

DOMESTIC HOUSEHOLD FOOD WASTES AS POTENTIAL NATURAL ORGANIC ENHANCERS FOR GROWTH OPTIMIZATION AND ACCLIMATIZATION OF *Cosmos caudatus*

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Abstract: Studies on using domestic household food wastes on *Cosmos caudatus* were undertaken mainly to investigate its effects as potential organic enhancers for the growth optimization and acclimatization. Various kind of food wastes such as used coffee ground, squeezed coconut dregs and water residue of cleaned fish were used to initiate the treatment. These food wastes were added in the medium (topsoil) in different volumes; 30 ml, 60 ml and 90 ml for each treatment. This study also includes certain parameters as guide to determine the growth of *Cosmos caudatus* such as plant height and leaf length. From the result, *Cosmos caudatus* treated with 90 ml water residue of cleaned fish gave the best response comparing to all treatments; from 26.51 cm \pm 0.65 cm for plant height, and 11.34 cm \pm 0.57 cm for average leaf length, at week-9 of germination and growth. The optimum volume for coffee ground treatment was at 60 ml. Meanwhile, the optimum treatment for coconut dregs was also at 60 ml. Based on the study, household food wastes have the potential to be used as organic plant growth enhancer. In future, these wastes could have the potential to be commercialized and at the same time food wastes could be converted into useful product to the agricultural field.

Keywords: *Cosmos caudatus*, natural enhancer, food waste, organic, growth, acclimatization.

I. INTRODUCTION

Cosmos caudatus is a popular edible herb in Malaysia and is locally known as 'ulam raja'[1]. This plant is native to tropical regions of the Americas and has been naturalized in Java, where it is often cultivated as an ornamental and edible plant [2]. *Cosmos caudatus* is basically planted as an ornamental plant because it has beautiful and colorful flower. Being named as 'ulam raja', it is well-known among local Malay community in Malaysia. It is an edible plant and the part of the plant that is normally eaten is the young shoots. The pinnate leaves of the plant are consumed as a leafy vegetable, usually in the raw form, also being cooked. It constitutes as one of the most common raw plant leaves eaten in salad-like form called 'ulam'. *Cosmos caudatus* requires sunny outdoors with well-draining, fertile and moist soil. This plant also demands constant supply of nutrient. It is suitable to plant *Cosmos caudatus* in Southeast Asia because it grows quickly under optimal condition. The flowers and seeds can be seen readily when the plants are growing up. Therefore, it is common for regular harvesting to stimulate the production of useful and edible foliage, cum helps to delay flowering. In Malaysia, *Cosmos caudatus* is widely used as salad in the main dish, to be eaten with rice. It is also used as ornamental plant because of the beautiful flower and leaves. It is also used traditionally for improving blood circulation, as anti-aging agent, reducing body heat, strengthening bone marrow (because of its high calcium content), to promote fresh breath and to treat infections associated with pathogenic

microorganisms [3][4]. The methanol extract of *Cosmos caudatus* has been reported to show moderate antioxidant activity when tested using the xanthine oxidase enzymatic assay [5]. This plant has a sweet taste and cooling characteristic and is considered a blood purifier, tonic for the muscles and can strengthen the bones [6]. In the Malay traditions of salad consumption, *Cosmos caudatus* is considered as an appetite stimulant and enhancer due to its sweet and bitter aromatic taste [7].

Nowadays, people tend to choose the easiest way towards the development and modernization in their living. The increasing of domestic household waste can be seen anywhere. As the world population is increasing, it is important for the consumer to manage the environment wisely. In Malaysia, the amount of total food waste produced in the year 2006 was 15000 metric tonnes [8]. According to the statistics from Solid Waste Management and Public Cleansing Corporation (SWCORP) of Malaysia, Malaysians throw away about 39078 metric tonnes of solid waste daily and food makes up the largest component of domestic waste at 30.6% [9].

To date, food crops in the market are produced by farmer and the high quality yield by using inorganic fertilizer could be guaranteed. Inorganic fertilizer will give the best crops yield on plants but in long term they will harm the structure of soil and cause depletion of nutrient contents in soil. On the other hand, the use of proper method and materials are important in order to supply deeds to the soil and consequently the quality of the soil could be sustained. In Malaysia, looking back at the routine of the villagers, usually the elderly are still using traditional practices in their daily life. Most of them still use organic fertilizer like chicken and cow manure to their planted plant rather than volatile chemical compounds. Alternatively, besides using manure fertilizers, from the present study, the usage of food wastes as natural organic plant enhancers could be practiced. The food waste could be utilized as plant growth enhancer rather than being disposed in garbage and it is also very friendly to our environment.

The present work aimed to study the effects of domestic household food wastes as potential natural organic plant growth enhancers for *in vivo* growth optimization and acclimatization of *Cosmos caudatus*. The findings are hoped to encourage the society to reuse food waste material wisely. Additionally, farmers could also recycle the agricultural waste product either to be used as compost or fertilizer. In this study, several domestic household food wastes were used as potential natural organic enhancers for the growth of *Cosmos caudatus*. Through the findings of this study, awareness on the importance of recycling food waste into useful product to the agricultural field could be created and initiated.

II. METHODOLOGY

All experiments were conducted at the Agriculture Farm of Faculty of Technical and Vocational, Sultan Idris Education University, Tanjung Malim, Perak, Malaysia. Seeds of *Cosmos caudatus* were purchased from the plant nursery. Seeds were first soaked with water to soften the outer layer (Fig. 1a). Seeds of *Cosmos caudatus* were germinated in a germinating tray which contained topsoil as medium (Fig. 1b). The seeds were watered twice a day. After about a week, healthy plantlets were transferred to polybags (Fig. 1c). Each polybag contained one plantlet to facilitate the treatment to be applied and monitored. To ensure the optimum acclimatization of established plantlets, the polybags were placed at a shaded area with netting whereby the plants were not directly exposed to the sunlight. The plantlets were exposed to sunlight gradually so that the plant could undergo hardening process (Fig. 1d).

After 3 weeks of germination, the application of selected food wastes was applied to the soil. The types of food wastes used in this experiment were squeezed coconut dregs, water residue from cleaned fish and used coffee ground. The treatment was applied only once a week then they were watered as usual. Plantlets not treated with food wastes were considered as control. The observation of each parameter was recorded every 2 weeks for 6 weeks continuously. Twenty plants were used in each treatment and experiments were repeated thrice. Experimental design was completely random and factorial with plant height and leaf length. All data were subjected to analysis of variance and comparison of mean was carried out using Duncan's Multiple Range Test (DMRT) and significance differences was determined at 5% level.

III. RESULTS AND DISCUSSION

Table 1 shows the effects of food wastes on plant height while table 2 shows the effects of food waste on leaf length. Results were recorded until week-9 of plantation. Based on the results, 90 ml water residue from cleaned fish gave the best response rather than 30 ml and 60 ml with $26.51 \text{ cm} \pm 0.65 \text{ cm}$ for plant height (Table 1) and 11.34 ± 0.57 for average leaf length (Table 2, Fig. 1e). The lowest respond was be observed when 30 ml water residue from cleaned fish was applied with $20.38 \text{ cm} \pm 0.92 \text{ cm}$ for plant height and $6.56 \text{ cm} \pm 0.54 \text{ cm}$ for average leaf length. (Table 2).

In the meantime, 60 ml of used coffee ground gave the best response compared to other volumes with $16.86 \text{ cm} \pm 0.30 \text{ cm}$ for plant height (Table 1) and 8.52 ± 0.29 for average leaf length. The lowest response was observed when 90 ml of used coffee ground was used, with $14.49 \text{ cm} \pm 0.43 \text{ cm}$ for plant height and $5.76 \text{ cm} \pm 0.26 \text{ cm}$ for average leaf length (Table 2).

The final treatment applied was squeezed coconut dregs (Table 1). Results show that 60 ml of squeezed coconut dregs gave the best response compared to other volumes; from $23.06 \text{ cm} \pm 0.08 \text{ cm}$ for plant height and $8.13 \text{ cm} \pm 0.44 \text{ cm}$ for average leaf length (Table 2, Fig. 1f). The lowest response was observed for 30 ml of squeezed coconut dregs with $12.70 \text{ cm} \pm 0.38 \text{ cm}$ for plant height and $7.53 \text{ cm} \pm 0.29 \text{ cm}$ for average leaf length. Table 1 and table 2 also show that control treatment gave the lowest response compared to all treatments.

The usage of domestic household food wastes for plant is not something new among the elderly people in villages. Food waste can be utilized as plant growth enhancer than being disposed into garbage. There is a high amount of energy in food wastes and it is beneficial to utilize the energy production towards enhancing plant growth and also for the waste's stabilization [10]. As what the world concerns now is to use less synthetic chemical product and promoting the application of organic fertilizer to help sustain the longevity of the nature and using environmentally friendly products to sustain the ecosystem. According to the University of California's integrated pest management program, all organic fertilizers are classified as 'slow-release' fertilizers, and therefore would not cause nitrogen burn. Leguminous cover crops are also grown to enrich soil as a green manure through nitrogen fixation from the atmosphere; as well as phosphorus (through nutrient mobilization) content of soils [11]. Meanwhile, according to [12], composition of phosphorus is 1.5 times higher in an organic compost generated from food waste compared to goat manure fertilizer.

The main objective of this study was to look at the effects of domestic household food wastes as potential natural organic plant growth enhancers to *Cosmos caudatus* plant. It was also important to study the most suitable food wastes added in planting medium that gave positive effects toward parameters tested in determining the growth of *Cosmos caudatus*. In long term, it encourages the society to recycle and reuse waste materials wisely. Farmers could recycle their agricultural product and housewives could use the food waste as enhancers for plant growth. The dependence on synthetic chemical product can be reduced by most farmers, at the same time increasing the soil fertility of their farm. On the other hand, the present study was aimed to increase the awareness among young generation about the importance of protecting and nurturing the nature.

Based on previous studies, lettuce also has been grown with the treatment of spent coffee ground. The research of carotenoids of lettuce (*Lactuca sativa*) grown on soil enriched with spent coffee grounds by [13] proved that all evaluated pigments increased proportionally to spent coffee amounts. Lutein and β -carotene levels increased up to 90% and 72%, respectively, while chlorophylls increased up to 61%. Plants nutritional features, with regards to these bioactive compounds, could be improved by the presence of low amounts of spent coffee grounds (up to 10%). This observation was particularly important because soil amendment with spent coffee grounds is becoming increasingly common within domestic agriculture.

The success factors in using domestic household food wastes as potential natural enhancers for growth of *Cosmos caudatus* are including physical factor, media used, sources of seeds and the procedures structured. It is important for physical factor like temperature and light to ensure the growth of plant. The ideal temperature for growing most herbs around 22°C to 27°C considering its humidity. The *Cosmos caudatus* thrives in soils with pH between 5.5 to 6.6. The plant must be watered everyday either for control or with treatments so that the physiological mechanism can be done.

Water residue of cleaned fish contains nutritional constituents. The highest nutritional content of fish was protein, followed by vitamin A, sodium, potassium and phosphorus. The protein contents at water residue of fish could be used for growth of *Cosmos caudatus* while the mineral contents like potassium and phosphorus play as main roles as macronutrient in soil. Recycling used coffee ground can increase plant available Fe in alkaline soils [14]. It is also part of micronutrient (Fe) needed for the growth of plant. Besides, used coffee ground is widely used among farmer to directly apply and acts as compost. They have a 20:1 ratio of nitrogen to carbon; which makes them ideal for growing plants. It is also believed that coffee ground can be used to deter pests. Snails and slugs are not eager to coffee ground that sprinkled around plants. As for coconut, the main nutrients of extract coconut dregs are highly with fat (50%), protein and water [15]. Previous study by Lai [16] showed that banana peel has the potential in supporting the growth of green onion plants and water spinach. Fruit peels such as banana peel could promote soil nutrient and plant growth [17]. Besides banana peels, other household food wastes such as tea waste, wood ash and eggshells also could enhance plant growth organically [18]. These food wastes also manage to substitute chemical fertilizers in promoting plant growth [19].

The present study showed that domestic household food wastes have high potential to be used as natural organic plant growth enhancer and these wastes could be further exploited for the benefit of the agricultural field, especially on crops

production. In future, the physiological mechanism of the plant could be investigated to examine the effects of different food waste treatments on plant growth. This study could be expanded and explored on various plant species. The growth and development of various plant species added with domestic household food waste as organic growth enhancer could be a promising way of reducing waste and thus, protecting the environment.

Table 1: Effect of different food wastes treatment on plant height. Plants untreated with food waste were used as control.

Week	Treatment Volume (ml)	Plant Height (cm)		
		Squeezed coconut dregs	Used coffee ground	Water residue from cleaned fish
3	Control	10.01 ± 0.29a		
	30	9.97 ± 0.27b	12.87 ± 0.50c	15.95 ± 0.42d
	60	19.09 ± 0.96e	12.85 ± 0.36c	19.84 ± 0.42e
	90	19.80 ± 0.56e	12.21 ± 0.42c	20.03 ± 0.47f
5	Control	10.35 ± 0.32a		
	30	10.86 ± 0.28a	14.44 ± 0.51ab	17.55 ± 0.81c
	60	20.48 ± 0.95d	14.94 ± 0.29ab	21.02 ± 0.61e
	90	21.15 ± 0.63e	13.46 ± 0.44ab	23.16 ± 0.55f
7	Control	11.40 ± 0.34a		
	30	11.47 ± 0.29ab	15.39 ± 0.52b	18.68 ± 0.84d
	60	22.23 ± 0.88e	16.32 ± 0.28bc	23.06 ± 0.08f
	90	22.83 ± 0.72e	14.00 ± 0.44b	25.42 ± 0.65g
9	Control	11.68 ± 0.37a		
	30	18.68 ± 0.84bc	16.57 ± 0.48bc	20.38 ± 0.92d
	60	23.06 ± 0.08e	16.86 ± 0.30bc	25.7 ± 0.92f
	90	25.42 ± 0.65f	14.49 ± 0.43b	26.51 ± 0.65g

Means followed by the same letter in the same row did not differ according to Duncan's Multiple Range

(DMRT) Test at 5% significance level

Table 2: Effect of different food wastes treatment on leaf length. Plants untreated with food waste were used as control.

Week	Treatment Volume (ml)	Leaf Length (cm)		
		Squeezed coconut dregs	Used coffee ground	Water residue from cleaned fish
3	Control	5.21 ± 0.3a		
	30	5.67 ± 0.31a	7.17 ± 0.42c	4.73 ± 0.44a
	60	5.99 ± 0.33a	6.09 ± 0.22ab	5.9 ± 0.66ab
	90	6.04 ± 0.30ab	4.29 ± 0.23a	7.61 ± 0.37c
5	Control	5.46 ± 0.31a		
	30	6.38 ± 0.29ab	8.52 ± 0.39d	5.29 ± 0.44a
	60	6.63 ± 0.35b	7.30 ± 0.22c	6.78 ± 0.72b
	90	6.67 ± 0.33b	5.09 ± 0.25a	8.74 ± 0.37e
7	Control	5.93 ± 0.37a		
	30	6.73 ± 0.29b	8.80 ± 0.34e	5.92 ± 0.54a
	60	7.59 ± 0.38c	8.11 ± 0.29cd	8.39 ± 0.89d
	90	7.19 ± 0.37bc	5.23 ± 0.25a	10.11 ± 0.57f
9	Control	6.15 ± 0.38a		
	30	7.53 ± 0.29bc	9.28 ± 0.30f	6.56 ± 0.54ab
	60	8.13 ± 0.44de	8.52 ± 0.29e	10.04 ± 0.93g
	90	7.84 ± 0.39cd	5.76 ± 0.26a	11.34 ± 0.57h

Means followed by the same letter in the same row did not differ according to Duncan's Multiple Range (DMRT) Test at 5% significance level

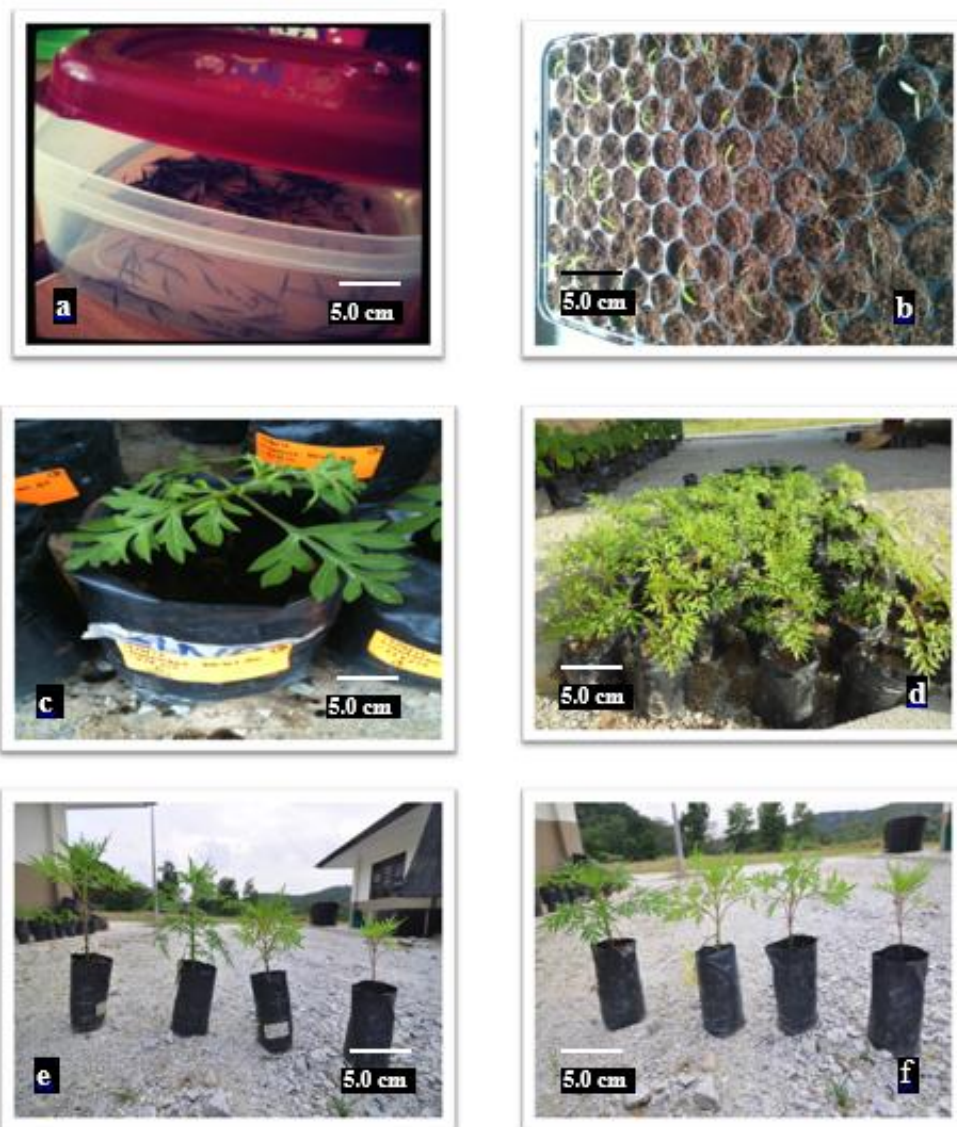


Fig. 1: (a) *Cosmos caudatus* seeds being soaked in water to soften the endosperm. (b) The seeds were germinated in germinating tray. (c) Morphology of *Cosmos caudatus* leaves. (d) Acclimatized plantlets at 5 weeks treated with water residue from cleaned fish. (e) Plantlets at week 9 treated with water residue from cleaned fish (from left to right: 90ml, 60ml, 30 ml and control). (f) Plantlets at week 9 treated with squeezed coconut dregs (from left to right: 90ml, 60ml, 30 ml and control).

IV. CONCLUSION

It can be concluded that the application of water residue from cleaned fish could successfully enhance the growth optimization and acclimatization of *Cosmos caudatus* (Fig. 1d). In fact, the other food wastes tested in this study such as used coffee ground and squeezed coconut dregs could also be used as natural enhancer with suitable and sufficient amount. This study outcome could be applied in our daily life and the application of synthetic chemical fertilizer for plant growth could be reduced. Simultaneously, this study also hopes to encourage the society to recycle and reuse food wastes either to use as compost or natural enhancers for plant growth. The usage of household food wastes as potential natural organic growth enhancers would provide significant effect to the growth of plants along with the sustainable of clean and protected environment.

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