



Application of Organic Fertilizer and Coconut Water to Improve the Growth of Butterfly Tree (*Bahunea purpurea* L.) in Karst Land

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Abstract

Butterfly tree (*Bauhinia purpurea* L.) is known to possess high adaptability and can be cultivated in karst regions of Indonesia. In this context, organic fertilization combined with coconut water as a natural growth hormone is applied to enhance plant growth. Therefore, this research aims to determine the interaction between various organic fertilizers and coconut water in increasing the growth of the butterfly tree in the experimental garden of the Faculty of Agriculture, UPN Veteran Yogyakarta. A Completely Randomized Design (CRD) was used with a Factorial method between August and September 2025. The first factor was the type of organic fertilizer, consisting of cow and goat manure, as well as vermicompost. The second factor was the 25%, 50%, and 75% concentrations of coconut water. The results showed that there was no interaction between organic fertilizers and coconut water. Organic goat manure and vermicompost produced percentage of live plants, plant height, and number of leaves than cow manure. Meanwhile, vermicompost showed the longest root length and the largest number of roots compared to cow and goat manure. The 50% coconut water concentration produced the largest percentage of live plants and the number of roots.

Keywords: Organic Fertilizer, Coconut Water, Butterfly Tree, Karst Land

INTRODUCTION

Karst land is characterized by unique topography and geomorphology (Kusumayudha, 2018). In ancient times, karst was known as a barren, arid region frequently affected by drought. However, the land can be used to cultivate the butterfly tree or *Bauhinia purpurea* L., which is an edible species of flowering plant in the Fabaceae family. In Indonesia, the tree is known as *daun kupu-kupu*, and the leaves have a citrusy, sour taste. The Philippines uses the plant as a souring agent for *sinigang* and similar dishes, or pickle seasoning (Seidemann, 2005). Furthermore, ethanol extracts from the young leaves and fruit have antitoxin activity and can control toxin levels in the human body. The flower extract is also reported to have anti-inflammatory, antinociceptive, and antipyretic activity (Anonymous, 2002).

Butterfly tree belongs to the legume family and has the advantage of strong wood. The roots grow slowly and do not damage road construction (Megumi, 2009). The wood is quite hard, dark brown in color, and sinks in water but possesses soft and smooth fibers, with beautiful, textured colors. Additionally, the plant serves multiple functions, including use as ornamental or shade plants, agents for erosion prevention and resistance, enhancers of food flavor, sources of animal feed to increase protein content in goats by 12.6%, and natural soil fertilizers. The leaves have a fairly high nutritional value, with a water, ash, crude protein, fat, BETN, Ca, and P content of 68.46%, 6.88%, 17.47%, 33.55%, 36.95%, 0.02%, and 1.15%, respectively (Anonymous, 2005).

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A "back to nature" lifestyle has become a popular choice, making the use of organic fertilizers a priority. Butterfly tree can grow in karst areas with dry environments, but fertilization is necessary to increase the seedling growth. Fertilization increases the nutrient content in the soil to improve crop quality and quantity (Popi *et al.*, 2018). The USEPA defines organic fertilizer as manure or compost applied to plants as a source of nutrients (Funk, 2014).

Fertilizer is an organic material subjected to a composting process, leading to a homogeneous texture and color. This product can be obtained from cow, goat, and vermicompost manure, fermented into organic fertilizer. The quality of fertilizer depends on the raw materials, but not all types are suitable for the plants being cultivated.

A plant growth regulator (PGR) is a non-nutrient organic compound that can promote, inhibit, or qualitatively alter plant growth and development (Ratnasari dan Ansar, 2022). According to Harjadi (2009), the activity of PGR in plants is influenced by the concentration and sensitivity of the tissue. Coconut water contains auxin, cytokinin, and gibberellin, with nutrients known to promote growth, such as potassium, vitamins, and minerals. This natural ingredient can be used as a PGR to increase plant height, total leaves, and the area of leaves (Herastuti *et al.*, 2024).

Organic fertilizers made from cow and goat manure, as well as vermicompost, are used to supplement plant nutrients, while coconut water provides natural PGR. Different organic fertilizers interact with coconut water to stimulate the growth of the butterfly tree. Therefore, this research aims to determine the interaction between various organic fertilizers and coconut water on the growth of butterfly tree seedlings.

Theoretically, this study enriches the knowledge of organic fertilizer and coconut water in improving the adaptability of the butterfly tree or *Bauhinia purpurea* L., in marginal land such as karst areas and environmental risk. Practically, the findings can serve as a reference for local farmers and land managers in selecting suitable organic fertilizers and coconut water to enhance plant survival and productivity in degraded environments.

LITERATURE REVIEW

Butterfly flower belongs to the Papilionaceae family and is characterized by two-lobed or twin-leafed leaves. The *Bauhinia* genus features flowers with five petals, resembling orchids; hence, the name "Orchid Tree." These flowers are arranged in racemes. The morphological characteristics of these leaves and flowers are characteristic of the *Bauhinia* genus (Anonymous, 2002). Butterfly tree is a medium-sized and grows to a height of 5 meters. The bark is grayish-brown, and the leaves are 10-20 cm long and green, resembling butterfly wings. The base is doubly rounded (heart-shaped), and the tip is oval. The flowers are pink, five-petaled, and fragrant. Ripe fruit is dark brown, firm, and slightly open, with the flower blooming late in the year (Alamendah, 2014). The trees thrive in tropical regions at altitudes of 500–2,000 meters above sea level, under fertile, moist, well-drained sandy, clayey, or gravelly soils, with temperatures ranging from 12–21°C and annual rainfall between 1,000–5,000 mm. The classification includes Kingdom: Plantae, Division: Tracheophyta, Class: Dicotyledon, Order: Fabales, Family: Fabaceae, Genus: *Bauhinia*, Species: *Bauhinia Purpurea* L. This plant has single, alternate leaves, rounded to shallow-heart-shaped base, up to 12 cm x 12 cm. The Length and width of leaves are about 7-12 cm, while the edges possess a smooth surface. The stalks are finely hairy to glabrous at 2.5-3.5 cm long, and the blades are 4.5-11 cm long (Megumi, 2009). The tree produces inflorescence racemes consisting of 6–10 flowers arranged in terminal panicles, with numerous blooms featuring a turbinate hypanthium and petals that range from purple to nearly white. Flower buds are club-shaped (velvety-shaped), about 3-4 cm long before anthesis. The flowers contain 3–4 fertile stamens with versatile anthers approximately 6 mm long, a superior ovary, and a corolla comprising five narrow, basally

constricted, oblong petals measuring 3–5 cm in length with claws 5–10 mm long. The banner petal is about 7 mm wide and marked with purple streaks (Fern, 2014).

The two valves of the calyx are tubular with five teeth and a corolla along the side of a fully developed flower. In the fall, the Orchid-Tree is adorned with numerous showy, fragrant flowers, with purple, pink, and lavender petals before the leaves drop. The flowers appear on the tree from September to November and are followed by slender, 12-inch-long brown seed pods in the winter. The fruit is a brown, strap-like, non-septate, elongated, dehiscent pod, approximately 15-30 cm long and up to 1.5-2.5 cm wide, containing 10-15 shiny, brown, glabrous, dehiscent, round, flat seeds that twist when opened. The seeds form very quickly, and flowering trees show numerous green pods. Even though most pods open in drier winter weather, some persist in the next flowering season. The fruit ripens in spring and summer and is attractive to wildlife. The ovoid seeds are 13-16 mm in diameter and 1-2 mm thick. The two leaf lobes represent two siblings, and the specific name refers to the purple color of the flowers. Seeds ripen between February and May, with an increased tendency in the West than in the East. The brown pods are collected and dried before extracting the seeds (Anonymous, 2001).

Butterfly tree can grow in karst and dry areas. However, organic fertilizer is needed to stimulate root growth due to slow growth. The role of organic fertilizer in improving soil physical properties is to enhance the structure since organic matter can bind particles into aggregates, improving pore size distribution, soil water retention, and aeration (Herastuti *et al.*, 2024). In soil chemical properties, fertilizer serves as a provider of macro and micro nutrients, increasing soil cation exchange capacity, and forming complex compounds with toxic metal ions such as Al, Fe, and Mn. Meanwhile, in soil biological properties, fertilizer acts as a source of energy and food for soil micro and meso fauna (Husnain and Widowati 2015).

Organic fertilizer is obtained from cow, goat, and vermicompost manure. The nutrient contents of cow (Khayum *et al.*, 2018) and goat (Novriani *et al.*, 2020) manure are 0.4% and 0.7% nitrogen (N), 0.2% and 0.4% phosphorus (P), as well as 0.17% and 0.25% potassium (K). Meanwhile, the nutrient content of vermicompost fertilizer is 1.79% nitrogen, 1.85% potassium, and 0.85% phosphate (Lokha *et al.*, 2021). According to Nabilah *et al.* (2023), the application of goat manure can increase the number of leaves, number of branches, header diameter, plant fresh weight, chlorophyll analysis, and omega-3 analysis. Peni *et al.* (2023) found that the application of a goat manure dose of 15 tons/ha obtained the best height and number of lettuce leaves.

Vermicompost is an organic fertilizer processed from the waste of cultivated worms. This fertilizer is rich in macro and micronutrients (Afsyah *et al.*, 2021). Damaita *et al.* (2024) found that vermicompost provided maximum harvest index and fresh weight for bok choy. Masito *et al.* (2014) reported that cow manure could increase the active compound content of tannin, flavonoid, and alkaloid in soursop plants. A dose of 100 kg per plot of cow manure can produce the best results for rice plants (Benauli *et al.*, 2023).

Coconut water is a natural PGR used to stimulate cell division and plant growth. Yong *et al.* (2009) stated that coconut water PGR contained auxin, as well as cytokinins such as trans-zeatin and kinetin, gibberellin, and ABA. Coconut water contains indole-3-acetic acid (IAA), the main auxin in plants. IAA is a weak acid synthesized in the meristematic region located at the shoot tip and transported to the root of the plant. Ratnasari and Ansar (2022) stated that the addition of coconut water at 20% led to a better number of leaves and fresh weight 15 and 25 days after planting in shallot plants. According to Ariyanti *et al.* (2020), a coconut water concentration of 25%-50% resulted in better growth in plant height, stem diameter, and chlorophyll content in cinchona.

RESEARCH METHOD

This research was conducted in the experimental garden of the Faculty of Agriculture, UPN

"Veteran" Yogyakarta, at an altitude of 190 m above sea level between August and September 2025. The materials used were seeds from the butterfly tree, distilled water, organic fertilizer from cow, goat, and vermicompost manure, and coconut water. The tools used were meters and measuring cups. The method adopted in the field experiments was a Completely Randomized Design (CRD), arranged in a factorial manner with three replications. The first factor was the type of organic fertilizer, with three levels: cow manure, goat manure, and vermicompost. The second factor tested was the 25%, 50% and 75% concentration of coconut water.

The planting medium used was a mixture of soil and organic fertilizer, composed of cow manure, goat manure, and vermicompost, in a 1:1 ratio. The container used was a 10 cm x 10 cm polybag, and the seeds were soaked in warm water for 24 hours. The observed variables were the percentage of live, plant height, number of leaves, as well as length and number of roots. Data were analyzed for variance at the 5% level, followed by comparison of the mean value using Duncan's Multiple Range Test at the 5% level.

FINDINGS AND DISCUSSION

The live percentage of goat manure is better than cow manure and vermicompost. Goat manure is preferred because many people in the surrounding area keep goats. The survival rate is calculated by dividing the number of plants grown by the number of plants. A 75% coconut water concentration leads to a higher survival rate than 25%, but not significantly different from 50%. The survival rate is more influenced by the surrounding environment, namely temperature, rainfall, and humidity.

Table 1. Application of organic fertilizer and coconut water to increase the growth of the butterfly tree in terms of percentage of live (%), plant height (cm), and number of leaves

Types of Organic Fertilizers	Growth		
	Percentage of Live	Plant Height	Number of Leaves
Cow Manure	84.72 b	10.13 b	3.22 b
Goat Manure	98.61 a	13.40 ab	3.83 a
Vermicompost Fertilizer	94.44 ab	14.99 a	3.89 a
Coconut Water Concentration			
25%	87.5 b	12.12 a	3.67 a
50%	91.67 ab	13.36 a	3.72 a
75%	98.60 a	13.04 a	3.56 a
Interaction	(-)	(-)	(-)

Description: The average treatment followed by the same letter in the same column shows no significant difference based on the DMRT level of 5%; (-) shows no interaction.

In terms of plant height growth, vermicompost with a high nitrogen content of 1.79% significantly outperformed cow manure. Nitrogen plays a role in plant vegetative growth as a component of essential amino acids necessary for tissues to form and divide cells ([Napitupulu and Winarto, 2010](#)). Coconut water concentrations of 25%, 50%, and 75% showed no significant difference. This is because applying coconut water three times was not sufficient for plant growth.

Goat manure and vermicompost fertilizer were equally effective in increasing the number of leaves compared to cow manure. The slow-release nature of goat manure ensures that plants receive sufficient nutrients. The high nitrogen content of vermicompost also contributes to an increased number of leaves. Nitrogen stimulates growth and formation of leaves as well as plays a crucial role in the formation of chlorophyll used in photosynthesis ([Mastur et al., 2016](#)). Factors

influencing plant growth include the availability of water, nutrients, and sunlight essential for photosynthesis. Therefore, increasing the number of leaves can improve photosynthesis (Syifa *et al.*, 2020). Coconut water concentrations of 25%, 50%, and 75% did not significantly increase leaf growth. This is because the three applications did not provide sufficient additional natural growth regulators.

The root length growth in the application of vermicompost fertilizer was the longest compared to cow and goat manure. Vermicompost contains 1.79% nitrogen, 1.85% potassium, and 0.85% phosphate. This fertilizer has a positive effect on plant root length due to the nutrient content, particularly phosphorus and potassium. Furthermore, vermicompost increases soil fertility, loosens the growing medium, and improves the structure and water retention capacity to support the development of healthy and strong plant root systems. The application of coconut water at 25%, 50%, and 75% did not significantly differ between treatments since the plants use internal plant PGR. External PGR was not required because the plants were young.

Table 2. Application of organic fertilizer and coconut water to increase the growth of butterfly tree in terms of length and number of roots

Types of Organic Fertilizers	Growth	
	Root length	Number of roots
Cow Manure	3.70 c	5.12 b
Goat Manure	4.78 b	5.13 b
Vermicompost Fertilizer	6.22 a	6.20 a
Coconut Water Concentration		
25 %	4.49 a	5.19 b
50%	5.00 a	6.24 a
75%	5.22 a	5.02 b
Interaction	(-)	(-)

Description: The average treatment followed by the same letter in the same column shows no significant difference based on the BUMRT level of 5; (-) reports no interaction.

Vermicompost produces more root length and number of roots than cow and goat manure because the number of roots is influenced by the higher nutrient content. Vermicompost also increases root length by providing macronutrients such as nitrogen and phosphorus. This fertilizer enhances soil structure, creating a looser texture that facilitates root penetration and the ability to retain moisture for optimal nutrient and water absorption. Organic matter content supports the development of soil microbes, which help break down nutrients into forms absorbed by the roots.

A 50% concentration of coconut water produces more roots than 25% and 75%. Coconut water influences the root because of hormones auxin, cytokinin, and gibberellin, as well as various nutrients. Auxin at 50% also improves the number of roots, but lower or higher concentrations do not affect plants. This hormone plays a role in stimulating cell division and increasing root count.

CONCLUSIONS AND FURTHER RESEARCH

In conclusion, there was no interaction between organic fertilizer and coconut water. Organic goat manure and vermicompost produced percentage of live plants, plant height, and number of leaves than cow manure. Meanwhile, vermicompost showed the longest length and the highest number of roots compared to cow and goat manure. Coconut water concentration of 50% produced the highest percentage of live plants and number of roots.

Future research should be conducted over a longer duration, three to four months. Parameters should be added with fresh production, dry matter production, organic matter

production, crude fiber, and crude protein to expand these findings.

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