AGROTECH
e-ISSN: 2821-3106
DOI: https://doi.org/10.53797/agrotech.v1i2.3.2022

Effects of Biochar and Banana Peel Application on Ulam Raja (*Cosmos caudatus*) Growth

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Available online 01 December 2022

Abstract: Excessive consumption of chemical fertilizers in recent years have increased throughout the world, causing serious environmental problems. This research can minimize the usage of chemical fertilizers and reduce the waste management. Hence, the aim of this study is to determine the effects of biochar and banana peel application on growth performance of *Cosmos caudatus*. The plants were treated by 100 g biochar, 100 g banana peel, the mixture of 50 g biochar and 50 g banana peel and control with five replications as treatments. The research was conducted by using Randomized Complete Block Design (RCBD). The data was analysed by using Analysis of Variance (ANOVA), Statistical Package for the Social Sciences (SPSS) and the differences between treatments mean were compared using Tukey test with significant level ($P \leq 0.05$). The growth parameters measured were shoot length, root length, soil pH and number of leaves. The results suggested that the shoot length and number of leaves for all the treatments were significantly higher compared to the control. All the treatments also showed a significantly higher root length compared to the control except 100 g banana peel treatment. There were no significant changes in soil pH for all the treatments. Hence, the study showed that biochar and banana peel gave significant effects on *Cosmos caudatus* growth.

Keywords: Biochar, banana peel, *cosmos caudatus*, ulam raja

1. Introduction

Cosmos caudatus, known as Ulam Raja, is a very popular traditional vegetable from the family *Asteraceae* and is commonly classified as microgreens. Microgreens are young vegetable greens harvested at the age of 7-14 days after germination (Efendi & Dewi, 2020) when the cotyledons have fully grown. *Cosmos caudatus* need fertilizers to improve their nutrient in soil and quality of growth. Due to a lack of nutrients in soil and plant growth, many farmers have used chemical fertilizer as an alternative. However, using chemical fertilizers may harm the environment, such as through waterway pollution and acidification of the soil.

Chemical fertilizers are now being used excessively worldwide, significantly affecting the ecosystem. The production of sufficient crops to feed the world's population is mostly made possible by chemical fertilizers, but their excessive usage has significant negative consequences.

Due to these problems, the development of organic soil amendments such as biochar and the banana peel has been used to improve soil nutrients instead of using chemical fertilizers. Adding biochar to soil has been found to have multiple benefits for soil conditions (Kondrlova et al., 2018).

This study aims to determine the effects of biochar and banana peel application on the growth performance of Cosmos caudatus. This research can minimize the waste management issues of fruit peel waste. Banana peels have not been used for other purposes and are often discarded at great cost as solid waste (Sudha et al., 2015). Thus, the waste of banana peel can be used as organic matter. This research may be helpful to the government, farmers and other researchers. In addition, it may be a source of information for further agricultural studies. Furthermore, this could inspire other researchers to further research on the issue.

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2. Literature Review

2.1 *Cosmos caudatus*

Cosmos caudatus Kunth is from the Asteraceae family that lives as an annual to short-lived perennial aromatic herb (Moshawih et al., 2017). Numerous researchers have thoroughly investigated the Asteraceae family's antimicrobial characteristics (Asghari et al., 2012). It can grow up to 3 m and start flowering from June to November in pink, white or purple colour of flower (Shui et al., 2005). Cosmos caudatus can usually be found globally in tropical countries such as Mexico, South America, Malaysia, the United States and Thailand (Salehan et al., 2013).

2.2 Biochar and Banana Peel

Biochar is burnt (temperatures of maximum 500°C) in a state of oxygen through the pyrolysis process of organic matter, which are leaves, crop residues, manure, and wood and rich in carbon (Yu et al., 2013). Organic materials are thermochemically burned with a specific amount of oxygen to produce biochar. Biochar nowadays is commonly used for soil amendment on the soil.

The banana originated in Malaysia and is now grown in the tropical and subtropical continents. In the world, banana plants are the largest herbs widely grown in many progressive countries (Aurore et al., 2009). Fruit peel is a factor of environmental trouble since it contains large amounts of nitrogen and phosphorus and its great water content makes it susceptible to altering microorganisms (González-Montelongo et al., 2010).

2.3 Effect of Biochar and Banana Peel on Plant Growth

Due to biochar's numerous potential advantages and hazards, current research on its benefits in soil has been growing over the past several years, and this trend is anticipated to last for the next ten years (Tammeorg et al., 2017). According to Gautam et al. (2021), applying biochar has increased plant growth; crop yields showed only slight increases. A higher percentage of biochar (4-32%) compared to (1-3%) had major effects on total of plant fresh weight, weight of leaf, root fresh weight and dry weight of wood (Tian et al., 2017).

Unripe and ripe banana peel powder that had been integrated into the soil was created, and it was discovered that the ripe powder increased soil fertility (Ginandjar et al., 2021). Studies reported that ripe banana peels added to the soil each day to boost the amount of organic carbon (Panwar, 2015).

3. Materials and Methods

The study was conducted in Saratok, Sarawak. The experiment was conducted for 35 days from transplanting until the harvesting process.

3.1 Seed Germination

Seeds of *Cosmos caudatus* were germinated in a germinating tray containing 51 holes. The *Cosmos caudatus* seeds were obtained from hardware. The seeds used were technologically processed and hygienically packed. The top soil was used as the medium filled three quartered for each hole of the germinating tray. Small apertures were made of 2 mm to 5 mm depth in the middle of each medium-filled hole in the germinating tray. Each medium hole was placed with one dried seed in the aperture, and 50 seeds were germinated in the tray. The seeds were covered slightly with the leftover medium. The seeds were placed centrally so that seedling roots could uniformly grow. Then, the seedlings were watered using a spraying bottle. The germinating tray was placed a little bit far from direct sunlight to avoid medium from fast drying. Watering was done one time a day to prevent water loss. Within 14 days, seeds germinated. At this stage, seedlings produced more leaves. When more leaves were grown, seedlings were transferred to the exposed area with moderate sunlight for the hardening process. The good seedlings were chosen to grow, and the poor one was removed.

3.2 Preparation of Biochar and Banana Peel

Five kg of biochar that had been processed and packed was purchased from a hardware shop. The hardwood biochar from the rubber tree was chosen as it can keep nutrients in the soil and increase soil fertility. The biochar was crushed into small pieces by using a mortar and pestle. Then, the crushed biochar was held at room temperature.

Three kg of ripe banana peel was collected and cut into small pieces for the banana peel. Then, the banana peels were dried in direct sunlight for two weeks. The banana peels were dried, ground in a mill, and then stored at room temperature.

3.3 Pot Preparation

Approximately, 500 g of topsoil was placed in each pot. These 20 pots (5” length X 7” width) were used with drainage holes. Each pot was labelled before being arranged.

3.4 Root Length

After harvesting, a ruler was used to measure the length of each root from the base to the tip. Data collected for all plants were recorded.

3.5 Shoot Length

A ruler was used to measure the length of each shoot from the collar (the point on the stem where roots first appear) to the leaf's tip. Data collected for all plants were recorded.

3.6 Number of Leaves

After harvesting, the total number of leaves were calculated and recorded.

3.7 Treatments and Experimental Design

There were four treatments were utilized in the study's Randomized Complete Block Design (RCBD). Twenty experimental units were obtained by repeating each treatment five times. *Cosmos caudatus* was harvested at 35 days after transplanting. Potting media was prepared using control (T1), 500 g topsoil and 100 g biochar (T2), 500 g topsoil and 100 g banana peel (T3) and 500 g topsoil with 50 g of biochar and 50 g of banana peel (T4). The control treatment represents no amendments. All the characterizations on the growth parameter of *Cosmos caudatus* were conducted with five replications. The summarized of the treatments and rate of each treatment is described in the Table 1.

Table 1: The treatments and the rate of each treatment

Treatment	Rate of treatment (g/ pot)
T1 (Control)	0
T2	100 g of biochar
T3	100 g of banana peel
T4	50 g of biochar and 50 g of banana peel

*Note: 1 pot contained 500 g of top soil

3.8 Statistical Analysis

The collected data were represented as means ± standard errors. Software called Statistical Package for the Social Sciences (SPSS) was used to conduct the statistical analysis. The data were analyzed by using one-way analysis of variance (ANOVA) and compared by using Tukey's test. The 95% confidence interval ($P \leq 0.05$) was used to estimate the significance of the difference.

4. Results and Discussion

4.1 Root Length

There were significant effects on the root length of *Cosmos caudatus* growth. Plant growth in 100 g biochar (T2) was significantly higher compared to other treatments (Fig. 1). In this study, the root length of *Cosmos caudatus* was measured after 35 days of transplanting. It is important to measure the root length as plant root systems are critical for plant growth. Moreover, root length measurement can determine plants' capability for nutrient availability and water eradication (Guan et al., 2014).

The 100 g biochar treatment (T2) showed the highest root length as, according to the previous study of Prendergast-Miller et al. (2014), biochar particles come into relation with plant roots, and it may have a major impact on root development and function. Similar to Jha et al. (2010), the development of biochar and its application to the soil will result in actual benefits such as increased soil fertility and product yield.

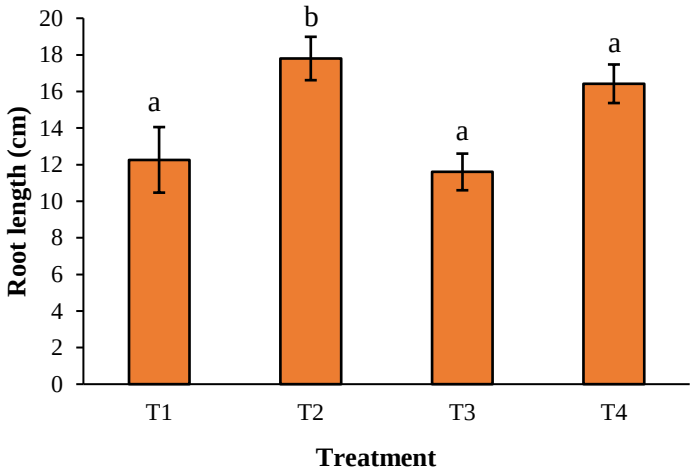

Fig. 1: Effects of biochar and banana peel application on root length of *Cosmos caudatus*

4.2 Shoot Length

There were significant effects on shoot length of *Cosmos caudatus* growth. The growth of plants in T2 and T4 were significantly higher than in the control treatment (Fig. 2). In this study, the shoot length of *Cosmos caudatus* was measured at harvesting (35 days after transplanting).

The 100 g biochar treatment (T2) has the highest shoot length. This result was similar to the previous study of Efendi & Dewi (2020), which stated that biochar's effect on plant height is significant. The previous study shows that biochar's favourable impact on soil health and fertility, enhance nutrient cycling, lowered nutrient leaching from soil, and encouraged soil microbial activity are likely outcomes (Semida et al., 2019). Fruit peel significantly boosted the shoot length and height of *Solanum scabrum* plants compared to untreated plants, which is similar to a prior study by Kadir et al. (2016).

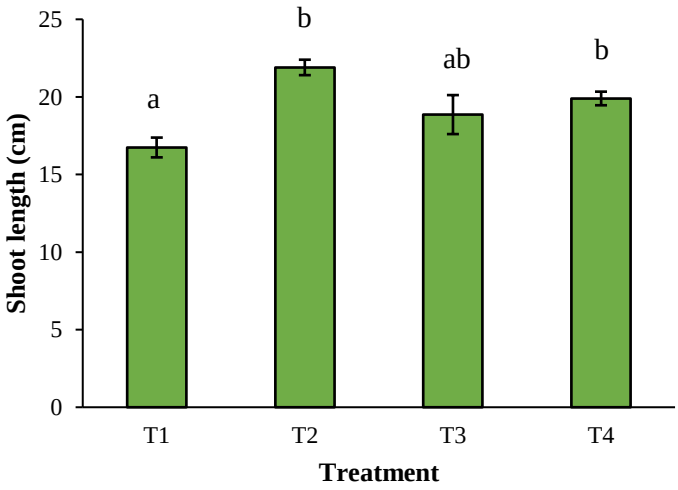

Fig. 2: Effects of biochar and banana peel application on shoot length of *Cosmos caudatus*

4.3 Number of Leaves

There were significant effects on the number of leaves of *Cosmos caudatus* growth. The mean number of leaves in 100 g biochar (T2) and 100 g banana peel (T3) were significantly higher compared to the plants in control (T1) (Fig. 3).

From the study, the number of leaves for *Cosmos caudatus* plants in 100 g biochar (T2) was highly significant compared to the control (T1) because the application of biochar has increased plant growth (Gautam et al., 2021). Plants treated with banana peel (T3) also showed significant effects on a number of leaves compared to the control. Anhwange et al. (2009) stated that peel of a fruit includes a significant number of macronutrients necessary for plant growth. It aids in the growth of plants, such as plant height and the number of branches, as well as the dry weight of stems. This study has a similar finding to Dayarathna & Karunarathna (2021), which found that banana peel had significant differences

(P≤0.05) in the number of leaves. Treatment of control (T1) has the lowest number of leaves because it did not receive any additional nutrients to grow.

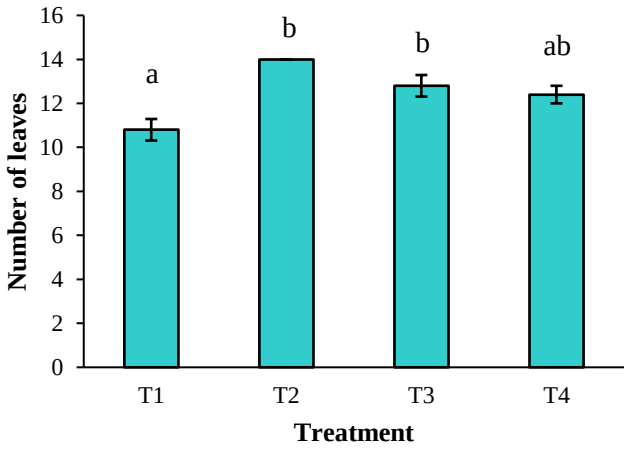

Fig. 3: Effects of biochar and banana peel application on the number of leaves of *Cosmos caudatus*

5. Conclusion

This study seeks to determine the biochar and banana peel application on growth performance of *Cosmos caudatus*. This study measures the biochar application and banana peel's growth performance of Cosmos caudatus based on four parameters: shoot length, root length, soil pH and the number of leaves after 35 days of observation. Based on this study, biochar, banana peel and the mixture of biochar and banana peel treatments increased the root length, shoot length and number of leaves compared to the control (T1), indicating that the addition of biochar and banana peel promoted the growth of *Cosmos caudatus* and can be used as an alternative fertilizer to reduce the usage of chemical fertilizer.

Acknowledgement

The work has carried out for fulfilment of the requirements for the Bachelor of Education (Agricultural Science) with honours. We grateful to the Universiti Pendidikan Sultan Idris, Malaysia for supporting this research.

References

Anhwange, B. A., Ugye, T. J., & Nyiaatagher, T. D. (2009). Chemical composition of Musa sapientum (banana) peels. *Electronic Journal of Environmental, Agricultural and Food Chemistry*, *8*(6), 437-442.

Asghari, G., Jalali, M., & Sadoughi, E. (2012). Antimicrobial activity and chemical composition of essential oil from the seeds of Artemisia aucheri Boiss. *Jundishapur journal of natural pharmaceutical products*, *7*(1), 11-15.

Aurore, G., Parfait, B., & Fahrasmane, L. (2009). Bananas, raw materials for making processed food products. *Trends in Food Science & Technology*, *20*(2), 78-91.

Dayarathna, S. G. A. R. M., & Karunarathna, B. (2021). Effect of different fruit peel powders as natural fertilizers on growth of Okra (Abelmoschus esculentus l.).

Efendi, B., & Dewi, W. S. (2020, March). Growth And Nitrogen Uptake of Kenikir (Cosmos caudatus Kunth.) Microgreens In A Combination of Manure And Biochar Planting Media. In *IOP Conference Series: Earth and Environmental Science* (Vol. 466, No. 1, p. 012018). IOP Publishing.

Gautam, D. K., Bajracharya, R. M., & Sitaula, B. K. (2021). The Effects of Biochar and Farm Yard Manure on Soil Properties and Crop Growth in the Himalayan Agroforestry System. *Cutting-edge Research in Agricultural Sciences Vol. 8*, 146-156.

Ginandjar, S., Hakim, L. A., Subandi, M., Rahmadi, A., & Hakim, M. T. A. (2021, April). The effect of dung and local microorganism of banana corm application on the growth and the yield of mung beans (Vigna radiata L) Vima-2 variety. In *IOP Conference Series: Earth and Environmental Science* (Vol. 739, No. 1, p. 012078). IOP Publishing.

González-Montelongo, R., Lobo, M. G., & González, M. (2010). Antioxidant activity in banana peel extracts: Testing extraction conditions and related bioactive compounds. *Food Chemistry*, *119*(3), 1030-1039.

Guan, D., Al-Kaisi, M. M., Zhang, Y., Duan, L., Tan, W., Zhang, M., & Li, Z. (2014). Tillage practices affect biomass

and grain yield through regulating root growth, root-bleeding sap and nutrients uptake in summer maize. *Field Crops Research*, *157*, 89-97.

Jha, P., Biswas, A. K., Lakaria, B. L., & Rao, A. S. (2010). Biochar in agriculture–prospects and related implications. *Current science*, 1218-1225.

Kadir, A. A., Rahman, N. A., & Azhari, N. W. (2016, July). The utilization of banana peel in the fermentation liquid in food waste composting. In *IOP Conference Series: Materials Science and Engineering* (Vol. 136, No. 1, p. 012055). IOP Publishing.

Kondrlova, E., Horak, J., & Igaz, D. (2018). Effect of biochar and nutrient amendment on vegetative growth of spring barley ('Hordeum vulgare'L. var. Malz). *Australian journal of crop science*, *12*(2), 178-184.

Moshawih, S., Cheema, M. S., Ahmad, Z., Zakaria, Z. A., & Hakim, M. N. (2017). A comprehensive review on Cosmos caudatus (Ulam raja): pharmacology, ethnopharmacology, and phytochemistry. *International Research Journal of Education and Sciences*, *1*(1), 14-31.

Panwar, N. (2015). Studies on physicochemical characteristics and fertility of soil by addition of banana peels–waste management. *IJSRD—International Journal for Scientific Research and Development*, *3*(1), 2321-2613.

Prendergast-Miller, M. T., Duvall, M., & Sohi, S. P. (2014). Biochar–root interactions are mediated by biochar nutrient content and impacts on soil nutrient availability. *European journal of soil science*, *65*(1), 173-185.

Salehan, N. M., Meon, S., & Ismail, I. S. (2013). Antifungal activity of Cosmos caudatus extracts against seven economically important plant pathogens. *International Journal of Agriculture and Biology*, *15*(5).

Semida, W. M., Beheiry, H. R., Sétamou, M., Simpson, C. R., Abd El-Mageed, T. A., Rady, M. M., & Nelson, S. D. (2019). Biochar implications for sustainable agriculture and environment: A review. *South African Journal of Botany*, *127*, 333-347.

Sudha, K., Anitta, S., Devi, P. M., & Thejomayah, G. (2015). Biosynthesis of iron nanoparticle from green banana peel extract. *International Journal of Social Science and Interdisciplinary Research*, *4*(6), 165-176.

Shui, G., Leong, L. P., & Wong, S. P. (2005). Rapid screening and characterisation of antioxidants of Cosmos caudatus using liquid chromatography coupled with mass spectrometry. *Journal of Chromatography B*, *827*(1), 127-138.

Tammeorg, P., Bastos, A. C., Jeffery, S., Rees, F., Kern, J., Graber, E. R., ... & Verheijen, F. G. (2017). Biochars in soils: towards the required level of scientific understanding. *Journal of Environmental Engineering and Landscape Management*, *25*(2), 192-207.

Tian, D., Liu, A., & Xiang, Y. (2017). Effects of biochar on plant growth and cadmium uptake: Case Studies on Asian lotus (Nelumbo nucifera) and Chinese sage (Salvia miltiorrhiza). *Engineering applications of biochar*, *2017*, 49-69.

Yu, O. Y., Raichle, B., & Sink, S. (2013). Impact of biochar on the water holding capacity of loamy sand soil. *International Journal of Energy and Environmental Engineering*, *4*(1), 1-9.