The oilseed palm *Acrocomia* Mart.

unlocking flowering patterns of various wild types from Brazil

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INTRODUCTION

As the world seeks resilient crops for sustainable development, the oilseed palm genus *Acrocomia* Mart. has become a focus due to its high-yield potential of vegetable oil production and adaptability to diverse environments. Endemic to the sub-humid tropics and subtropics of South and Central America, this emerging crop plays a vital role as an alternative to oil palm in sustainable vegetable oil cultivation, offering promising resources for the food industry, biofuel production, and other agro-industrial applications.

Acrocomia is monoecious, with both male and female flowers spatially separated on the same inflorescence. The genus displays protogynous flowering, where female flowers are receptive before the anthesis of the male flowers, effectively promoting genetic diversity through cross-pollination. While cross-pollination, facilitated by mystropine sap beetles and derelomine flower weevils, typically dominates, acrocomia is also self-compatible. The palm trees produce multiple inflorescences per season, which generally flower successively. Thus, flowering synchrony—both within individual plants and plant stands—is essential for maximizing pollination success and fruit set.

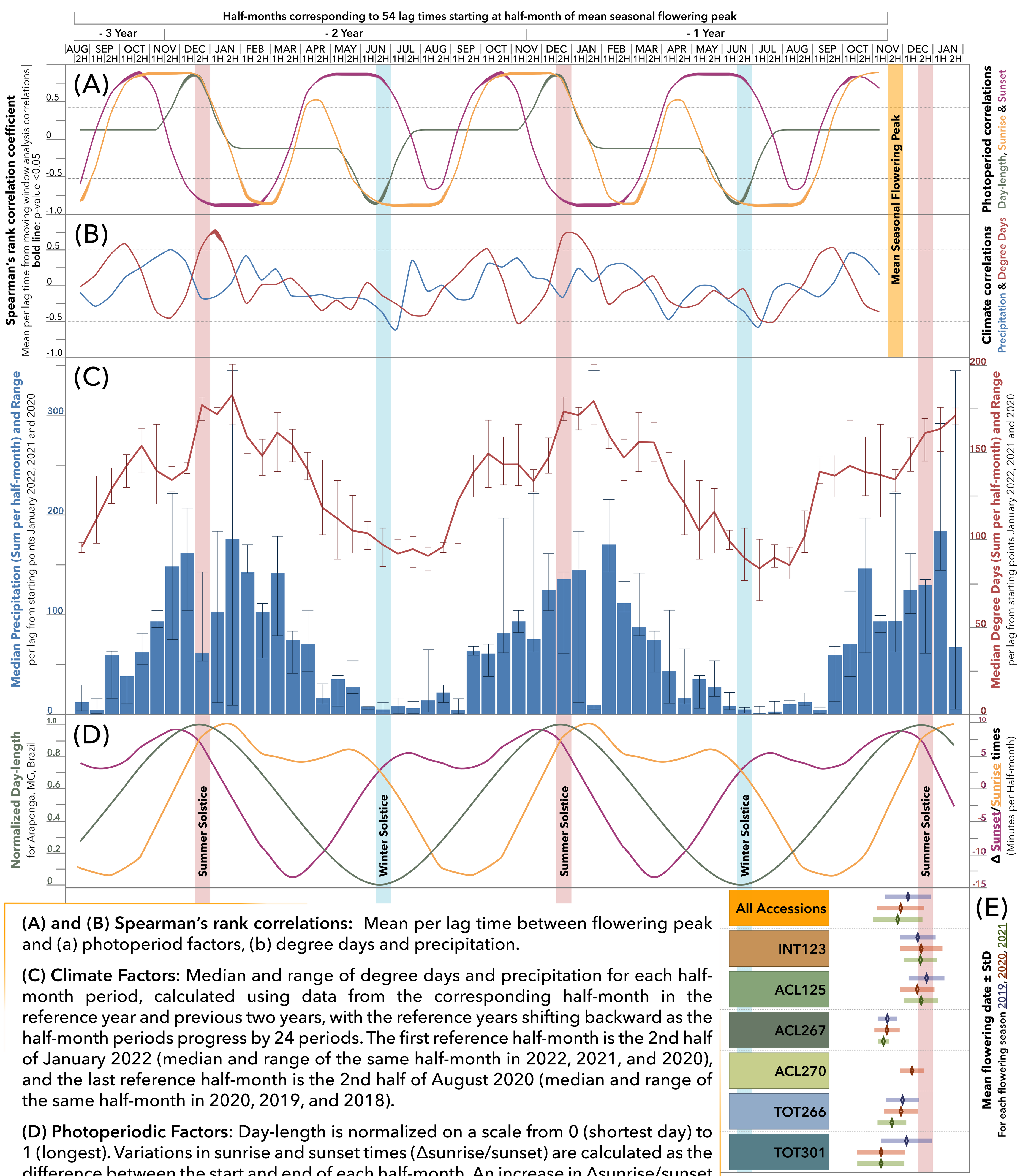
Notably, hypotheses[1] suggest that precipitation may act as a trigger for flowering, as acrocomia flowering starts with the transition from the dry season into the rainy season in its growing regions. Exploring the potential link between environmental factors and flowering timing could provide valuable insights for optimizing cultivation practices and advancing plant breeding programs aimed at improving yield stability and enhancing resilience to climate variability.

Therefore, the flowering phenology of six accessions from the BAG-Macaúba living germ-plasm collection at the Federal University of Viçosa, Brazil was monitored over three years to explore its relationship with climate and photoperiod factors .

CONCLUSION

While the number of the accessions' flowering events varies annually, flowering synchrony is closely linked to photoperiodic factors, enabling prediction of flowering cycles and the potential for maximizing productivity through strategic cultivation management.

RESULTS II: LINKING FLOWERING PEAK WITH CLIMATE & PHOTOPERIOD



(A) and (B) Spearman's rank correlations: Mean per lag time between flowering peak and (a) photoperiod factors, (b) degree days and precipitation.

(C) Climate Factors: Median and range of degree days and precipitation for each half-month period, calculated using data from the corresponding half-month in the reference year and previous two years, with the reference years shifting backward as the half-month periods progress by 24 periods. The first reference half-month is the 2nd half of January 2022 (median and range of the same half-month in 2022, 2021, and 2020), and the last reference half-month is the 2nd half of August 2020 (median and range of the same half-month in 2020, 2019, and 2018).

(D) Photoperiodic Factors: Day-length is normalized on a scale from 0 (shortest day) to 1 (longest). Variations in sunrise and sunset times (Δsunrise/sunset) are calculated as the difference between the start and end of each half-month. An increase in Δsunrise/sunset indicates later sunrise or sunset, while a decrease signifies earlier times.

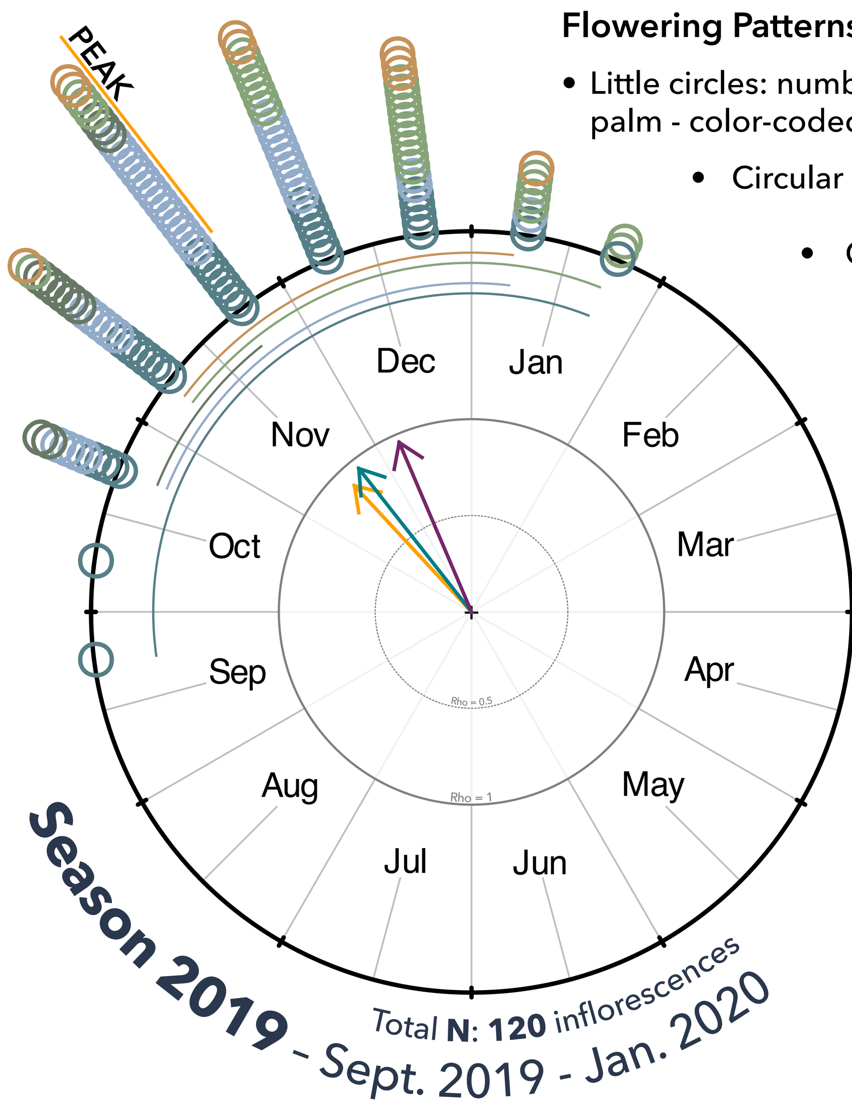
(E) Flowering time: mean ± standard deviation per season and accession, linearized from circular mean and angular deviation.

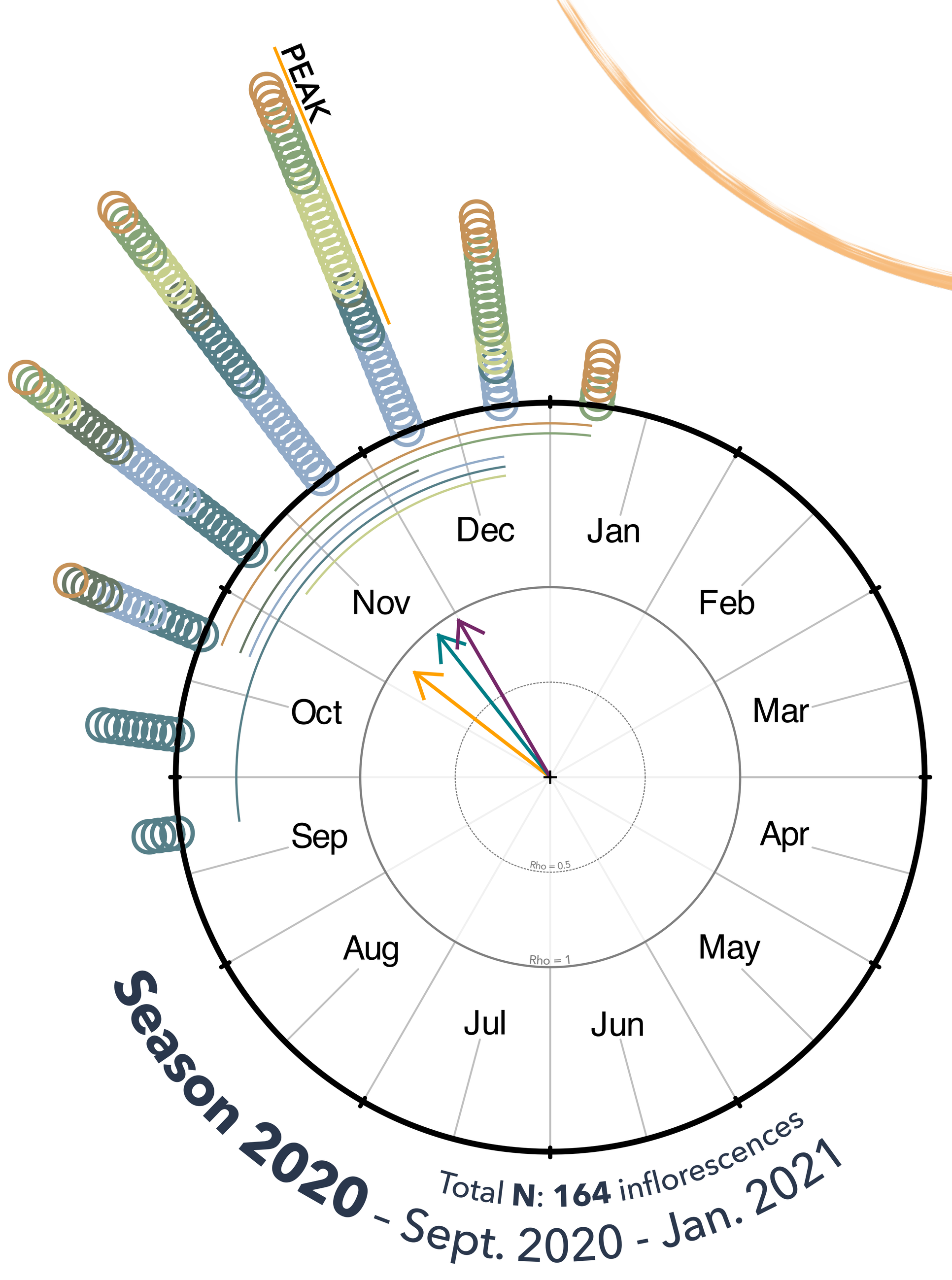
RESULTS I: PHENOLOGY AND FLORAL ABUNDANCE

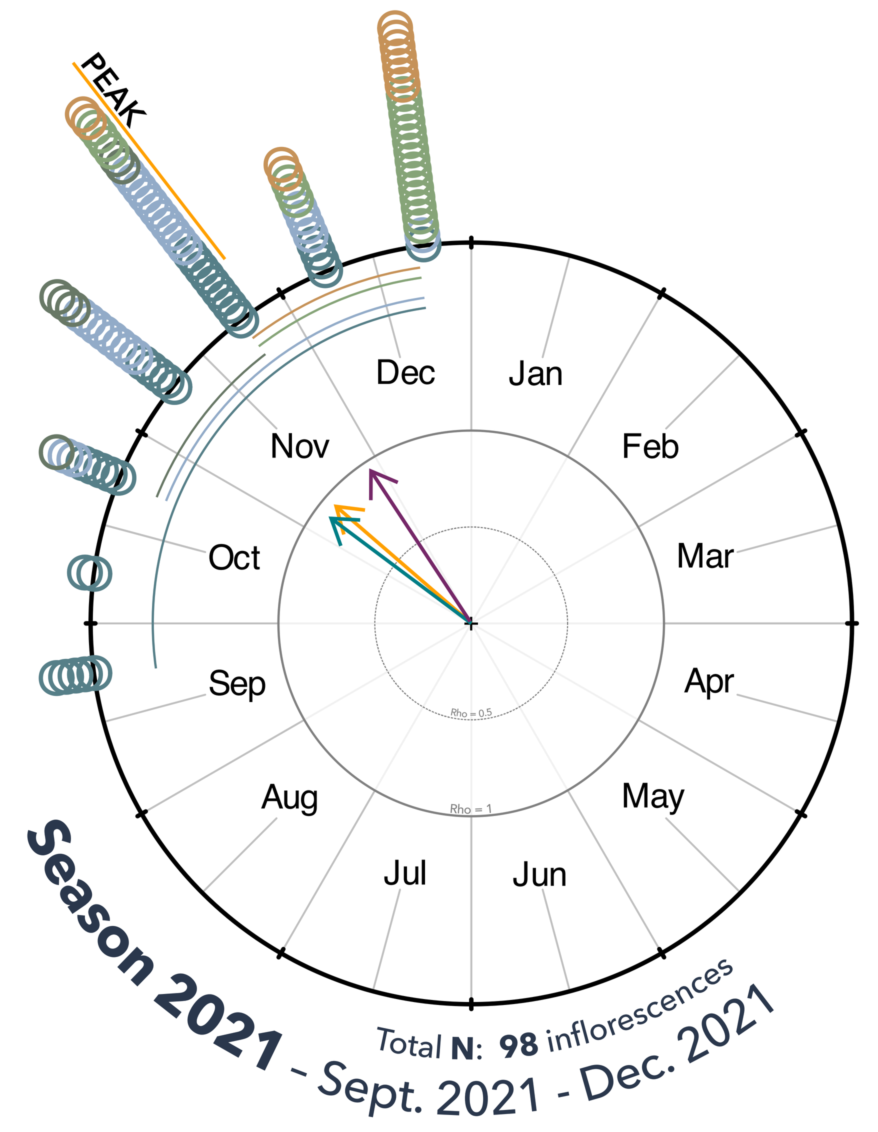
Flowering Patterns for the season 2019, 2020 and 2021

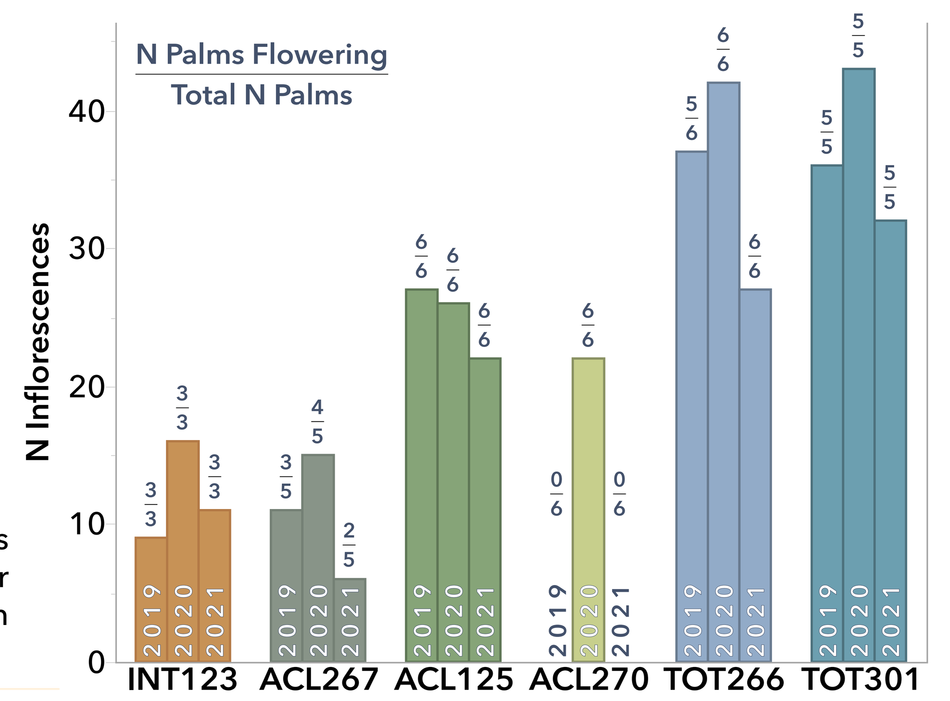
- Little circles: number of inflorescences per half-month for 31 palm - color-coded by accession
- Circular lines: range of flowering for each accession
- Circular statistics measures (arrows) including:
  - the circular mean of flowering
  - the circular mean of onset
  - the circular median corresponding to season midpoint
  - Length of arrows: Rho (resultant mean length) describing the degree of clustering around these statistical measures

Accession color-code: INT123, ACL125, ACL267, ACL270, TOT266, TOT301









High variability in flowering events across seasons

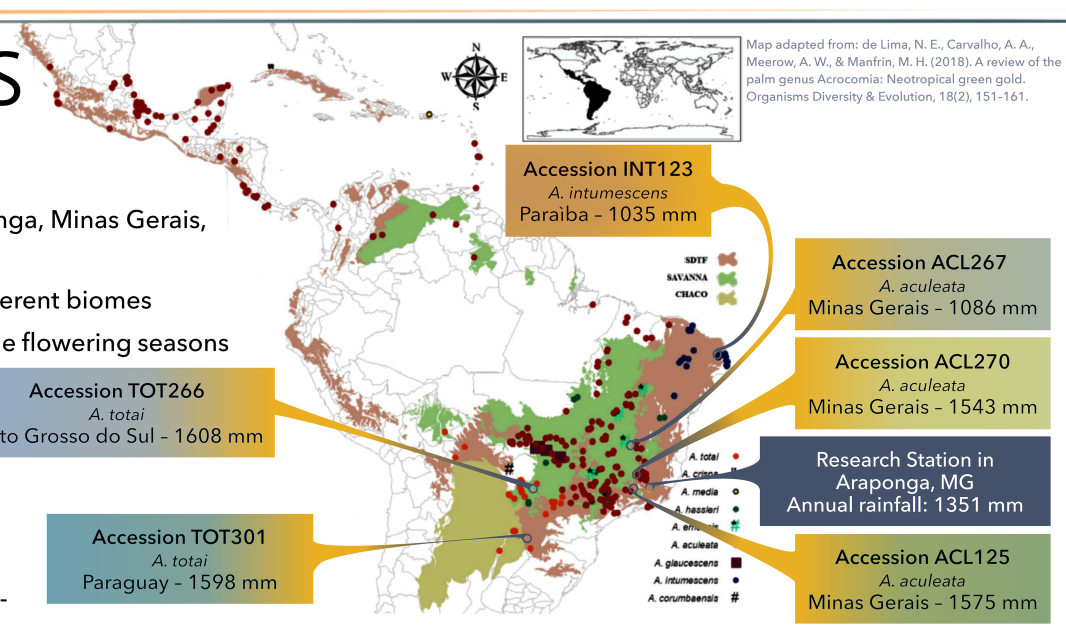
The number of inflorescences per accession and season is presented. This includes the number of palms assessed per accession and the number of flowering palms per season for each accession.

ACCESSIONS	MEAN FLOWERING TIME	MEAN FLOWERING ONSET
ALL	0.1664	0.3398
INT123	0.8262	0.8359
ACL267	0.9726	0.4283
ACL125	0.6733	0.4531
ACL270	/	/
TOT266	0.8701	**0.01352**
TOT301	0.8122	0.6889

Flowering pattern shows high synchrony across seasons

Seasonal means of flowering time and onset time were compared to evaluate differences in the flowering pattern among seasons using the Wallraff test. The p-values are shown with bolded values indicating statistically significant differences.

MATERIALS & METHODS



Flowering Phenology Monitoring

- **Location**: BAG-Macaúba living germ-plasm collection in Araponga, Minas Gerais, Brazil
- **Specimens**: Six accessions of three *Acrocomia* species from different biomes
- **Data collection**: weekly counting of opened inflorescences in the flowering seasons of 2019, 2020 and 2021

Circular Statistics

- statistics providing meaningful measures of tendency and dispersion for data with inherent periodicity treating the year as a circular continuum without boundaries—an approach particularly important for phenological data in tropical, non-resting ecosystems.
- used to calculate phenology pattern measures: seasonal onset means, season and acession flowering time means, seasonal flowering time medians, season and accession angular deviations, and Wallraff test (Kruskal Wallis test chi-squared for circular data)

Moving Window Analysis

- method allows detection of changes in the relationship between flowering peaks and environmental factors over a series of overlapping, consecutive time intervals.
- Flowering Peak Window: fixed window of 7 half-month periods. The flowering peak was positioned in the middle of this window (the 4th half-month).
- Environmental Factors Window: moving window of 7 half-month periods. This window shifts backwards by 1 half-month for a total of 54 lag times.
- Calculations performed separate for each season using Spearman's Rank Correlations

ACKNOWLEDGMENTS

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REFERENCE

1. Scariot, A. O., Lleras, E., & Hay, J. D. (1991). Reproductive biology of the palm *Acrocomia aculeata* in Central Brazil. Biotropica, 23(1), 12. https://doi.org/10.2307/2388683

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