ISETC2025

UNIVERSITI TEKNOLOGI MARA

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2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

TRAIT-BASED ANALYSIS OF RAINFALL PARTITIONING IN TROPICAL SHRUBS: A COMPARATIVE STUDY OF *Cordyline* sp. AND *Heliconia* sp.

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Abstract: his study investigates the rainfall interception dynamics of two morphologically distinct tropical shrub species, *Heliconia* sp. and *Cordyline* sp., in a coastal equatorial region of Malaysia. With increasing recognition of shrubs in urban hydrology and ecological landscaping, the research aims to quantify how structural traits influence interception, throughfall, and stemflow. A 30-day field experiment was conducted involving replicated measurements of rainfall partitioning under controlled monitoring of gross precipitation, throughfall, and stemflow. Results reveal that *Cordyline* sp., characterized by taller stature, linear leaves, and rough, channeled stems, exhibited significantly higher interception losses (8.96–35.14%) and stemflow (0.64–1.21%), whereas *Heliconia* sp., with shorter height and broader, smooth-leaved canopies, allowed more throughfall (0.91–33.37 mm) and exhibited lower interception (5.30–7.67%). Interception losses were particularly pronounced under low rainfall (<10 mm), where over 95% interception was recorded in certain instances, especially for dense *Cordyline* canopies. Regression analyses identified canopy coverage and shrub height as significant structural factors influencing interception partitioning. These findings underscore the need to integrate species-specific shrub traits into urban water management and ecological planning strategies.

Keywords: *Rainfall interception, plant morphology, tropical, shrubs, urban management*

INTRODUCTION

Rainfall interception is a hydrological process where vegetation such as shrubs intercepts and retains a portion of precipitation before it reaches the ground. This process influences water distribution, nutrient cycling, and stormwater management, especially in urban ecosystems. Shrubs, with their diverse canopy structures, are effective in rainfall interception, which helps mitigate urban flooding (Qin, 2020), reduce runoff, and enhance water quality (Cleophas et al., 2022) . This study focuses on two tropical shrub species, *Heliconia* sp. and *Cordyline* sp. The aim is to measure and compare their interception capacity to inform green infrastructure and sustainable water management practices. Past studies indicate interception varies by species, leaf morphology, canopy density, and environmental factors (Yang et al., 2019) (Nowak et al., 2020). This study employs empirical field measurements from 30 rainfall events, quantifying gross precipitation, throughfall, and stemflow to assess rainfall interception.

MATERIALS AND METHODS

The study was conducted at a designated research site characterized by a tropical climate, offering consistent rainfall and humidity conducive to monitoring rainfall interception. *Heliconia* sp. and *Cordyline* sp. were selected for their contrasting structural features. In general, *Heliconia* sp. is characterized by large, broad, and horizontally spreading leaves with a dense foliage structure, which enhances its canopy storage capacity. Its smooth, upright stems facilitate effective stemflow. In contrast, *Cordyline* sp. exhibits narrower, lance-shaped leaves arranged vertically with sparser canopy coverage, leading to higher throughfall and reduced interception capacity. In this study, *Heliconia* sp. has a

height range of 0.3 to 1.2 meters, with ovate and lanceolate glossy leaves and smooth stems. In contrast, *Cordyline* sp. ranges from 1.0 to 1.9 meters in height, with linear and blade-shaped glossy leaves and rough stems. These morphological differences influence their interception capabilities and were central to this comparative study.

Instruments included rain gauges, rubber tubes, adhesive materials, measuring tapes, measuring cylinders, and d-tapes. Gross precipitation was measured using rain gauges placed in open areas. Throughfall was collected via gauges placed under the shrub canopies, while stemflow was captured using collars and tubes attached to shrub stems, leading to collection bottles. Data was recorded for 30 rainfall events. Canopy dimensions and stem diameters were measured to correlate plant morphology with interception capacity. Data was analyzed using standard hydrological formulas to compute interception (I = P - TF - SF).

RESULTS AND DISCUSSION

The total precipitation recorded during the study period was 339.4 mm, with daily rainfall ranging from 1.43 mm to 34.22 mm. Most rainfall events (67%) were classified as low intensity (<10 mm), highlighting the importance of canopy interception under light rain conditions. *Cordyline* sp. demonstrated interception losses reaching up to 95% during these light rainfall events, reflecting its high capacity for rainfall retention. In contrast, *Heliconia* sp. exhibited more stable and consistently lower interception rates. Throughfall was negatively correlated with canopy coverage ($R^2 = 0.54$) (Figure 1) and shrub height ($R^2 = 0.27$) (Figure 2), indicating that denser and taller shrubs intercepted more rainfall, reducing the volume that reached the ground. Conversely, stemflow showed a strong positive correlation with shrub height ($R^2 = 0.79$) (Figure 3) and moderate correlation with canopy coverage ($R^2 = 0.36$) (Figure 4), suggesting that taller, denser shrubs, especially *Cordyline* sp., more effectively funneled intercepted water down the stem. These trends underscore the role of morphological traits, such as vertical leaf orientation and textured stems, in modulating hydrological partitioning between interception, throughfall, and stemflow (Liu & Zhao, 2020).

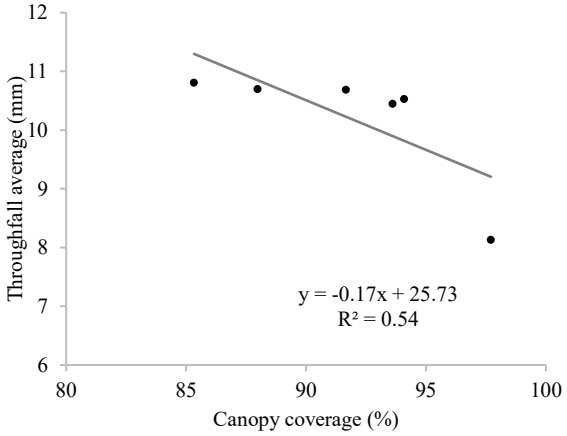


Figure 1. Relationship between throughfall and canopy coverage

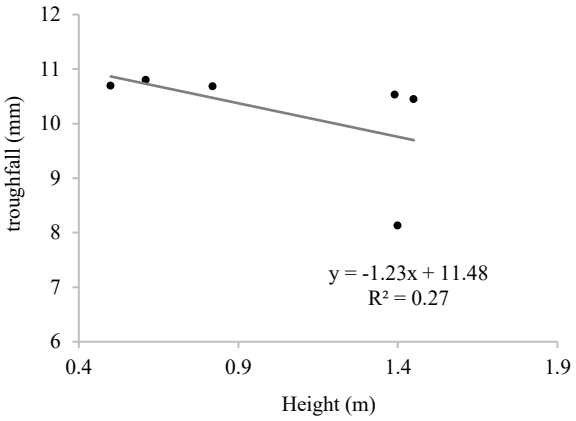


Figure 2. Relationship between throughfall and shrub height

Differences in interception and water redistribution between the two species reflect their structural adaptations. *Cordyline* sp.'s architecture facilitates rainfall capture and channeling, making it suitable for erosion-prone zones and root-zone moisture enhancement. In contrast, *Heliconia* sp. promotes even water distribution via higher throughfall, benefiting broader soil coverage. Interception variability, especially under low rainfall (Magliano et al., 2019; Zabret & Šraj, 2019), indicates a saturation effect where small events are mostly intercepted before contributing to throughfall or stemflow.

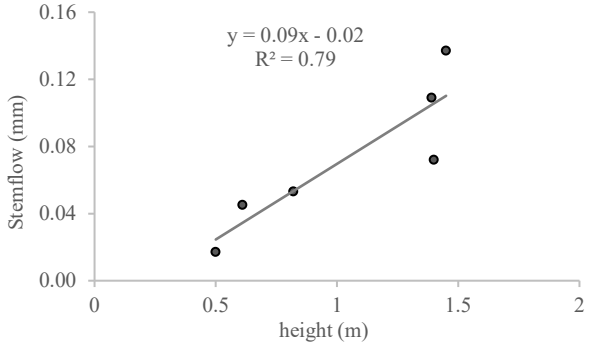


Figure 3. Relationship between stemflow and shrub height

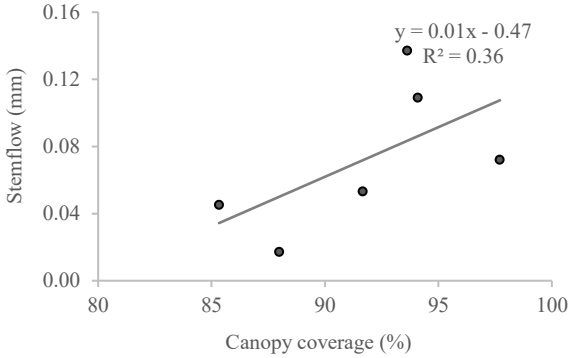


Figure 4. Relationship between stemflow and shrub height

CONCLUSIONS

The morphological divergence between *Heliconia* sp. and *Cordyline* sp. underscores the critical role of plant functional traits in shaping hydrological processes, particularly rainfall interception, stemflow, and throughfall. The study found that interception loss ranged from 5.30% to 7.67% for *Heliconia* sp. and from 8.96% to as high as 95% for *Cordyline* sp., particularly under low-intensity rainfall conditions. These differences highlight how specific morphological traits, such as canopy architecture, leaf shape and orientation, stem texture, and overall plant height, directly influence the partitioning of rainfall. *Cordyline* sp., with its taller stature, linear blade-shaped leaves, and rough but channeled stems, exhibited significantly higher interception and stemflow, making it suitable for applications in erosion control and localized moisture retention. In contrast, *Heliconia* sp., characterized by a shorter height and broader leaves, promoted higher throughfall, supporting wider soil moisture distribution. By leveraging such plant-specific traits, land managers and urban planners can optimize landscape design to enhance water retention, reduce runoff, and improve climate resilience. These findings reinforce the value of trait-based ecological research in developing sustainable, water-sensitive environments.

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Sekian, terima kasih.

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