Effect of Banana Stem Compost on Pak Choi (*Brassica rapa chinensis L*) Groth

Wan Aminuddin Wan Aman
Jabatan Agroteknologi & Bio-Industri,
Politeknik Jeli, Jalan Raya Timur-barat, 17600 Jeli, Kelantan, Malaysia.
Emel: aminuddin@pjk.edu.my

Abstract

Compost derived from banana stem could be added as a mixture in nursery medium for growing Pak Choi (*Brassica rapa chinensis L*). In general, the cultivation of pak choi using banana stem medium has been carried out at Politeknik Jeli, Kelantan. The aim of study is to identify the effectiveness of the banana stems compost on pak choi growth and determine ability of banana stem to retain water. The comparison between compost banana stem and normal soil were made. The parameters recorded are plant height, leaf width, pH soil, soil moisture, relative humidity, and also water potential. After 2 month of study, overall result shows that the pak choi plant using banana stem compost recorded the highest height of plant which is 9 cm and largest size of leaf width pak choi plant which is 3.1 cm. Meanwhile, pak choi plant in soil medium recorded the lowest height of plant which is 8.4 cm and the size of leaf width is 2.7 cm. For relative humidity, the air temperature decreases and causes the relative humidity increases. Soil moisture in compost banana stem recorded 0.8m^3 and give good effect on pak choi growth. For water potential, compost banana stem and soil medium show the negative cause of water move from soil into plants root via osmosis. The pak choi in banana stem compost recorded the better growth rate than on soil medium. This happens due to the root of pak choi on banana stem compost intake more water than in soil medium.

Keywords: Banana stem, pak choi, Brassica rapa chinensis L, growth

1 Introduction

Compost is organic matter that has been decomposed and recycled as a fertilizer and soil amended (Haug, 1993). Compost is a key ingredient in organic farming and basically, composting requires only a pile of waste in rural areas and waits for these materials decompose in six weeks or more (Haug, 1993). Modern composting methods using several process steps, closely monitored by the ingress of water, air, and carbon-rich material and nitrogen (Haug, 1993). Composting process is assisted with shredded plant material, add water and ensure proper ventilation with heaves mixture periodically and worms, fungi decompose more (Haug, 1993). The aim of this project to see the effectiveness of compos banana stem on pak choi growth and also on low fertility soil. In agriculture, banana stems uses as substrate for compost because banana stem could be enriched with nitrogen and phosphorus that needed for plants (Feriotti and Iguti, 2009). The use of renewable agricultural such as banana stem also can use by product for pulp production as non – wood cellulosic fiber would be great advantage for countries with limited wood forest and would increase the profit of farmers in developing countries (Ganan, Zuluage, Velez & Mondragon, 2004).

2 Material & method

2.1 Preparation of compost banana stem

Firstly, the materials such as banana stem, rice straw, Effective Microorganism (EM), top soil, nutrient fertilizer and equipment for cutting were prepared. After that, the banana was cut into the small pieces about one until two centimeter. Then, those three media were put in the canvas. Then, banana stem, rice straw and top soil were mix until well mixed. Later, a little of nutrient fertilizer and EM were put on media. Measuring liquid EM according to the required ratio (5ml EM:1L water) and mixed thoroughly into the media. Lastly, the media were kept in a sealed container and were placed in a shady place. The media were stirred every week to keep media in moist condition and well. The compost will be used on the plant after 2 week.

2.2 Planting pak choi in the normal soil medium

The first step was sowed the pak choi seed with the peat moss in the tray. After two weeks, pak choi was transferred into the polybag that have normal soil medium. The data was taken for every week based on the height of plant, leaf width, soil moisture, water potential and relative humidity. After 40 days, the pak choi ready to harvest.

2.3 Planting pak choi in the compost banana stem

The first step was sowed the pak choi seed with the peat moss in the tray. Then, after two weeks, the pak choi plant was transferred into the polybag that have normal soil mixed with compost banana stem at ration 7:3:2. The data will be taking based on the height of plant, leaf width, soil moisture, water potential and relative humidity for every week until harvest. After 40 days, the pak choi plant ready to harvest.

2.4 Collected data on pH, soil moisture, water potential and relative humidity

Instrument use for collecting pH data is by using pH meter. The pH meter were takes and recorded based on two different soils that is soil medium, and compost banana stem. Every week, plant height and leaf width of plant was taken by using ruler. For soil moisture, water potential and relative humidity, the data was collected for 3 minute with 1 minute interval time for each polybag and the data is recorded using Decagon data logger. The sensor was used to collect data on soil moisture, water potential and relative humidity. The relative humidity data was taken using P1 – RH VP – 4, for soil moisture using P5 - m^3/m^3 VWC 5TM and for water potential data, the data show in P2 – kPa Potential MPS – 2. The water potential, soil moisture and relative humidity are important in the cultivation of pak choi to see the water holding of plant and the levels of soil moist during pak choi growth.

2.5 Sampling technique

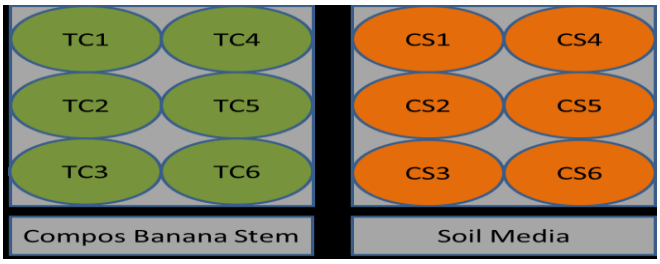

Figure 2.1: Sampling Technique

Technique for sampling, we are using completely randomized designs (CRD) for studying the effects of one primary factor without the need to take other nuisance variables into account. In a completely randomized design, treatment levels or combinations are assigned to experimental units at random. This is typically done by listing the treatment levels or treatment combinations and assigning a random number to each. Based on the Figure 2.1, we had six replication and a total of 12 experimental units (a potted plant) and we had arranged the polybag. Symbol TC is represent for treatment of compost banana stem, and CS is represent for a normal media soil. The data had been taken and recorded for each plant in polybag from TC 1 until TC 6 and also from CS 1 until CS 6. The treatment and control was used plant booster and the provision of water in each polybag is 250 ml for morning and 250 ml for evening. The data was taken for every week based on the height of plant, leaf width, soil moisture, water potential and relative humidity.

3 Result and Discussion

Table 3.1: pH soil and compos banana stem result

Sample of pH / Sample of media	pH sample (1)	pH sample (2)	pH sample (3)	Average of medium pH
Soil	**6.95**	**6.89**	**6.92**	**6.92**
Compos banana stem	**7.31**	**7.29**	**7.34**	**7.31**

Based on the Table 3.1, there are two samples from different media, which is soil media and compost banana stem. The average of pH value of the soil sample and compost banana stem is at 6.92 and 7.31 respectively, which is higher than acceptable pH for cultivation which is pH 5.5-6.5. Higher pH value can cause deficiency in macro and micronutrient intake for plant, but the usage of fertilizer and plant booster can reduce the effect of nutrient deficiency due to higher pH.

Other than that potential of hydrogen (pH) is a value (on a scale of 0-14), which describes the relative amount of H+ ions in the soil solution. Soil solution is called acidic if the pH is in the range of 0-6 means that the solution contains more H+ ions than OH- ions. Otherwise, the number of H+ ions in the soil solution is smaller than OH- ions in the soil solution are alkaline conditions or has a pH value of 8 - 14. The pH of a soil will change over time influenced by factors including parent material, weathering and current agricultural practices. Soil pH will affect how plants grow. Based on Table 3.1, the acidic of soil medium content in the soil is 6.92 cause of content of zinc and sulphate excess. The pH of compost banana stem recorded 7.31 and can be classified as neutral condition. This is because banana stem from the organic material and natural.

3.1 Leaf width and plant height

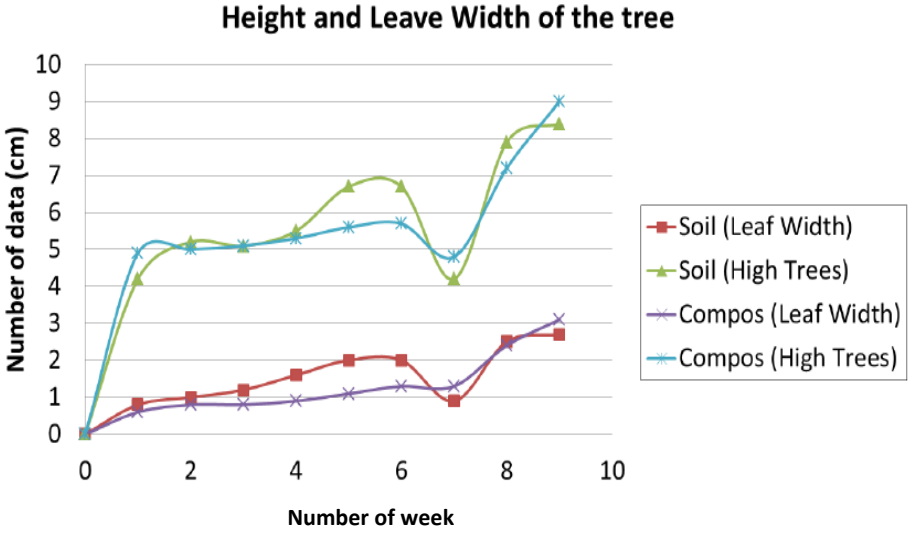

Figure 3.1: Graph of height and width vs no. of week

Based on the Figure 3.1, overall result shows that the pak choi plant using banana stem compost recorded the highest height of plant which is 9 cm and largest size of leaf width pak choi plant which is 3.1 cm. Meanwhile, pak choi plant in soil medium recorded the lowest height of plant which is 8.4 cm and the size of leaf width is 2.7 cm.

For the compost banana stem, we had used banana stem, top soil and sandy soil at the ratio of 7:3:2 respectively. Based on our observation, to keep medium stay moist, banana stem can be used in cultivation because it contain fiber which have high water content and moisture that can retain water and nutrient in soil media (Sunarjono, 2004). In addition Sunarjono, (2004), also has stated that the banana fiber has content 80 – 90 % of water and banana fiber or banana stem also contain nutrients such as phosphorus, and potassium as well as to improve the quality of compost and soil. The size of the banana stem cut also should be focus during composting because the

period of decomposition also depends on the size of banana stem. Besides, we were using EM as the agent for the decomposing banana stem. Otherwise, we were used organic plant booster as the fertilizer to help in boosting the growth rate for the pak choi plant.

In the other hand, pak choi which has been cultivated with normal soil media shows the lowest growth rate due to low water retaining compare to compost banana stem, although have same ratio of top soil and sandy soil except there is no banana stem in normal soil.

3.2 Relative humidity (RH)

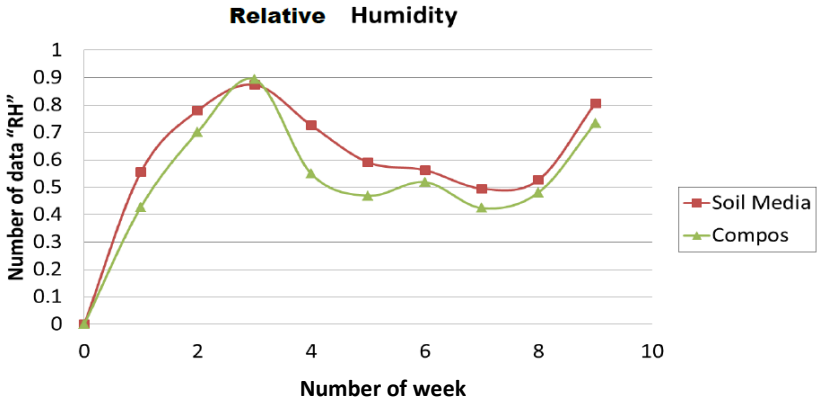

Figure 3.2: Graph of RH vs no. of week

Figure 3.2 show that RH for both treatments is not significantly different due to area of cultivation is at the same area. Week 3 recorded the highest RH compared to the other week with compost banana stems recorded the highest of relative humidity that is 0.9g/m^3 and 0.8g/m^3 for soil medium. It is because of raining that cause temperature to drop and significantly increase the RH. Other than that, from week 4 to 8 show that RH is fluctuate due to unpredictable weather condition than rain again at week 9.

Therefore, other factors involved in changing RH also relate to the pressure of water vapor at a certain temperature. This is due to the hot weather and the water vapor rises due to the occurrence of the heat caused by the high humidity. The decline that occurred in for both treatment is caused by environmental conditions that occur during data capture.

3.3 Water Potential (WP)

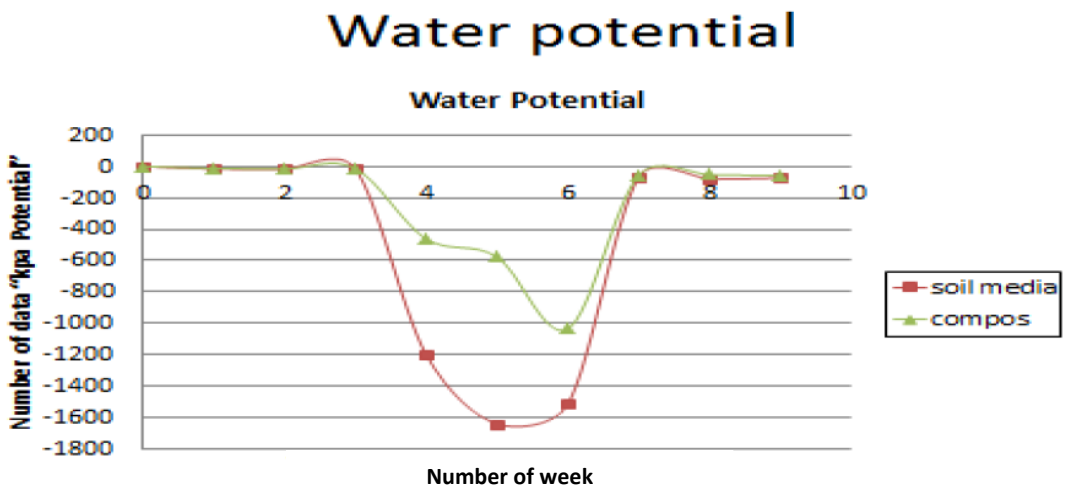

Figure 3.3: Graph of WP vs no. of week

Based on the Figure 3.3, the following graph showed the data soil media and compos for nine week. The figure showed a positive data from the first week until third week for both media. While in the third week until week five the data on graph showed more upsurge. At week six the data on the figure show the upward and stable data until week nine. WP in soil media showed the value was -1600kPa because soil medium cannot retain more water than compost banana stem. For compost banana stem has been showed the value was -1000kPa because compost banana stem able to hold the water without needed any excess water.

Water potential for both soil medium and compost banana stem tend to decreased at week 3 to week 6 also due to the high salt content cause by chlorinated water on a media we use. There was also a factor that caused the decline WP is caused by excess water also gave negative in the media as well the planted. In this research also shows that the excess of water during flush can cause pak choi become flaccid and the tree cannot absorb water well that lead to lower WP. From week 7 to week 9 shows the horizontal value of WP for both treatment that have effect on plant growth. The other factor is also the mechanical stress, and is an important component of total WP in plant cells. Potentially increasing pressure as the water enters the cell. Like water through the cell wall and cell membrane, it increases the amount of water present in the cell, which in pose external pressure opposed to the rigidity of the structure of the cell wall (Taiz & Zeiger, 2002).

3.4 Soil moisture (SM)

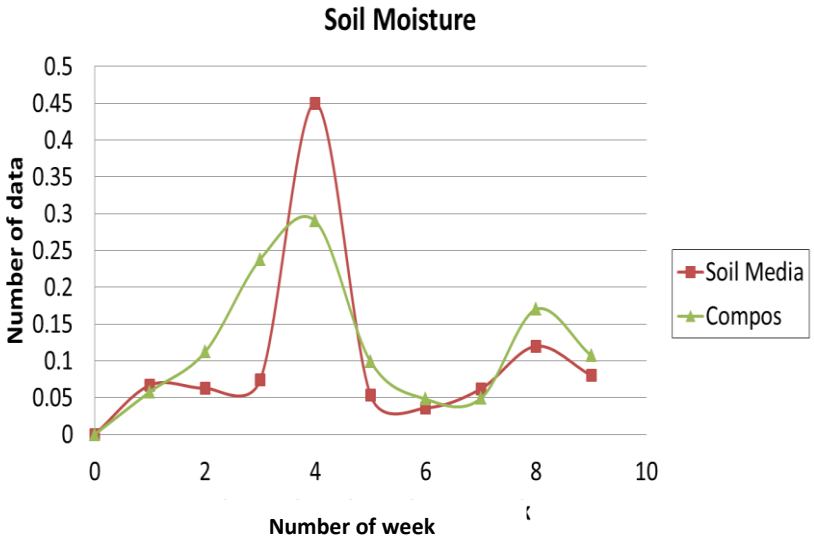

Figure 3.4: Graph of SM vs no. of week

Based on the Figure 3.4, the following graph showed the data of soil media and compos banana stem for nine week. The highest soil moisture for both treatments recorded at week 4 with 0.45m^3 for soil media and 0.29m^3 for compost banana stem. Odd result recorded at starting at week 3 to week 4 is due to rain that drops the surrounding temperature, increasing the RH and reduces WP while soil moisture is increase.

This is because due to the moisture in the soil due to water retention in polybag for both soil media and compost banana stem. Water reservoir located in a polybag also can cause it to become moist that cause increasing in SM. Data from week 5 to week 9 is a benchmark for which media can hold water better. From week 5 until 9 there is no raining and temperature is hot that cause water to evaporate. Based on result show that compost banana stem have significantly higher soil moisture than soil media and the highest is at week 8 (0.17m^3) compared to soil media (0.12m^3).

4 Conclusion

In general, this project has been carried out and achieved the objective. As conclusion, compost banana stem is slightly have advantage in retaining water compared to soil medium. However both treatment have pro and con that can be improve. For further, there shold be more study on it capacity and ability to holding macronutrient or micronutrient for plant intake.

5 Acknowledgements

Alhamdulillah and praise be to Allah the Almighty for His blessing to enable me to complete this research. I would like to take this opportunity to express my gratitude to Director of Politeknik Jeli Kelantan, Tn Hj Wan Azlan Wan Ismail for his support during my research. I would also like to take this opportunity to express my highest gratitude to Head of Department of Agrotechnology & Bioindustry, Mr Abdul Aziz Talib for his guidance, advice, information, help, criticisms and kindness to share his valuable time during the preparation of this report. My appreciation also extend to all my fellow colleagues and to all who were directly or indirectly involved in helping me to complete this report.

References

D. G. Feriotti & A. M. Iguti (2009) Proposal for Use of Pseudostem from Banana Tree (Musa cavendish) Maua Institute of Technology, Sao Caetano do Sul, Brazil

P. Ganan, R. Zuluage, J M Velez, I. Mondragon (2004). Cellulose microfibrils from banana farming residues: isolation and characterization. Springer International Publishing. ISSN: 0969-0239

Roger Tim Haug (1993). Practical Handbook of Compost Engineering [Hardcover]. Lewis Publishers

Sunarjono, H, H., (2004). Bertanam 30 Jenis Sayur. Penebar Swadaya, Jakarta Hal: 78-82

Taiz; Zeiger (2002), Plant Physiology, Third Edition. Sinauer Associates; 3 edition. ISBN: 0878938230