



A study of Parah (*Elateriospermum tapos*) Phenology at Park Ranger Station 5 Hui Lek

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ABSTRACT

Leaf and flower phenology of *Elateriospermum tapos* (Euphorbiaceae) was studied at Hui Lek Ranger Station, Khao Nan National Park during 2007~2010. In 2007, the timing of Parah budburst at Hui Lek Ranger Station started on the 13th February 2007 and ended on the 24th March 2007 with a budburst duration of 40 days. In 2008, the timing of budburst at Hui Lek Ranger Station on the 2nd January 2008 and ended on the 29th March 2008 with a budburst duration of 90 days. In 2009, the timing of budburst at Hui Lek Ranger Station was started on the 13th February 2009 and ended on the 17th March 2009 with a budburst duration of 33 days. In 2010, the timing of budburst at Hui Lek Ranger Station on the 10th February 2010 and ended on the 1st April 2009 with a budburst duration of 51 days. The mean \pm SD of climatic factors at the Parah forest from November 2006 to April 2010 was 24.17 ± 1.29 °C with a relative humidity of 88.35 ± 10.86 %, and a daily rainfall of 4.25 ± 9.78 mm. During budburst, there was almost no rainfall. This would help us to understand the effect of climate change by using Parah phenology as a bio-indicator.

KEY WORDS : Parah (*Elateriospermum tapos*), Phenology, Climate, Nakhon Si Thammarat, Thailand.

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ชีพลักษ์ของต้นประ (*Elateriospermum tapos*) หน่วยพิทักษ์อุทยานแห่งชาติเขานัน หน่วยย่อยที่ 5 ห้วยเลข

บทคัดย่อ

การศึกษานี้เป็นการศึกษาชีพลักษ์ของใบและดอกของต้นประ (*Elateriospermum tapos* (Euphorbiaceae) จากจุดศึกษา บริเวณห้วยเลข อุทยานแห่งชาติเขานัน จังหวัดนครศรีธรรมราช ในระหว่างปี พ.ศ. 2550 ถึงปี พ.ศ. 2553 ที่จุดศึกษาห้วยเลขในปี พ.ศ. 2550 ต้นประแตกตาดอดตั้งแต่ 13 ก.พ.-24 มี.ค. 2550 เป็นเวลา 40 วัน ในปี พ.ศ. 2551 ต้นประแตกตาดอดตั้งแต่ 2 ม.ค.-29 มี.ค. 2551 เป็นเวลา 90 วัน ในปี พ.ศ. 2552 ต้นประแตกตาดอดตั้งแต่ 13 ก.พ.-17 มี.ค. 2552 เป็นเวลา 33 วัน ในปี พ.ศ. 2553 ต้นประแตกตาดอดตั้งแต่ 10 ก.พ.-1 เม.ย. 2553 เป็นเวลา 51 วัน ที่จุดศึกษาห้วยเลขมีอุณหภูมิเฉลี่ยเท่ากับ 24.17 ± 1.29 °C ความชื้นสัมพัทธ์เท่ากับ $88.35 \pm 10.86\%$ และน้ำฝนเฉลี่ยวันละ 4.25 ± 9.78 มม. ในระหว่างที่มีการแตกตาดอดแทบจะไม่มีฝนตกเลย ข้อมูลนี้จะเป็นประโยชน์ในการ ศึกษาการเปลี่ยนแปลงของสภาพอากาศ โดยใช้ชีพลักษ์ของต้นประเป็นดัชนีบ่งชี้

คำสำคัญ : ประ, ชีพลักษ์, อุทยานแห่งชาติเขานัน จังหวัดนครศรีธรรมราช



1. Introduction

In tropical regions, leaf phenology and demography are highly diverse across various tree species [1]. Because leaf phenology and demography strongly influence forest productivity and plant-animal interactions, these traits have been investigated in tropical forests [2]. Leaf phenology has been related to abiotic factors, such as the amount of rainfall or water stress. In seasonal tropical rain forests, water stress would not be the main factor affecting leaf phenology [3,4]. Alternatively, irradiance seasonality and the effects of herbivores have been emphasized as the main factors [4,5]. However, most of these studies have concentrated on leaf phenology at forest community, species and/or individual tree levels. In seasonal forests, seasonality in meteorological factors does not regulate the phenology. The timing of leaf production may depend on the accumulation of carbohydrates in the shoots. Actually, leaf production phenology is not related to any meteorological factors at the population level, and the frequency of leaf emergence per year is greater in saplings exposed to more light in a tropical tree, such as *Elateriospermum tapos* [6].

Parah (*Elateriospermum tapos*) is the only plant in the monotypic family native to Thailand, Malaysia, and Sumatra Island. Parah (*Elateriospermum tapos*) is found at Jengka national forest in Malaysia [7], Belalong forest in Brunei [8] and Khao Nan National Park in Thailand. This species is abundant on the very friable, relatively

nutrient rich soil of the Segga neat series, with lower soil-water content, at least in the dry period [7]. Leaf phenology has been studied in the canopy species, *Elateriospermum tapos* (Euphorbiaceae), at various ontogenetic stages in a Malaysian rain forest [9]. The timing of leaf emergence was not synchronized among sapling individuals, and was not correlated with any meteorological factors of the preceding months. The leaf production rate is greater when there is more light, but the leaf shedding rate is not related to the light regime of the saplings. Thus, leaf production is enhanced by the light availability for each individual leaf. Non-synchronous leaf production appears to be important for sapling growth allowing saplings to occupy better-lit space quickly.

Parah (*Elateriospermum tapos*) is a big perennial canopy plant. This tree can tower from 20 to 40 m. The crown can easily spread to 10 meters. The leaf is monocotyledon, elliptic and stipule. Young leaves are pink and eye-catching. When fully grown the leaf is green and the stem is 6 ~ 8 centimeters long. Parah is a perennial that sheds leaves all year. When the Para flowers bloom they will be in a bunch. They look very much like the Para rubber tree flower. The female Para flower is about 0.5 cm wide.

As the Earth's climate changes, scientists are seeing changes in the phenology of global vegetation using satellite imagery [10]. In Biomes where climate changes seasonally, soil moisture and temperature also show seasonal patterns, which correspond with above ground climate [11]. Thus, the variability in the length of the growing season may be due to the number of days that moisture and heat in the soil are available for plant growth.



Soil moisture and temperature are dynamic in that they change rapidly depending on the climate, topography, land cover and soil properties that are present. They play a major role in the type, amount, and timing of vegetative growth as well as in the hydrologic cycle by affecting the rate of evapotranspiration (ET), drainage, and surface runoff. These processes are difficult to measure directly, but regardless, are nonetheless important for understanding water and energy fluxes. Furthermore, evapotranspiration and soil moisture are recognized as the central physical process and variable for predicting these fluxes [12].

This study aimed finding some associations between climatic factors, and phenology at study sites.

2. Proposed Techniques

Study Sites

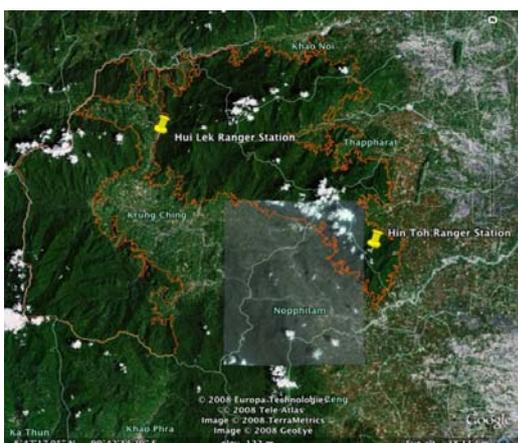


Figure 1. Study sites at Khao Nan National Park, Nakhon Si Thammarat province, Thailand. Yellow

pins represent Hui Lek and Hin Toh Ranger Stations.

Khao Nan was located at 8° 22'- 8° 45' N, 99° 37'- 99° 51' E, southern Thailand (Figure 1). We studied Parah Phenology at two study sites: Hui Lek Ranger station and Hin Toh Ranger Station. We installed the Davis Vantage Pro II plus wireless weather station (hereafter known as the Davis weather station) at the Hui Lek Ranger Station latitude 8.86543 °N and longitude 99.62230 °E) on the 21st November 2006 (Figure 1). Climatic factors were composed of the amount of daily rainfall, max/min temperature, relative humidity, solar radiation, UV, wind speed, and wind direction.

Parah phenology

At each study site, we selected 30 Parah trees and marked them by placing an individual tag on each tree at a height of 1.30 m (diameter at breast height (DBH)). We measured the diameter at the base (DAB), DBH, and the tree height. We visited these 30 selected Parah trees once every two weeks until the budburst occurred. Once the budburst occurred, we visited daily and recorded the timing of budburst and bloom burst at the top, the middle and the base of Parah trees.

3. Results and Discussion

Phenology

In 2007, the timing of Parah budburst at Hui Lek Ranger Station started on the 13th February 2007 and ended on the 24th March 2007 with a budburst duration of 40 days. The mean \pm SD of the number of budbursts at Parah forest was 2.25 ± 2.97 branches/day. The maximum number of budbursts/day occurred on the 1st March 2007



with a total of 12 branches/day. The flower burst started on the 15th February 2007 and ended on the 30th March 2007 with a flower burst duration of 44 days. The mean \pm SD of the number of flower bursts at the Parah forest was 2.05 ± 2.81 branches/day. The maximum number of flower bursts/day occurred on the 8th March 2007 with a total of 10 branches/day. This indicates that the timing of budbursts occurred 1 week prior to the timing of flower bursts. There were two day time lags between the timing of budbursts and flower bursts of Parah trees at the Parah park ranger station, Khao Nan National Park.

In 2008, the timing of budburst at Hui Lek Ranger Station on the 2nd January 2008 and ended on the 29th March 2008 with a budburst duration of 88 days. The mean \pm SD of the number of budbursts at Parah forest was 0.99 ± 1.84 branches/day. The maximum number of budbursts/day occurred on the 4th March 2008 with a total of 12 branches/day. The flower burst started on the 2nd January 2008 and ended on the 31th March 2008 with a flower burst duration of 90 days. The mean \pm SD of the number of flower bursts at the Parah forest was 0.99 ± 1.84 branches/day. The maximum number of flower bursts/day occurred on the 4th March 2008 with a total of 12 branches/day. This indicates that the timing of budbursts occurred at the same time prior to the timing of flower bursts. There were two days at the same time lags between the timing of budbursts and flower bursts of Parah trees at the Hui Lek Ranger Station, Khao Nan National Park.

In 2009, the timing of budburst at Hui Lek Ranger Station on the 13th February 2009 and ended on the 17th March 2009 with a budburst duration of 33 days. The mean \pm SD of the number of budbursts at Parah forest was 2.70 ± 3.54 branches/day. The maximum number of budbursts/day occurred on the 1st and 6th March 2009 with a total of 11 branches/day. The flower burst started on the 13th February 2009 and ended on the 13th March 2009 with a flower burst duration of 29 days. The mean \pm SD of the number of flower bursts at the Parah forest was 1.69 ± 2.91 branches/day. The maximum number of flower bursts/day occurred on the 23th February 2009 with a total of 9 branches/day. This indicates that the timing of budbursts occurred at the same time prior to the timing of flower bursts.

In 2010, the timing of budburst at Hui Lek Ranger Station on the 10th February 2010 and ended on the 1st April 2010 with a budburst duration of 51 days. The mean \pm SD of the number of budbursts at Parah forest was 4.24 ± 4.76 branches/day. The maximum number of budbursts/day occurred on the 10th March 2010 with a total of 19 branches/day. The flower burst started on the 10th February 2010 and ended on the 28th March 2010 with a flower burst duration of 46 days. The mean \pm SD of the number of flower bursts at the Parah forest was 2.82 ± 1.60 branches/day. The maximum number of flower bursts/day occurred on the 10th March 2010 with a total of 5 branches/day. This indicates that the timing of budbursts occurred at the same time prior to the timing of flower bursts.



Climatic factors

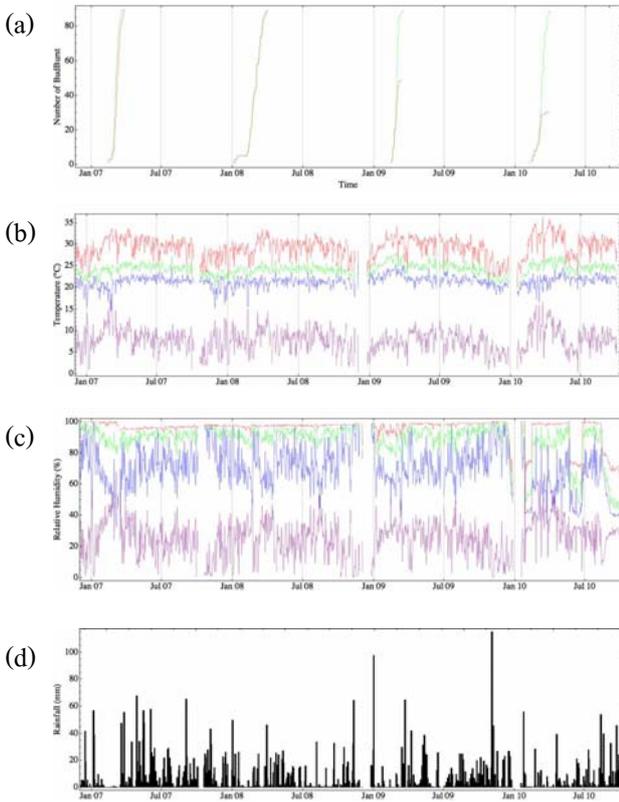


Figure 2. (a) bud burst (green line) and bloom burst (red line) and climatic data at Hui Lek study site from 2007-2009, (b) temperature (°C), (c) relative humidity (%) and (d) rainfall (mm). Red line (max), Green line (average), Blue line (min) and Purple line (max-min)

The mean \pm SD of climatic factors at the Parah forest from November 2006 to April 2010 was 24.17 ± 1.29 °C with a relative humidity of 88.35 ± 10.86 %, and a daily rainfall of 4.25 ± 9.78 mm. During budburst and flower burst period in 2007, there was almost no rainfall with some increases in max temperature, max-min

temperatures, and max-min relative humidity, and some decreases in minimum temperature and minimum relative humidity (Figure 2b-d). This would lead to synchronise budburst and flower burst in 2007.

On the other hand, in 2008, there were composed of three periods: (the first period) there was no rainfall in the beginning of January 2008, during this period there were 15 budburst branches occurred, (the second period) there were some rainfalls period, during this rainfall period, the budburst ceased, and (the third period) there was almost no rainfall, during this period, there were 75 budburst branches occurred (Figure 2a). This suggests that Parah trees require some drought period as an indicative cue for budbursts and flower burst. This drought stress signal for leaf shedding, budburst, and flower burst have been shown in many crop species including wheat, and sorghum.

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References

N. Osada, H. Takeda, A. Furukawa and M. Awang. “Leaf dynamics and maintenance of tree crowns in a Malaysian rain forest”, *Journal of Ecology*, Vol. 89, 2001, pp. 774–782.



L. Medway. "Phenology of a tropical rainforest in Malaya", *Journal of Linneous Society*, Vol. 4, 1972, pp. 117-146.

C. P. Van Schaik, J. W. Terborgh and S. J. Wright. "The phenology of tropical forests: adaptive significance and consequences for primary consumers", *Annual Review of Ecological Systematics*, Vol. 24, 1993, pp. 353-377.

S. J. Wright. "Phenological responses to seasonality in tropical forest plants", In: *Tropical forest plant ecophysiology*, S. S. Mullkey, R. L. Chazdon, and A. P. Smith (Eds.), Chapman and Hall, New York, USA, pp. 440-460, 1996.

T. M. Aide. "Pattern of leaf development and herbivory in a tropical understory community", *Ecology*, Vol. 74, 1993, pp. 455-466.

N. Osada, H. Takeda, A. Furukawa and M. Awang. Ontogenetic changes in leaf phenology of a canopy species, *Elateriospermum tapos* (Euphorbiaceae), in a Malaysian rain forest. *Journal of Tropical Ecology*, Vol. 18, 2002, pp. 91-105.

N. Osada, H. Takeda, A. Furukawa, T. Okuda and M. Awang. "Leaf phenology of trees in the Pasoh Forest Reserve," In: *Pasoh: ecology of lowland rain forest in Southeast Asia*, T. Okuda, N. Manokaran, Y. Matsumoto, K. Niyama, S. C. Thomas, and P. S. Ashton Eds., Springer- Verlag, Tokyo, Japan, a, pp. 111-121, 2003.

E. Cranbrook and D. S. Edwards. "A tropical rainforest: The nature of Biodiversity in Borneo at Belalong, Brunei", The Royal Geographical Society & Sun Tree Publishing, Singapore, 1994, pp. 389, 2003.

S. J. Riha, D. G. Rossiter and P. Simoends. "GAPS: general purpose atmosphere-plant-soil simulator", Cornell University, Ithaca, NY, 2003.

R. B. Myneni, C. D. Keeling, C. J. Tucker, G. Asrar and R. R. Nemani. "Increased plant growth in the northern high latitudes from 1981 to 1991", *Nature* Vol. 386, 1997, pp. 698-702.

E. R. Levine and R. G. Knox. "A comprehensive framework for modeling soil genesis", In: *Quantitative Modeling of Soil Forming Processes*, SSSA Special Publication 39, 1994.

B. Felzer and P. Heard. "Precipitation differences among GCMs used for the US National Assessment", *Journal of American Water Resources Association*, Vol. 35, 1999, pp. 1327-1340.