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Comparing Durations of Plant and Human Physiological Processes and Highlighting Their Importance to the Earth System

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Abstract

Highly dynamic physiology limits our ability to understand and compare durations of plant physiological and human physiological processes in concert. In this study, I used literature data and examined a reproductive process, fruiting, for deciduous rubber trees from two tropical rubber plantations grown in different geographical locations. In particular, I focused on fruiting timings and found that fruiting in rubber trees occurs within eight to nine months from the time when the rubber tree is dormant. The duration of this interesting physiological process is analogous to a situation, where women take about nine months to deliver a baby following fertilization. Based on the data, I generalize ("extrapolate") that every deciduous tree fruiting takes about eight to nine months since it is dormant. I recommend that the fruiting process be represented in earth system models for deciduous trees. I also suggest follow-up work that can be done in this field of research.

Keywords

Plant Physiology, Human Physiology, Fruiting, Deciduous Trees, Earth System Models

1. Introduction

Plants are invaluable and extraordinary in that they can turn sunlight's energy into food [e.g., [1]], which we humans cannot do. In general, appreciating this fact and communicating this fact to non-plant scientists takes a lot of work. The non-plant community often thinks it is a well-known process and thus has been well documented and quantified, which is not true. Plants provide many services to humans (including animals), such as oxygen [2], food, and shelter. In contrast, humans provide carbon dioxide concentrations to plants (both directly and

indirectly) [3] [4] so that plants can function. In the context of the environment, plants help sequester atmospheric carbon dioxide concentration [5], thus reducing atmospheric warming potentials.

Plants have several physiological processes that enable them to function and survive. Some basic physiological processes include photosynthesis, respiration, nutrient and water uptake, and light capture [6] [7] [8]. To my knowledge, most of these processes have been extensively studied in controlled environments (e.g., in greenhouses). Since atmospheric carbon dioxide concentration is predicted to continue to rise in the future [9] and there are so many plant species around the globe, plants' sensitivity to changed environmental conditions remains to be understood and elucidated.

Unlike plant physiology, human physiology consists of a much broader church of systems and is relatively complex. Some examples include blood/air circulation, digestive/excretory, immune, and reproductive and respiratory systems [10] [11]. Comparing duration of human physiology with plant physiology is not so straightforward. For example, human physiologists are still trying to understand how the male and the female reproductive system works [11]. Nutrients are one of the critical drivers of photosynthesis [e.g., [12]], whereas nutrients could have no value to the human body unless they enter the bloodstream. The above examples indicate that there could be data limitations.

It was in the early 1980s that we came to know that plants can eat air [13]. Subsequently, several earth system models (ESMs) [e.g., [14] [15]] have been developed to predict terrestrial plants' carbon, nutrient, and water cycles and scale them up to ecosystem levels. Over the last ten years, much effort has been put into ESMs to improve their carbon, nutrient, and water cycling processes [e.g., [16]]. One physiological process in plants is related to reproduction, fruiting. Fruiting is rarely represented in ESMs, likely due to a lack of observational data. Therefore, in this study, my main goal is to look into data for some deciduous trees, namely rubber trees from the tropics and explore timings of fruiting.

2. Methods

It is worth noting that rubber is an agricultural woody crop [17]. Historically rubber trees have been studied for a long time now. Rubber trees start blooming in the spring (around March in the northern hemisphere and July/August in the southern hemisphere) [18]. Rubber trees start producing fruits when they are four years old [19] and after two years following fruiting, the trees become mature [18].

To obtain the fruiting data, I looked into studies that I used recently from several geographical locations from Southeast Asiato implement a new rubber plant functional type in a community land model (CLM5) [20]. Since fruiting data was only available in studies from Indonesia [21] and China [22], I focused on these two studies. I would like to mention that the above two studies are on

mature rubber trees.

3. Results & Discussion

I observed fruiting in rubber trees occurring within eight to nine months from when the rubber tree is dormant. One mechanism could be related to the length of the growing season [18]. Since rubber trees are partly deciduous, I make a generalization that every deciduous tree fruiting takes about eight to nine months since it is dormant (or from the peak dormant time). This is obviously a broad extrapolation or stretch. Nevertheless, I tested this generalization by looking at data from temperate biomes (*i.e.*, sites from Germany) [23], and the fruiting is around nine to ten months in Germany too. Overall, the duration of this interesting physiological process is analogous to a situation, where women take about nine months to deliver a baby following fertilization. By this comparison, we note that the duration of plant and human physiological processes are similar.

Rubber trees drop their leaves when fruiting [21] [22]. This means their leaf carbon and transpiration rates decline when they do fruiting. This generally affects rubber trees' carbon, nutrient, and water cycles. Based on this implication, I recommend that the fruiting process be represented in ESMs for deciduous trees. Data on how fruiting affects leaf carbon and transpiration rates should be collected and looked into from around the globe. ESMs should generally improve their carbon and water biases for deciduous trees.

Through observation, I think we can find out how interesting nature is! The period of fruiting is similar in deciduous plants and women. This fascinating field needs further study, for example, by collecting more data to see to what extent my argument holds and also question the generalized observation I make. By synthesizing a large dataset, future work can also look into my observation's coincidence aspect.

4. Conclusion

My work about fruiting deciduous trees demonstrates how comparisons of duration of plant and human physiology can be made. My findings emphasize that the fruiting process be represented in earth system models for deciduous trees. I also suggest data collection on animal physiological data. Since many animals are so diverse, one can use some advanced techniques available today, such as Machine learning algorithms, and then look into plausible comparisons of duration of animal and plant physiological processes.

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Conflicts of Interest

I have no conflict of interest.

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