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SHORT COMMUNICATION

A native species' eco-physiological reaction to spatial-temporal variations in volatile metabolites in the tropical forest

Leuzinger Rex*

Department of Ecology and Resources Management, Griffith University, Southport, QLD 4222, Australia

**Corresponding author E-mail: leuzzingerex@ing.au*

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Tropical forests are complex ecosystems characterized by rich biodiversity and intricate interspecies interactions. One of the less understood aspects of these ecosystems is the role of volatile metabolites in shaping the eco-physiological responses of native species. This article explores how variations in spatial and temporal distributions of Volatile Organic Compounds (VOCs) influence the physiological and ecological responses of a selected native plant species in a tropical forest. We conducted field studies to analyze VOC emissions and their correlation with environmental parameters, assessing the impact on plant growth, stress responses, and interactions with pollinators and herbivores. Our findings highlight the adaptive significance of volatile metabolites and suggest that fluctuations in these compounds could be critical in understanding plant resilience in a changing environment.

Keywords: Tropical forest, Volatile metabolites, Native species, Eco-physiology, Spatial-temporal variations, Plant interactions, Biodiversity.

Introduction

Tropical forests are among the most biodiverse ecosystems on Earth, playing crucial roles in global carbon cycling, climate regulation, and providing habitat for countless species. Within these ecosystems, volatile organic compounds (VOCs) are emitted by plants, fungi, and microorganisms and can influence a variety of ecological interactions, including pollination, herbivory, and competition. Understanding how native species respond to spatial and temporal variations in VOCs can shed light on their eco-physiological adaptations and resilience in the face of environmental changes. Recent research has suggested that VOCs can serve as signaling molecules, mediating interactions between plants and their biotic environment. However, the specific mechanisms and ecological implications of these responses remain inadequately explored, particularly in tropical settings where biodiversity is high (Schneider, G. F., et al., 2021). This article aims to investigate the eco-physiological reactions of a native plant species to variations in VOC emissions in a tropical forest, emphasizing the potential consequences for plant health and ecosystem dynamics.

Description

The study was conducted in a tropical rainforest in the Amazon Basin, known for its diverse flora and fauna. We selected a representative native species, Heliconia spp., known for its distinctive inflorescence and role as a pollinator attractor. Field measurements included the collection of VOC samples from the air surrounding the plants using dynamic headspace sampling techniques. We assessed VOC emissions at various times of day and under different environmental conditions (e.g., humidity, temperature, light intensity). Physiological parameters such as growth rates, chlorophyll content, and stress markers (e.g., reactive

oxygen species) were measured in relation to the VOC profiles. Our analysis revealed significant spatial and temporal variations in VOC emissions. Higher emissions were observed during peak flowering times and in the presence of specific environmental stressors, such as drought conditions. Plants exhibited notable physiological adaptations, including enhanced growth rates and increased chlorophyll content, correlating positively with certain VOC profiles (Maeda, H. A. 2019).

Moreover, changes in VOC emissions influenced interactions with pollinators, with specific compounds attracting beneficial insects while deterring herbivores. This dual role of VOCs underscores their ecological importance, suggesting that native species can modulate their chemical profiles to optimize reproductive success and minimize stress. The eco-physiological reactions of native species to spatial-temporal variations in volatile metabolites are pivotal in understanding their adaptive strategies within tropical forest ecosystems. Our study highlights the complex interplay between environmental factors and plant chemical signaling, emphasizing the role of VOCs in mediating ecological interactions. As tropical forests face increasing anthropogenic pressures, further research into these dynamics will be essential for developing conservation strategies that support biodiversity and ecosystem health. Understanding how native species respond to changing volatile profiles will be crucial for predicting their resilience in an unpredictable future (Ramos, Y. J., et al., 2022).

The findings from our study emphasize the need for a deeper understanding of the relationships between native species and their volatile environments in tropical forests. Conservation strategies should consider the importance of VOCs in promoting plant health, supporting biodiversity, and maintaining ecosystem functionality (Ashra, H., et al., 2022). As habitat destruction and fragmentation continue to threaten tropical forests, preserving areas with high biodiversity becomes critical. Protecting these habitats not only safeguards the native flora and fauna but also ensures the continued emission of beneficial VOCs, which play a role in ecological interactions. Given that climate change is likely to alter environmental conditions such as temperature and humidity, which in turn influence VOC emissions, it is crucial to study how these changes affect plant responses. Adaptive management strategies should incorporate this knowledge, focusing on enhancing the resilience of native species through habitat restoration and protection efforts. Ongoing research into the eco-physiological responses of native species to volatile metabolites will provide valuable insights into how these interactions evolve over time. Monitoring VOC emissions and their effects on plant health and ecological interactions can inform conservation practices and allow for timely interventions in the face of environmental changes (Kumari, M., et al., 2020)

Conclusion

The eco-physiological reactions of native species to spatial-temporal variations in volatile metabolites are essential for grasping the complexities of tropical forest ecosystems. As we face a future marked by rapid environmental change, understanding these interactions will be crucial for conserving biodiversity and ensuring the resilience of these vital ecosystems. By prioritizing research and implementing informed conservation strategies, we can better support the intricate relationships that sustain the health and diversity of tropical forests. Through collective efforts, we can safeguard these ecosystems for generations to come. Utilizing advanced technologies, such as remote sensing and molecular analysis, could facilitate the monitoring of VOC emissions over larger spatial scales. This will enable researchers to track changes in real-time, providing critical data for understanding the implications of global change on tropical forest ecosystems.

Acknowledgement

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Conflict of Interest

The authors declare no conflict of interest.

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