Simpur Journal of Agricultural Sciences (2025), Vol. 1 (1): 42 - 55
ISSN: 3104-4069 | eISSN: 3104-4077

EFFECT OF DIFFERENT ORGANIC AND BIO-ENRICHED FERTILIZERS ON GROWTH AND YIELD OF POTTED *Cucumis anguria* L. (var. Chandini)

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ABSTRACT

The extensive application of chemical fertilizers has raised serious concerns regarding their impact on agricultural sustainability. In response, organic and bio-enriched fertilizers have gained importance as a sustainable alternative, enhancing soil health, boosting crop productivity, and promoting environmentally friendly agricultural practices. This study evaluated the effects of various organic and bio-enriched fertilizers on the growth and yield of *Cucumis anguria* L. (var. Chandini) through a pot experiment conducted at the University Farm, Eastern University of Sri Lanka, from July to September 2024. The experiment was laid out in a Completely Randomized Design (CRD) with 12 treatments and five replicates. The treatments included: T1 (Amirthakaraisal), T2 (Jeewamrutha), T3 (Modified Panchagavya), T4 (Fish Tonic), T5 (Kunapajala), T6 (Sasyagavya), T7 (Compost), T8 (Discovery), T9 (Vegi Super), T10 (Cocoly), T11 (Maxicrop), and T12 (Control). Growth and yield parameters were statistically analyzed using one-way ANOVA in MINITAB 17. The results revealed significant ($p < 0.05$) improvements in plants treated with T10, which exhibited superior performance in vine length (38.33%), number of leaves (40.3%), number of branches (65.91%), chlorophyll content (32.65%), leaf area (84.31%), shoot fresh (61.6%) and dry (67.87%) weights, root fresh (68.94%) and dry (70.38%) weights, root length (38.8%), number of pods per vine (73.74%), yield per vine (69.63%) and total yield (69.63%), achieving the highest net profit of Rs. 405,758.14/ha compared to T12. The superior performance observed can be attributed to Cocoly's unique composition, which includes a balanced blend of macro- and micronutrients, along with organic bio-enriched additives that synergistically enhance nutrient uptake, stimulate root development, and significantly improve plant growth and yield. Based on these findings, the application of Cocoly fertilizer shows considerable potential to enhance the growth and yield of pot-grown *Cucumis anguria* L., thereby promoting profitable cultivation in the dry zone of Sri Lanka.

Keywords: *Cocoly, gherkin, growth parameters, nitrogen and yield parameters*

1. Introduction

Cucumis anguria L., also known as gherkin or West Indian gherkin, is an annual trailing vine from the gourd family, primarily cultivated for its edible fruit. Gherkin plants are most likely native to Southern Africa and are grown in warm regions across the world (Neelambika et al., 2024). It is a popular cash crop that has recently been incorporated into the greenhouse vegetable sub-sector in Sri Lanka (Karunarathne et al., 2015). As a rapidly income-generating crop, gherkin cultivation has become increasingly popular across various regions in Sri Lanka over the last three decades. Gherkin cultivation in Sri Lanka is concentrated in several regions, such as Ampara, Mahaweli System B, Monaragala, Polonnaruwa, Badulla, Puttalam, Matale, Anuradhapura, and Kurunegala (Abeyrathna et al., 2013).

Gherkin thrives best in regions located up to 1000 meters above sea level. This crop prefers a mean daytime temperature exceeding 22°C, along with more than 8 hours of sunlight daily and an annual rainfall of 1500 to 2000 mm evenly distributed throughout the year. For optimal growth, the soil should be well-drained and contain ample organic matter, while saline soils are not recommended (Godagampala et al., 2013). The crop needs red sandy loam soil that is well-drained and maintains a pH level of 6.5 to 7.5 for optimal growth (Gunadal et al., 2024).

The crop branches freely with slender, rough hairy, angled stems and tendrils. The immature fruits are utilized for pickles, consumed as a cooked vegetable, and used in curries. In traditional medicine, gherkin fruits, roots, and seeds are utilized for various ailments, including stomach pain, jaundice, and hemorrhoids, while also serving to prevent stone formation in the kidneys (Thiruvengadam and Chung, 2015).

Gherkin plants have a unique ability to thrive in less fertile conditions and adapt well to sandy soils. Many farmers cultivate gherkins without any additional fertilization, depending instead on the leftover nutrients from the preceding crop. However, to counteract the limitations of low-quality soils, farmers are advised to use fertilizers to boost the fertility levels needed for successful gherkin cultivation (de Oliveira et al., 2009). Chemical fertilizers are primarily used to enhance crop quantity and quality and influence the taste of food crops. However, inappropriate application and misuse pose significant risks (Tayoh, 2020). The application of organic fertilizers and soil amendments is promising for increasing food production and soil fertility while minimizing environmental damage (Chew et al., 2019). Hence, the present study was undertaken to determine the effects of different organic and bio-enriched fertilizers on the growth and yield of potted *Cucumis anguria* L.

2. Materials and methods

2.1 Experimental Site

A polybag experiment was carried out at the University Farm, Faculty of Agriculture, Eastern University of Sri Lanka in Palachcholai during the period of July to September 2024. It is located at the latitude of 7º 48’36.64” and the longitude of 81º 35’30.76”. This site is categorized under the Agro Ecological Zone of Low Country Dry Zone (DL2b). The annual average temperature varies from 26.36°C to 36.98°C, and the yearly precipitation amounts vary from 1400 mm to 1680 mm. The soil type of the region is Sandy Regosols.

2.2 Collection of seeds

Certified seeds of gherkin (*Cucumis anguria* L.) variety Chandini RZ F1 (12-79) were used for this experiment.

2.3 Treatment structure

The polybag experiment was laid out in a Completely Randomized Design (CRD) with twelve treatments and five replicates. The details of the twelve treatments are given below in Table 1.

2.4 Agronomic practices

Polybags were filled with red soil, topsoil and cow dung in a 1:1:1 ratio. All the polybags were arranged at a spacing of 150 × 30 cm. In each polybag, one seed was sown at a depth of 2.5 cm. Trellises were installed using bamboo poles and rope. A weekly application of fertilizer was done at a recommended rate of application. For the pest and disease control, neem leaf extract was applied twice a week. Grade 3 fruits with a diameter range of 32 mm to 45 mm were harvested.

Table 1: Treatments and Application rate

Treatment Code	Treatment	Application rate
T1	Amirthakaraisal	(500 L/ha)
T2	Jeewamrutha	(500 L/ha)
T3	Modified Panchagavya	(500 L/ha)
T4	Fish tonic	(500 L/ha)
T5	Kunapajala	(500 L/ha)
T6	Sasyagavya	(500 L/ha)
T7	Compost	(30 tons/ha)
T8	Discovery (Commercial fertilizer)	(5 kg/acre)
T9	Vegi Super (Commercial fertilizer)	(16.2 L/acre)
T10	Cocoly (Commercial fertilizer)	5 g/plant-at the time of planting 20 kg/acre – at the growth stage
T11	Maxicrop (Commercial fertilizer)	(400 L/ha)
T12	Control (Without any fertilizer)	-

2.5 Preparation of organic fertilizers

Preparation of Amirthakaraisal

A plastic container was filled with 20 kg cow dung, 20 L cow urine, 2 kg jaggery, and 20 L water, and stirred for 15 minutes to mix thoroughly. The solution was stirred clockwise twice daily to activate microorganisms. After 24 hours, it was filtered through muslin cloth and diluted at a 1:10 ratio before application (Kumarasinghe and Sutharsan, 2023).

Preparation of Jeewamrutha

A mixture of 15 kg of fresh cow dung, 15 L of cow urine, 2 kg of jaggery, 2 kg of pulse powder, 200 L of water, and approximately 150 g of living soil was added to a plastic barrel. The soil, preferably fertile topsoil from an undisturbed area such as under a tree canopy, was included specifically to introduce beneficial native microbes into the preparation. The mixture was stirred thoroughly for 5 minutes using a wooden stick, then covered with a gunny mat and kept in the shade. To enhance microbial activity, the contents were stirred twice daily in a clockwise direction. After fermenting for 24 hours, the Jeewamirtha was diluted at a 1:10 ratio with water before application (Sandeepani et al., 2021).

Preparation of Modified Panchagavya

Modified liquid Panchagavya was prepared using 5 kg fresh cow dung, 3 L cow urine, 2 L cow milk, 500 g cow ghee, 2 L cow curd, 3 L sugarcane juice (or 500 g jaggery in 3 L water), 3 L tender coconut water, 12 ripe bananas, and 2 L toddy (or 100 g yeast and 100 g jaggery in 2 L warm water). Cow dung and ghee were stirred in a mud pot and allowed to rest for 3 days. On day 4, the remaining ingredients were added, mixed, and covered with a fine mesh. The mixture was stirred twice daily for 18 days. Before application it was diluted 1:10 with water (Jaiswal et al., 2019).

Preparation of Fish tonic

A 1 kg of fish was chopped into pieces and added with 1 kg of jaggery. The components were mixed thoroughly, sealed air tightly and allowed to ferment for 26 days in a cool shady place.

Finally, fish tonic was filtered and stored in a container. The Fish tonic was diluted at a 1:100 ratio with water before application (Arani et al., 2023).

Preparation of Kunapajala

A 1 kg of fish flesh was boiled in water and it was transferred in an earthen container. Then, 1 L of cow urine, 1 L of cow milk, 1 kg of ghee and 500 g of honey were added into it. 5 L of hot water was added into the mixture. The mixture was stirred regularly up to 14 days. After that, materials were sieved well and applied on the crop. Kunapajala was diluted at a 1:10 ratio with water before application (Biswas and Das, 2023).

Preparation of Sasyagavya

Vegetable waste or crop residues were cut into small pieces about 2–3 cm in length. Then, cow dung, cow urine, chopped organic waste and water were mixed at 1:1:1:2 ratios. It was allowed to ferment for 10-12 days. The mixture was stirred twice a day. After 10-12 days, the solution was filtered. Sasyagavya was diluted at a 1:10 ratio with water before application (Biswas et al., 2023).

2.6 Data collection

At the end of the experiment, 8 weeks after planting (8 WAP), vine length was measured using a measuring tape, and the total number of leaves and branches were counted. Leaf area was measured using a leaf area meter (LI–3100, USA), and chlorophyll content was assessed using a chlorophyll meter (SPAD–502 Plus). Fresh shoot weight, dry shoot weight, fresh root weight, and dry root weight were determined using an electronic balance (BSA822–CW, Germany). The total number of pods and the total weight of all pods harvested from each vine were recorded. Total yield per hectare was calculated by extrapolating the yield data from all plants.

2.7 Statistical analysis

The data collected in this experiment were subjected to one-way analysis of variance (ANOVA) using Minitab 17 Statistical Software and means were compared by Tukey’s test at 5% significant level.

3. Results and Discussion

3.1 Growth parameters

Vine length

Table 2 revealed a significant difference ($p < 0.05$) among treatments on the vine length of *Cucumis anguria* L. at 8 WAP. Treatment 10 (Cocoly) recorded the highest vine length of 197.94 cm, whereas T12 (Control) recorded the lowest vine length of 122.08 cm. The superior performance of Cocoly fertilizer in promoting vine elongation may be attributed to its high nitrogen content (15%). Wahocho et al. (2017) reported that the increased vine length observed in muskmelon with higher nitrogen application could be due to nitrogen’s crucial role in plant growth and development. Furthermore, it is well established that micronutrients play vital roles in enhancing plant growth and yield, while also protecting plants from the adverse effects of biotic and abiotic stresses (Tripathi et al., 2015). Cocoly fertilizer contains essential micronutrients such as calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn), and boron (B) (Lankem Agro, 2023), which may have also contributed to the observed increase in vine length.

In addition to macro- and micronutrients, Cocoly contains several bioactive compounds, including Polymeric Acid Substances (PAS), Fulvic Acid, Polyaspartic Acid (PASP), and Polyglutamic Acid (PGA), which enhance vegetative growth and vine elongation in *Cucumis anguria* L. Polyglutamic Acid, in particular, has been shown to significantly improve plant height. This is supported by the findings of Li et al. (2024), who reported that PGA significantly increased cucumber plant height by 6.3% to 39.5% during the flowering stage and by 1.8% to 12.1% during the melon blooming period, highlighting its role in enhancing vine elongation.

Number of leaves

Table 2 shows a significant ($p < 0.05$) variation in the number of leaves of *Cucumis anguria* L. across treatments at 8 WAP. Treatment 10 (Cocoly) produced the highest leaf count, reaching 72 leaves, compared to 43 leaves in the control treatment (T12), representing a 40.3% increase. This suggests that Cocoly fertilizer significantly enhances leaf production, which is essential for photosynthesis and overall plant health. The increase in leaf number observed in Cocoly-treated plants can be attributed to the presence of bioactive substances such as polyglutamic acid (PGA) and polyaspartic acid (PASP). These compounds improve nutrient retention within the root zone, facilitating better uptake of essential ions, particularly those critical for leaf development (Skalski et al., 2024; Yang et al., 2019). Liu et al. (2022) demonstrated that PASP treatment significantly boosted leaf number and biomass in wheat and lettuce, while Li et al. (2024) reported that cucumber plants treated with PGA exhibited more leaves than untreated plants, further emphasizing the role of these biopolymers in promoting leaf growth. Additionally, a preliminary study by Josline (2021) reported that potato plants treated with Cocoly during the vegetative stage developed more leaves, stronger stems, and exhibited overall vigorous growth, which is consistent with the positive effects observed in *Cucumis anguria* L.

Number of branches

There is a significant difference ($p < 0.05$) in the number of branches among the treatments due to the application of different organic and bio-enriched fertilizers. Plants treated with T10 (Cocoly) exhibited the highest number of branches (8.8), while T12 (Control) recorded a significantly lower value of 3 at 8 WAP, representing a 65.91% increase over the control. The nitrogen-rich composition of Cocoly likely accelerates branching by promoting lateral shoot development and vegetative growth. Wahocho et al. (2017) reported that nitrogen enhances branching in muskmelon by stimulating vegetative growth, which contributes to an increased number of branches at higher nitrogen application rates. Similarly, in cucumber, nitrogen has been shown to promote branching by enhancing leaf expansion and facilitating carbohydrate transport to developing sinks, thereby supporting lateral shoot development and overall plant architecture (Dong et al., 2016).

Beyond the effect of nitrogen, PASP present in Cocoly may also play a role in enhancing branch production. Li (2011) observed that PASP, when used in eco-friendly fertilizers, indirectly supports plant branching by improving nutrient retention and promoting root development. Liu et al. (2022) further confirmed that PASP, acting as a fertilizer synergist, significantly improves plant growth and nutrient accumulation, potentially leading to increased branching. Moreover, Machingura et al. (2024) reported that PASP treatment in *Arabidopsis thaliana* activated genes associated with nutrient metabolism and photosynthesis, providing a physiological explanation for enhanced branching and vegetative growth.

Chlorophyll content

A significant variation ($p < 0.05$) in chlorophyll content was observed among the treatments, as shown in Table 2. The chlorophyll content was significantly higher in T10 (104.2) compared to T12 (70.18) at 8 WAP. However, T8 (Discovery fertilizer) and T7 (Compost) were shown significantly highest chlorophyll content next to the T10.

The significantly superior chlorophyll content observed in plants treated with Cocoly fertilizer can be ascribed to its high nitrogen content and presence of PASP and essential micronutrients like Fe, Mg, and Zn. Veres et al. (2018) noted that nitrogen supply increases the chlorophyll content in cucumber leaves, with even half the optimal nitrogen level increasing Chlorophyll-b and carotenoid contents, which indicates improved photosynthetic capacity. Furthermore, micronutrients such as Zn and Fe participate in enzymatic activities and metabolic processes that boost chlorophyll synthesis, while Mg is essential for chlorophyll structure and hence promotes general plant health and production, as stated by Sidhu et al. (2019). Similarly, Saini and Saini (2019) observed that chlorophyll content in crops like cucumber and muskmelon is improved by the combined effects of magnesium, zinc, and iron, which all contribute to the production of chlorophyll, aid in plant growth hormones, and improve chlorophyll production.

Alongside these components, PASP has also been shown to significantly boost chlorophyll content and photosynthetic rates, resulting in increased leaf area and overall plant vigor, with a documented 25% increase in chlorophyll content following its application (Machingura et al., 2024). Collectively, these findings illustrate the crucial role of nitrogen, micronutrients, and PASP in enhancing chlorophyll content of leaves treated with Cocoly.

Table 2: Effect of different organic and bio-enriched fertilizers on vine length, number of leaves, number of branches and chlorophyll content of leaves at 8 WAP

Treatments	Vine length (cm)	Number of leaves	Number of branches	Chlorophyll content
T1	156.06 ±1.68^{cd}	52±1.41^{cd}	5.4±0.245 ^{c}	79.400±0.327^{e}
T2	158.66±2.35^{c}	53 ±0.894^{cd}	5.6±0.245 ^{c}	79.900±0.105^{e}
T3	174.82±1.63^{b}	61±0.894^{b}	9.0±0.000^{c}	88.400±0.235^{d}
T4	138.72±1.24^{f}	50±0.707^{d}	5.4±0.245^{c}	80.400±0.235^{e}
T5	133.48±1.16^{f}	51±0.707^{d}	5.6±0.245^{c}	79.200±0.261^{e}
T6	147.28±1.16^{e}	53±0.894^{cd}	7.8±0.200^{c}	87.500±0.235^{d}
T7	174.88±1.65^{b}	62±1.30^{b}	9.0±0.447^{b}	90.600±0.292^{c}
T8	162.42±0.937^{c}	56±0.707^{c}	4.6±0.245^{c}	92.840±0.121^{b}
T9	150.70±0.645^{de}	52±0.707^{cd}	4.4±0.245^{c}	88.820±0.136^{d}
T10	197.94±0.881^{a}	72±1.30^{a}	8.8±0.374^{a}	104.20±0.682^{a}
T11	145.92±0.949^{e}	51±0.707^{d}	4.4±0.245^{c}	87.600±0.332^{d}
T12	122.08±0.635^{g}	43±1.41^{e}	3.0±0.245^{c}	70.180±0.198^{f}
F test	ns	*	*	*

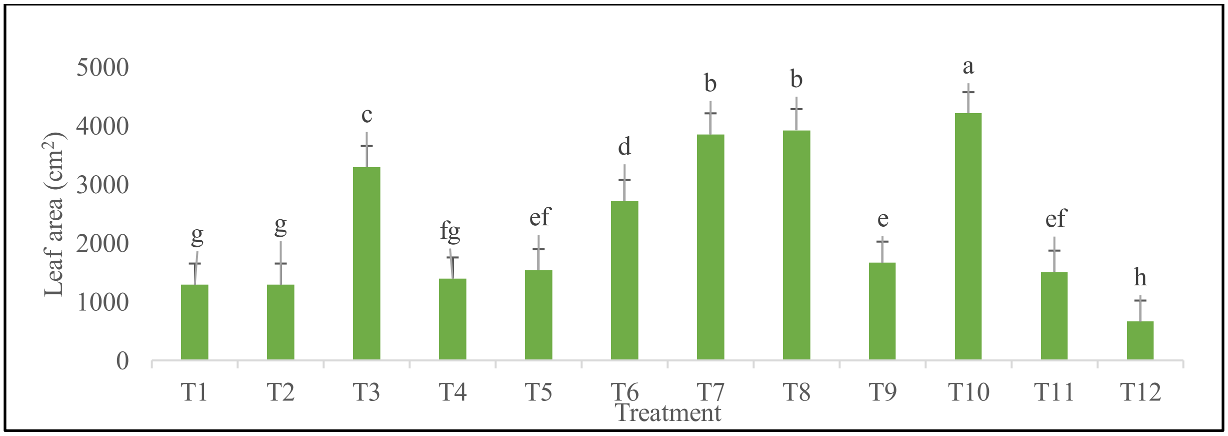
Value represents means ± standard error of 5 replicates. WAP – Weeks after planting; '' represents significant and 'ns' represents non-significant difference at 0.05 level of probability. Mean value in a column having the dissimilar letter or letters indicates significant difference at 0.05 level of significance by Tukey's Test.*

Leaf area

There is a significant difference ($p<0.05$) among the treatments in the leaf area as shown in Figure 1. Among the treatment, T10 (Cocoly) had significantly highest leaf area, measuring 4212.9 cm², indicating its superior capacity to encourage strong leaf growth. It exhibited a leaf area approximately 6.37 folds greater than that of T12 (control). Following T10, significantly high leaf areas of 3923.7 cm² and 3852.3 cm² were observed by T8 (Discovery) and T7 (Compost), respectively. The significantly highest value for leaf area in T10 (Cocoly) can be attributed to its higher nitrogen content (15%) and the presence of micronutrients (Fe, Zn, and Mg) as well as PASP. Nitrogen is essential for protein synthesis, which supports cell division and growth, ultimately increasing leaf area. Higher nitrogen levels have been shown to accelerate cell expansion and proliferation, resulting in larger leaves (Takahashi and Morikawa, 2015).

Specifically, micronutrients such as magnesium, zinc, and iron enhance leaf area by promoting chlorophyll synthesis, stimulating photosynthesis, and improving nutrient uptake, which collectively boost crop growth and development (Zahed et al., 2021). Moreover, the positive impact of PASP on leaf area is supported by the findings of Machingura et al. (2024), who reported a 33% increase in the leaf area of *Arabidopsis thaliana* following PASP application, highlighting its beneficial role in plant growth.

Fig 1: Effect of different organic and bio-enriched fertilizers on leaf area at 8 WAP



Value represents means ± standard error of 5 replicates. Mean value in a column having the dissimilar letter or letters indicates significant difference at 0.05 level of significance by Tukey's Test.

Shoot fresh and dry weight

As demonstrated in Table 3, there is a significant difference ($p<0.05$) among the treatments in shoot fresh weight and dry weight. T10 (Cocoly) showed a shoot fresh weight of 370.88 g, which was significantly higher than all other treatments. It exhibited a 61.6% increase compared to T12 (control). Following T10, T7 (Compost) and T8 (Discovery) recorded significantly higher values of shoot fresh weight with 320.19 g and 295.17 g respectively. Meanwhile, the lowest shoot fresh weight was recorded in T12 (Control) with 142.49 g.

Among the treatments, significantly highest shoot dry weight was observed in T10 (Cocoly) with 154.82 g followed by T7 (Compost), T8 (Discovery) and T3 (Modified Panchagavya). In contrast, T12 recorded significantly lowest shoot dry weight with 49.74 g compared to other treatments. The shoot dry weight in control treatment (T12) was 3.11 folds smaller than that of T10 (Cocoly).

The micronutrients found in Cocoly, including Zn, Mg, and Fe, may enhance chlorophyll content in leaves, thereby improving photosynthesis efficiency and ultimately contributing to increased shoot biomass. Patel et al. (2022) noted that Zn and Fe play a role in stimulating chlorophyll synthesis and enzymatic activities, which, in turn, improve photosynthesis and nutrient absorption, leading to increased shoot biomass. Likewise, Bityutskii et al. (2017) highlighted that zinc and iron support photosynthesis, nutrient uptake, enzyme functions, and chlorophyll production, all of which contribute to greater shoot biomass in cucumbers. Additionally, as highlighted by Lankem Agro (2023), polymeric acid substances (PAS) in cocoly fertilizer enhance cell division and stimulate metabolic processes in plants, which leads to increased production of plant tissues, particularly in the leaves and stems, thereby significantly boosting overall plant biomass (Bouchez et al., 2024; Margal et al., 2023).

Root fresh and dry weight

In the light of the findings derived from the statistical analysis, there is a significant ($p<0.05$) difference in the root fresh and dry weight due to the influence of different organic and bio-enriched fertilizers (Table 3). Treatment 10 (Cocoly) exhibited significantly highest root fresh and dry weight with 84.74 g and 16.16 g, showing 68.94% and 70.38% increase compared to T12 (control). Bio root promoters, which are integral to cocoly, play a crucial role in promoting strong root system (Lankem Agro, 2023). Bio-root promoters, which greatly increase root biomass in crops like cucumbers, contain vital hormones like auxin, cytokinin, and gibberellin. An acknowledged master regulator, auxin stimulates root elongation and organogenesis of lateral roots via signaling pathways and biosynthesis (Saini et al., 2013). Similarly, De Angelis et al. (2024) stated that auxin enhances root architecture in response to environmental stimuli, which may increase root biomass which is in agreement with present findings of this study.

Table 3: Effect of different organic and bio-enriched fertilizers on shoot fresh weight, shoot dry weight, root fresh weight and root dry weight of *Cucumis anguria* L. at 8 WAP

Treatment	Shoot fresh weight (g)	Shoot dry weight (g)	Root fresh weight (g)	Root dry weight (g)
T1	189.30±2.11 [e]	64.832±0.959 [e]	44.92±1.34 [f]	9.120±0.375 [c]
T2	195.88±1.90[e]	64.180±0.527[e]	53.74±1.10[d]	4.592±0.323[d]
T3	261.52±3.38[d]	89.720±0.469[c]	65.860±0.985[c]	13.624±0.542[b]
T4	173.91±3.63[fg]	63.700±0.455[e]	35.140±0.861[h]	8.846±0.531[c]
T5	163.38±2.75[g]	59.180±0.655[f]	47.940±0.919[ef]	5.226±0.376[d]
T6	187.67±1.68[e]	62.820±0.414[e]	62.000±0.959[c]	12.924±0.456[b]
T7	320.19±2.29[b]	100.80±0.430[b]	79.34±1.01[b]	13.760±0.445[b]
T8	295.17±3.51[c]	92.140±0.587[c]	75.320±0.694[b]	13.512±0.583[b]
T9	171.30±2.75[g]	68.600±0.479[d]	51.280±0.723[de]	9.778±0.399[c]
T10	370.88±2.55[a]	154.82±0.680[a]	84.740±0.434[a]	16.160±0.472[a]
T11	185.85±2.50[ef]	67.780±0.502[d]	40.320±0.701[g]	10.026±0.494[c]
T12	142.49±3.20[h]	49.740±0.480[g]	26.320±0.746[i]	4.786±0.429[d]
F test	*	*	*	*

Value represents means ± standard error of 5 replicates. WAP – Weeks after planting; '' represents significant and 'ns' represents non-significant difference at 0.05 level of probability. Mean value in a column having the dissimilar letter or letters indicates significant difference at 0.05 level of significance by Tukey's Test.*

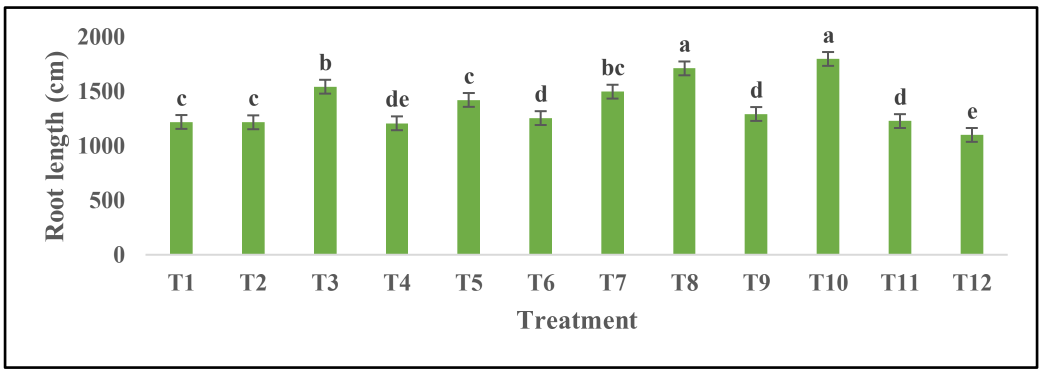
Root length

According to the findings derived from the statistical analysis, there is a significant ($p<0.05$) difference in root length due to the effect of different organic and bio-enriched fertilizers (Figure 2). Significantly highest root length was observed in T10 (Cocoly) and T8 (Discovery) with 1797.7

and 1711.1 cm, respectively. Bio root promoters present in Cocoly fertilizer encourage the formation of a strong, widespread root system, which in turn promotes root growth (Lankem Agro, 2023). Yang et al. (2022) stated that bio root promoters increase root growth and result in stronger and more broad root systems since they contain compounds like auxins, which stimulate cell division and elongation.

When Discovery fertilizer (T8) was applied, the roots showed a root length that was significantly similar to that of Cocoly fertilizer; both had much longer roots than the other treatments. The presence of seaweed extracts in Discovery fertilizer may be the reason of this improved root growth, as these substances are known to include plant growth-promoting elements like auxins, cytokinins, and other bioactive components that promote root development. This finding can be verified by Sarhan (2011), who reported that seaweed extracts one of the components of Discovery fertilizer increase root growth by improving nutrient absorption and root growth potential as seen by their beneficial impacts on a variety of crops, including cucumber.

Fig 2: Effect of different organic and bio-enriched fertilizers on root length of *Cucumis anguria* L.



Value represents means ± standard error of 5 replicates. Mean value in a column having the dissimilar letter or letters indicates significant difference at 0.05 level of significance by Tukey's Test.

3.2 Yield parameters

The results clearly demonstrate that Cocoly was the most effective treatment in enhancing the reproductive performance of *Cucumis anguria* L., as evidenced by the significantly higher number of pods per vine, yield per vine, and total yield compared to the control (T12) (Table 4). The improved performance is largely associated with Cocoly's well-balanced nutritional profile, especially its elevated nitrogen levels, vital micronutrients such as magnesium, zinc, and iron, and the inclusion of molasses fermentation solubles (CMS).

Nitrogen plays a central role in improving pod formation by expanding leaf area, increasing chlorophyll content, and strengthening the source-sink relationship, which facilitates better assimilate partitioning towards fruit development (de Souza et al., 2018). Supporting this, Li et al. (2023) reported that nitrogen application improves cucumber yield by enhancing sugar content, total soluble solids, and pod development, while also addressing nitrogen deficiency and improving overall productivity and quality. They further highlighted that the combined application of nitrogen and magnesium, along with effective water management, enhances nutrient uptake and moisture availability, thereby sustaining plant health and boosting yield.

Along with these components, molasses fermentation solubles (CMS) can improve plant development, resulting in enhanced pod formation and higher yields (Correa da Silva et al., 2024).

This improvement is likely due to enhanced soil health and nutrient availability, which promote stronger plant growth, resulting in the development of more pods and, consequently, higher overall production. A similar conclusion was reached by Li et al. (2020). The synergy of these elements, coupled with the treatment's remarkable capacity to enhance the physiological health of the plants, led to a noticeably increased yield. This strongly implies that, within the framework of organic farming practices, Cocoly creates the most favourable growing conditions for maximizing the yield and overall performance of gherkin crops.

Table 4: Effect of different organic and bio-enriched fertilizers on number of pods per vine, yield per vine and total yield

Treatment	Number of pods per vine	Yield per vine (kg)	Total yield (tons/ha)
T1	12.20±1.39^{c}	0.6851±0.0659^{c}	7.875±0.758^{c}
T2	12.400±0.600^{c}	0.6241±0.0492^{c}	7.174±0.565^{c}
T3	13.000±0.707^{c}	0.7005±0.0587^{c}	8.052±0.675^{c}
T4	12.60±1.29^{c}	0.6771±0.0179^{c}	7.783±0.205^{c}
T5	13.80±1.71^{c}	0.6370±0.0672^{c}	7.322±0.773^{c}
T6	15.20±1.02^{c}	0.6615±0.0234^{c}	7.603±0.269^{c}
T7	22.00±1.41^{b}	1.1210±0.0231^{b}	12.885±0.265^{b}
T8	27.00±1.41^{b}	1.3177±0.0440^{b}	15.146±0.506^{b}
T9	14.80±2.13^{c}	0.7797±0.0450^{c}	8.962±0.517^{c}
T10	35.80±1.36^{a}	1.729±0.187^{a}	19.87±2.15^{a}
T11	14.20±1.16^{c}	0.7377±0.0452^{c}	8.479±0.519^{c}
T12	9.40±0.927^{c}	0.5250±0.0378^{c}	6.034±0.434^{c}
F test	*	*	*

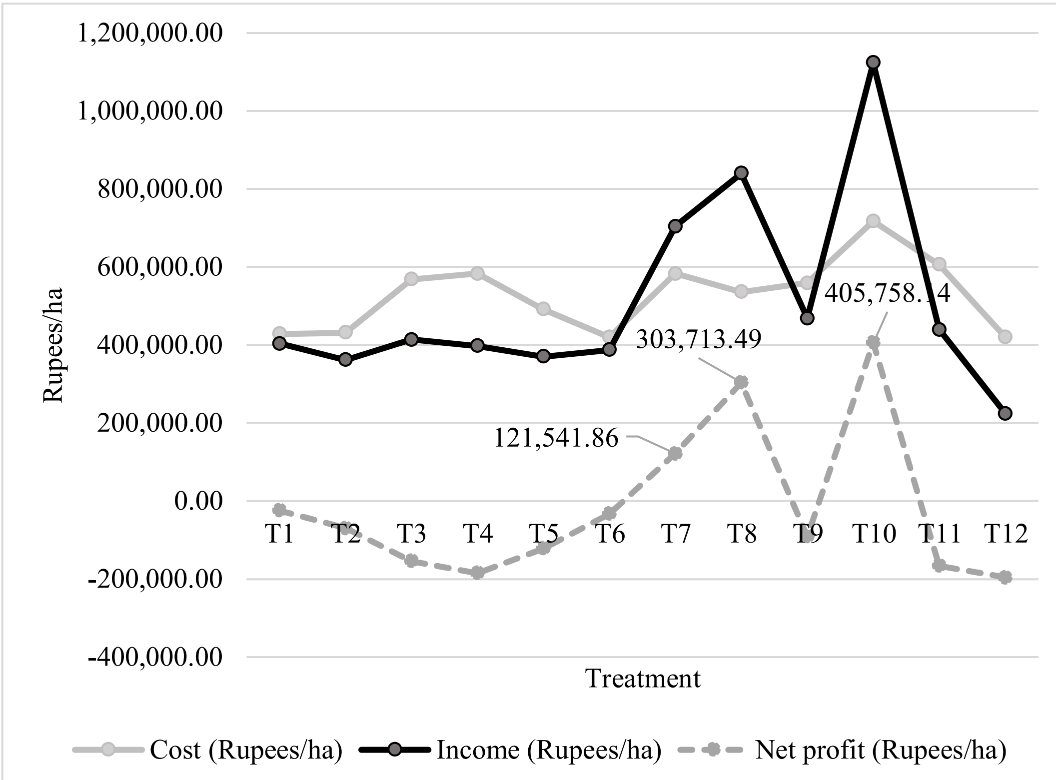
Value represents means ± standard error of 5 replicates. WAP – Weeks after planting; '' represents significant and 'ns' represents non-significant difference at 0.05 level of probability. Mean value in a column having the dissimilar letter or letters indicates significant difference at 0.05 level of significance by Tukey's Test.*

3.3 Cost – Benefit analysis of *Cucumis anguria* L. production

Among 12 treatments, only a few generated a profit, while the majority led to economic loss. Treatment 10 (Cocoly) produced the maximum yield of 18.72 tons per hectare, with a net profit of Rs. 405,758.14/ha. Following T10 (Cocoly), T8 (Discovery) yielded 13.996 tons/ha and generated a profit of Rs. 303,713.49/ha, indicating good performance as well. Further, T7 (Compost) had a lower yield than the other profitable treatments (11.735 tons/ha), it was still able to turn a profit of Rs. 121,541.86/ha.

The current study demonstrates that the application of Cocoly fertilizer significantly enhanced the growth and yield of *Cucumis anguria* L., leading to higher net profits compared to other treatments. Therefore, it is recommended to use this fertilizer for optimal production, providing a viable solution for farmers aiming to increase the profits of potted *Cucumis anguria* L. in the dry zone of Sri Lanka.

Fig 3: Cost – Benefit analysis of *Cucumis anguria* L. production



4. Conclusion

The analyzed data showed that T10 (Cocoly) was significantly superior across all growth and yield parameters of *Cucumis anguria* L. Treatment 10 recorded the highest yield per vine (1.729 kg), whereas T12 produced 0.525 kg. Similarly, T10 achieved the highest total yield per hectare (19.87 tons/ha), while T12 yielded 6.034 tons/ha, marking a 69.63% increase in total yield (tons/ha) compared to the control treatment. In addition, the cost-benefit analysis revealed that T10 (Cocoly) was the most profitable treatment, generating the highest net profit of Rs. 405,758.14/ha compared to all other treatments. However, it is important to note that these results were derived from small-scale pot experiments. Therefore, additional large-scale field studies are necessary to validate these findings in real-world agricultural settings. Based on these findings, the use of Cocoly fertilizer shows strong potential, as it significantly enhances the growth and yield of pot-grown *Cucumis anguria* L., supporting profitable cultivation in the dry zone of Sri Lanka.

5. Acknowledgement

The authors gratefully acknowledge the financial support provided through the Memorandum of Understanding (MOU) between Eastern University, Sri Lanka, and World Vision Lanka (GTE), Colombo.

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