep the area free from weeds and to avoid plant competition with nutrients and sunlight. Cultivation was also employed so the roots can easily penetrate into the soil and to improve the soil aeration.

Pest management. Pest damage can deteriorate the quality and reduce the quantity of products. Cultural management and biological control were used in this study to manage the pest. As such, hand-picking of insect pest and spraying of chili extract solution were employed.

Harvesting. Harvesting watermelon was done in the afternoon/late in the afternoon when the vine tendril is withering and change in belly color and if mature fruits when thumping give dull sound. Fruits were harvested by cutting the vines using a harvesting tool such as sharp knife and cutting scissors. Harvested fruits were piled in a shaded area to maintain its freshness and quality of products.

Data Gathering

The following parameters were observed and gathered in the study based on research design and objectives. The data collected were both for growth and yield variables from ten randomly selected sample plants of each plot. The growth parameters were length of vine, girth of vine and number of days to flowering. While the yield parameter includes, the diameter of the fruit, length of the fruit weight of fruits, yield per plot, and cost and return analysis.

Growth parameter

Length of vine. Vine length was measured from the base of each plant to the growing point of a main vine using meter stick in terms of centimeters of the ten (10) randomly selected sample plants. This was gathered at 7 days interval. The vine length data gathering was terminated as soon it bears 2 to 3 fruits. The top shoots were pruned to promote healthier vines and increase fruit size. Vine length was measured with a flexible tape rule from the ground level to the tip of the three randomly selected plants and the mean computed. A main vine was chosen from those beginning close to the base of the plant and extending farthest from the base (Law-Ogbomo et al., 2018).

Girth of vine. Vine girth was measured at the base of plant using caliper in terms of centimetre. Vine girth was taken 5 cm above ground level on each of the randomly selected plants by the use of vernier calliper and average computed (Law-Ogbomo et al., 2018).

Number of days to flowering. The number of days to flowering were counted and recorded from planting up to the onset of first flower appear.

Yield parameter

Data collected on yield parameters were fruit Length (cm) measured with a flexible tape rule, number of fruits that were counted during harvesting, fruit diameter (cm) measured using a flexible tape and fruit weighed using a digital weighing balance. Harvesting was done by carefully cutting off the peduncle of matured fruits from the vine.

Diameter of the fruit. Fruit diameter was measured from the base of each plant to the growing point of a main vine using meter stick in terms of centimeters of the ten (10) randomly selected sample plants. This was gathered at 7 days interval.

Length of fruit. Fruit length were measured from the base of each plant to the growing point of a main vine using meter stick in terms of centimeters of the ten (10) randomly selected sample plants.

Weight of fruit. The average weight of fruits per plants were weighted after harvesting using weighing scale in terms of kilograms.

Yield of watermelon. The total yield of fruits per treatment were weighed after the harvesting using standard weighing scale in terms of kilograms.

Cost and return analysis

The cost of all production inputs including seeds, labor, ingredients for formulating the treatments and other expenses were summed. Base from the total yield the gross sale was computed. To compute the net income the total expenses incurred in the production was subtracted from gross income. The return on investment (ROI) was computed from the net income over total expenses multiplied by 100, since ROI is in percentage.

Data Analysis

The data were analyzed using Analysis of Variance (ANOVA) in a Randomized Complete Block Design (RCBD) having four treatments and 3 blocks. Further analysis will be aided using LSD for pair comparison between treatment means.

Results and Discussions

Vine length

The results of study on vine length ranged from 115.67 centimeters (cm) to 168.88 cm. The treatment A had the longest vine with 168.88 cm, followed by treatment B that has 151.70 cm, treatment C with 142.43 cm and the last was the control with 115.67 cm vine length. As the data presented in the table 1, it was observed that watermelon planted in plots with 500 grams of aerobic bokashi (Treatment A) had a slightly longer vines compared to the other treatments in all measurement scheduled as well as in the overall tabulation. The results also found that the watermelon in control had slightly shorter vines. The statistical analysis revealed no significant differences among the treatment means in all the measurements conducted. This implied that the aerobic bokashi in this study has no significant effect on the vine length of watermelon. The vine length of watermelon considerably influenced by plant population and fertilizer types. The longer vines were observed on plants applied with 500 g of bokashi per hill compared to control plants. Similar to the study reported that fertilizer types had a significant effect on vine length. All fertilized plants were statistically had the same vine length, but significantly longer than untreated plants (Law-Ogbomo et al., 2018). The result of study on treatment A in terms of vine length was significantly higher on the vine length of watermelon that used organic and NPK fertilizers conducted last 2013 and 2014. In 2013, the longest vine length reported has 155.12 cm applied with NPK and 152.80 cm using poultry manure 70 days after planting (DAP). And in 2014 that have 161.48 cm using NPK and 161.14 cm using poultry manure both 70 DAP (Eifediyi et al, 2017). Furthermore, the result of this study is significantly higher to results of study on the effects of in-row plant spacing and mycorrhiza on watermelon main vine length conducted last 2003, 2004, and 2005 that has highest average length of 23.2 cm using mycorrhiza, 55.6 cm and 33.2 cm, respectively (Ban et al., 2011). These results confirmed that the application of bokashi improve the soil conditions that is favorable in plant growth, it increase soil biological life and enhance the availability and the balance of nutrient cycling through nitrogen fixation, nutrient absorption, addition and cycling of external fertilizers (Wijayanto et al., 2016).

Table 1. Vine length (cm) of watermelon

Treatment	R1	R2	R3	Treatment Total	Mean
A- 500 g AB	201.35	139.90	165.40	506.65	168.88
B-1000 g AB	122.90	207.70	124.50	455.10	151.70
C-1500 g AB	137.90	125.90	163.50	427.30	142.43
D- Control	68.80	128.35	149.85	347.00	115.67
Replication Total	**530.95**	**601.85**	**603.25**		
Grand Total				**1736.05**	
Grand Mean					**144.67**

CV = 28.25

Vine girth

The results of study on vine girth ranged from 0.53 cm to 0.63 cm. The treatment A found with largest vine girth with 0.63 cm, followed by treatment C with 0.60 cm, next was treatment B with 0.58 cm and the last was under the control with only have 0.53 cm vine girth. The girth (diameter) of vine in the table 2 showed that the watermelon planted with aerobic bokashi is slightly bigger than the control. The results of statistical analysis showed no significant differences among the treatment means in all observation period. Having all same results, this implied that bokashi application in terms of its levels in this study does not have a direct effect on the diameter of vines. The result of a study on vine diameter was significantly higher compared to the vine diameter of watermelon planted in different in-row plant spacing and mycorrhiza in 2003, 2004 and 2005, that has 0.5 cm, 0.49 cm and 0.39 cm respectively, (Ban et al., 2011). This plant response might be due to the effect of bokashi from cow manure that help improve physical properties of soil, particularly improving the soil structure and the ability of the soil to absorb water, and supply nutrients for plants. The application of organic fertilizer into the soil in the form of bokashi compost will directly increase the content of soil organic matter because it has a high content of organic matter (Ansar et al., 2021).

Table 2. Vine diameter (cm) of watermelon

Treatment	**R1**	**R2**	**R3**	**Treatment Total**	**Mean**
A- 500 g AB	0.73	0.58	0.59	1.90	0.63
B-1000 g AB	0.56	0.67	0.52	1.75	0.58
C-1500 g AB	0.59	0.58	0.63	1.80	0.60
D- Control	0.49	0.55	0.56	1.60	0.53
Replication Total	**2.37**	**2.38**	**2.30**		
Grand Total				**7.05**	
Grand Mean					**0.59**

CV = 11.93

Days to flowering

The days to flowering of watermelon was shown in table 3. The results of this study on days to flowering found that the flower development of watermelon ranged from 18.63 days to 21.0 days. An early flowering was observed in the watermelon plants under control. The treatment B had the longest time to flowering in 21 days, followed by treatment A with 19.67 days and treatment C with 19.33 days, respectively. This might be due to the effect of bokashi application that delayed the flowering initiation of watermelon. It was observed that the group of watermelon applied with bokashi produces longer and larger vines compared to control before the first flowering. The statistical analysis revealed no significant differences among the treatment means in term of days to flowering. The result implied that different levels of bokashi applied in this study does not have a direct effect on the flowering stage of watermelon. Mostly, the first male flower and female flower initiation depends on the cultivar and climatic conditions. The results of study on the number of days to flowering from DAT were comparable to the study reported that has 19.1 days for the first staminate flower developed by ‘Jenny’ watermelon variety in 2012 and 24.4 days of ‘SP 6’ watermelon in 2013. However, earlier than 27.6 days of ‘Fascination’ in 2012 and 32.7 days of ‘Super Seedless 7197’ in 2013 (McGregor et al., 2014). The days before flowering from the DAT might depend on the cultivars, poor seed germination, soil type, irrigation interval and climatic condition in the area.

Table 3. Number of days to flowering

Treatment	R1	R2	R3	Treatment Total	Mean
A- 500 g AB	18.90	21.50	18.60	59.00	19.67
B-1000 g AB	22.70	18.40	21.90	63.00	21.00
C-1500 g AB	17.20	22.00	18.80	58.00	19.33
D- Control	20.10	18.50	17.30	55.90	18.63
Replication Total	78.90	80.40	76.60		
Grand Total				235.90	
Grand Mean					19.66

CV = 11.30 *Not significant*

Diameter of the Fruit

The average diameter of fruits harvested was presented in the table 4. The results on fruit diameter ranged from 23.60 cm to 26.33 cm. The treatment A watermelon applied with 500 grams aerobic bokashi had the biggest diameter with 26.33 cm, followed by watermelon fruits in treatment B with 25.64 cm, next was fruits in treatment C with 25.52 cm and last was found in control plants with 23.60 cm fruit diameter. The overall results showed slightly bigger watermelon fruits were in plants applied with aerobic bokashi. It was observed that the larger diameter fruits were developed from larger and longer vines of plants treated. The statistical analysis revealed no significant differences among the treatment means in terms of fruit diameter in all observation periods. This implied that the different levels of bockashi applied in this study had no direct effect on the diameter of the fruit. The result of this study on fruit diameter was comparable to the watermelon diameter report that has 25.3 cm of Crimson Diamond (PI 600950) variety evaluated at Uvalde and Weslaco, Texas in 2018 and 2019 (Correa et al., 2020). However, slightly smaller than the highest major diameter of watermelon fruit reported that has a 27.07 cm (Khater et al., 2016). The fruit diameter in this study was significantly higher compared to the watermelon diameter reported using organic and inorganic materials conducted in 2013 and 2014. The highest diameter recorded was 14.75 cm (cow dung) and 15.01 cm (NPK) in 2013 and 15.17 cm (neem cake) and 15.33 cm (NPK) (Eifediyi et al., 2017).

Table 4. Average diameter (cm) of fruit

Treatment	R1	R2	R3	Treatment Total	Mean
A- 500 g AB	25.70	28.61	24.69	79.00	26.33
B-1000 g AB	26.00	26.04	24.89	76.93	25.64
C-1500 g AB	25.21	25.46	25.90	76.57	25.52
D- Control	23.69	22.87	24.24	70.80	23.60
Replication Total	**100.60**	**102.98**	**99.72**		
Grand Total				**303.30**	
Grand Mean					**25.28**

CV = 4.82 *Not significant*

Length of the Fruit

The result of study on fruit length ranged from 24.07 cm to 27.76 cm. The longest fruits in this study were recorded in treatment A watermelon plants applied with 500 grams aerobic bokashi with 27.76 cm fruit length. Next was the fruits from treatment B with 26.61 cm, followed by fruits in treatment C with average fruit length of 26.61 cm and the last was fruits from the control that has

24.07 cm. The result on fruit length was presented in the table 5. Results showed that watermelon plants in treated group have longer fruits. The fruits of plants applied with 500 grams of aerobic boskashi have slightly longer fruits than fruits of watermelon applied with 1000 grams and 1500 grams, respectively in all periods of data gathering. The shortest fruit in this study was recorded in the control (no aerobic bokashi application). The results of statistical analysis revealed significant differences among the treatment means in all the weekly measurements. This implied that the different levels of aerobic bokashi applied in watermelon significantly affect the fruit length. Further analysis of fruit length using LSD revealed that the treatment A (watermelon applied with 500 grams) is significantly different from treatment B and C, and watermelon fruit length in treatment D (control). The fruit length of watermelon on treatment B and C are significantly different on treatment D as presented in the table 5. The result of study on length of fruit was comparable to the watermelon length categorized as large size that has 28.77 cm reported (Khater et al., 2016). However, significantly shorter than 39.5 cm of ‘Calhoun Gray’ and 41.5 cm of ‘Sunshade (PI 635726)’variety reported (Correa, et al., 2020).

Table 5. Average length (cm) of fruit

Treatment	**R1**	**R2**	**R3**	**Treatment Total**	**Mean**
A- 500 g AB	27.33	29.39	26.57	83.29	27.76[a]
B-1000 g AB	26.47	27.43	25.94	79.84	26.61[ab]
C-1500 g AB	27.25	25.42	27.09	79.76	26.59[ab]
D- Control	24.56	22.94	24.71	72.21	24.07[b]
Replication Total	**105.61**	**105.18**	**104.31**		
Grand Total				**315.10**	
Grand Mean					**26.26**

CV = 4.71 *Significant*

Average Weight of Fruits

The result of study on the weight of watermelon fruit ranges from 1.76 kg to 2.63 kg. The heaviest average fruit weight recorded was from treatment A (plant applied with 500 grams aerobic bokashi) with 2.63 kg, followed by fruits from treatment C that have 2.33 kg, next was 2.31 kg from treatment B and the last was fruits from Treatment D with 1.76 kg. The average weight of the fruits was presented in table 6. Based from the observation watermelon plants under control have delayed maturity as its fruit was only available to harvest at the second and third period. It was also observed that the watermelon plants applied with bokashi showed slightly heavier fruits than of under control. The results in terms of average weight of fruits revealed that 500 grams of aerobic Bokashi produce heavier fruits than of the other treatments. However, the analysis of result showed no significant differences among the other treatments in the three harvesting period and in overall harvest. The weight of watermelon fruit in this study is slightly lighter than the watermelon that has 2.95 kg in 2005 and 4.87 kg in 2006 both applied with poultry manure (Dauda et al. 2009) and watermelon produced using organic and inorganic materials that has 4.10 kg fruit weight applied with NPK and 4.10 kg (heaviest in organic) using poultry manure in 2013, 4.10 kg fruit using NPK and 3.90 kg fruit applied with poultry manure in 2014 (Eifediyi et al., 2017). The result of this study on fruit of watermelon in terms of weight per fruit might be affected by climatic condition during crop season (peak of dry season) and insufficient irrigation water in the area. Water stress caused a significant effect in fresh weight of most fruits. Reduction of fruit fresh weight as a result of water stress is expected in the dry season of Philippines. Since the soil moisture content and water potential is extremely correlated with plant relative water content.

Table 6. Average weight (kg) of fruits

Treatment	R1	R2	R3	Treatment Total	Mean
A- 500 g AB	2.65	3.19	2.06	7.90	2.63
B-1000 g AB	2.44	2.41	2.09	6.94	2.31
C-1500 g AB	2.25	2.22	2.52	6.99	2.33
D- Control	1.88	1.58	1.82	5.28	1.76
Replication Total	**9.22**	**9.40**	**8.49**		
Grand Total				**27.11**	
Grand Mean					**2.26**

CV = 15.20 *Not significant*

Yield of Watermelon

The results of study on the average yield per plot range from 14.21 kg to 25.23 kg. The treatment A had the highest recorded yield with 25.35 kg, followed by treatment B with 18.62 kg, next was treatment C with 17.38 kg and the last was under the control (treatment D) with only have 14.21 kg harvest per plot. The yield of watermelon per plot was presented in table 7. The result revealed that the aerobic bokashi as basal fertilizer has a direct effect on yield of watermelon. Statistical analysis showed significant differences among the treatments. The 500 grams aerobic bokashi applied as basal fertilizer gave more and larger fruits that resulted in a higher yield. Comparison of means using LSD, further revealed that the treatment A is significantly different from treatment B and C, as to treatment D (control) as shown in the table 5. The treatment B and C were also significantly different from treatment D. This implied that the different levels of aerobic bokashi applied in watermelon as basal fertilizer gave significant results among each treatment in terms of yield. However, it was observed that the overall yield of watermelon in this study was greatly affected by hot climatic condition and limited irrigation interval.

Table 7. Yield (kg) of watermelon

Treatment	R1	R2	R3	Treatment Total	Mean
A- 500 g AB	24.30	29.15	22.60	76.05	25.35^{a}
B-1000 g AB	19.30	15.70	20.85	55.85	18.62^{ab}
C-1500 g AB	18.90	18.15	15.10	52.15	17.38^{ab}
D- Control	16.90	9.23	16.50	42.63	14.21^{b}
Replication Total	**79.40**	**72.23**	**75.05**		
Grand Total				**226.68**	
Grand Mean					**18.89**

CV = 4.71 *Significant*

Cost and Return Analysis

The viability and applicability of technology or business is easily described by simple cost and return analysis. The study on watermelon applied with different levels of aerobic bokashi as basal fertilizer found that the treatment A (use of 500 grams aerobic bokashi) gave the highest net income of PhP 1,651.00 and return on investment (ROI) of 118.69 %. These were based from the labor cost, material inputs, total yield and price of watermelon as presented in table 8. Next was the treatment B with PhP 748.00 net income and 50.34 % ROI. Then it was followed by treatment C that has PhP 505.00 net income and 31.94 % ROI, the last was treatment D with only have PhP 409.02 net income and 31.57% ROI. The plants in control plots had lower material inputs, hence they were not applied with aerobic bokashi as basal fertilizer. However, based on the plant response specifically in terms of yield the control treatment had the lowest performance thus this rested to lower net income and return on investment. The treated group of watermelon (applied with aerobic bokashi) has higher material inputs compared to control, however plant in the group had better response in terms growth and yield performance, specifically in yield that resulted to slightly higher net income and return rate.

Table 8. **Cost and return analysis**

Particulars	**Treatment**			
	A	**B**	**C**	**D**
Labor Cost				
Plowing	62.50	62.50	62.50	62.50
Harrowing	62.50	62.50	62.50	62.50
Plot construction	250.00	250.00	250.00	250.00
Care and management	500.00	500.00	500.00	500.00
Logistics	250.00	250.00	250.00	250.00
Total cost (PhP)	**1,125.00**	**1,125.00**	**1,125.00**	**1,125.00**
Materials Inputs				
Seeds	135.00	135.00	135.00	135.00
Plastic cups	36.00	36.00	36.00	36.00
Molasses	70.00	140.00	210.00	-
Cattle manure	25.00	50.00	75.00	-
Total cost	266.00	361.00	456.00	171.00
Total Expenses (PhP)	**1,391.00**	**1,486.00**	**1,581.00**	**1,296.00**
Sales and Income				
Total yield (kg)	76.05	55.85	52.15	42.63
Market price (PhP)	40.00	40.00	40.00	40.00
Gross Income (PhP)	**3,042.00**	**2,234.00**	**2,086.00**	**1,705.20**
Net Income (PhP)	**1,651.00**	**748.00**	**505.00**	**409.20**
ROI (%)	**118.69**	**50.34**	**31.94**	**31.57**

Conclusion

The study aimed to determine the effects of aerobic bokashi on the growth and yield of watermelon (Citrullus lunatus). Specifically, it aims to determine the growth response of watermelon in terms of length of vine, girth of vine and days to flowering. Further, this study will determine the yield response of watermelon using different levels of aerobic bokashi in terms of weight of fruits and yield per plot. The study also performed the simple cost and return analysis. The study used the Randomized Complete Block Design (RCBD) with four (4) treatments and 3 replications. The study used 12 experimental plots for the 3 different levels of bokashi mixture and 1 control treatment. The study used Treatment 1 – 500g of aerobic bokashi per hill, Treatment 2 - 1000g of aerobic bokashi per hill, Treatment 3 - 1500g of aerobic bokashi per hill, and Treatment 4 - control (no application). The study constructed 12 plots with 3 m width and 5 m length. The layout was provided with 0.5 m size of canal between plots. The study used 15 watermelon seedlings per plot and spaced 1.0 m between hills and 1.0 m between rows. A total of 180 watermelon seedlings were used in the study and 10 sample plants were observed for data gathering. The study used cattle dung, molasses, fermented plant and fruit juice extract, as well as indigenous microorganisms (IMO) for the treatment. The study is limited to the growth and yield response of watermelon applied with levels of aerobic bokashi as basal fertilizer.

The result of study concluded that the used of different levels of aerobic bokashi as applied as basal fertilizer has no significant effect on growth in terms of vine length, vine diameter and days to flower, and on yield parameters in terms of fruit diameter and weight of fruits. The treatment A had better response in growth and yield among other treatments. However, in terms of fruit length and yield per plot, the application of aerobic bokashi gave significant results. The fruit length and yield per plots were significantly different among other treatments. This implied that the different levels of boskashi applied as basal fertilizer will give a different response in terms of fruit length and yield. The most viable result of cost and return analysis was in treatment A. The used of aerobic bokashi in watermelon cost PhP 1,391.00, this investment gave a net income of PhP 1,651.00 and 118.69 % return on investment. Based on the results and interpretation of the data gathered, further research on the application of aerobic bokashi was recommended. Based from the results of cost and return analysis, aerobic bokashi is recommended as basal fertilizer to the farmers.

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