

# Sunrise and sunset times also trigger rice flowering time

1- Daily changes in sunrise and sunset times controls seasonal reproduction at the equator





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equator,

Flowering time of 35 equatorial tree species is synchronized with daily change of sunset time. (From Borchert et al. 2005)

#### Yearday

The reproduction of the equatorial Stonechat birds is synchronized in Kenya as well as in indoor rooms with simultaneous sunrise and sunset times as in Kenya. (From Goymann et al., 2012) temperature are stable throughout the year. However, plant and animal reproduction is synchronized by the daily change in sunrise and sunset times.

daylength

and

# 2- Model combining daylength and daily changes in sunrise and sunset times fits well all observed flowering time in multi-latitudinal monthly sown rice



Photoperiodism model (modified from Summerfield et al., 1992):
PSP(day) = Ps × max(0, PP – Pb) + SRs × dSR + SSs × dSS
where PSP= photoperiod sensitive phase, PP= photoperiod, Pb= base photoperiod,
dSR/dSS= daily change of sunrise/sunset times and Ps, SRs and SSs are three

At

the

estimated coefficients.

Daily progress towards panicle initiation = 1/ PSP(day)

Siam 29

300 ·

250

200

150

100

50

panicle initiation

Days

Photoperiod (A) with the year date, the daily rates of change of sunrise and sunset times (B) at four latitudes from the Equator to Japan. The sum of the daily rates of change (C) was similar at all





▲Malacca, 2°12'N ■Kota Bahru, 6°09'N ●Los Banos, 14°11'N



The daily changes in sunrise and sunset times are the cues for synchronizing the reproduction at the equator. Therefore, the same cues must be involved at other latitudes. Adding the effects of both changes in the previous model based only on daylength, all else being equal, resulted in a good fit to observations made over a wide range of latitudes.

## latitudes. Baños, Clerget et al., 2021).

# 3- In the field, daily changes in sunrise and sunset times are major factors in rice photoperiod sensitivity.

Further studies are needed to fully document photoperiod sensitivity in natural sunlight, especially at the equator.
 The gene network for flowering time has been described in stable daylengths. Artificial lighting can now adequately mimic the variations in sunlight, providing access to the natural dynamics and interactions of the cell clocks.

### Reference

Clerget B., Sidibe M., Bueno C.S., Grenier C., Kawakata T., Domingo A.J., Layaoen H.L., Gutiérrez Palacios N.D., Bernal J.H., Trouche G., Chantereau J. 2021. *Crop photoperiodism model 2.0 for the flowering time of sorghum and rice that includes daily changes in sunrise and sunset times and temperature acclimation*. Annals of Botany, 128(1):97-113.

