Some Biographical information:

- Academic: Engineering (Georgia Tech, 1968)
- Career: Pharma-industry (1969 – 1995)
- **Passion: Genus *Magnolia* (c.1970 – present)**
  - **Self-taught** (and still learning)
  - **Joined the Magnolia Society (1975)**
  - **Mentors** (many! 1975 – present)

Arnold Arboretum - Harvard 1981

Magnolia Society Annual Meeting

Arnold Arboretum - Harvard 1981

Prof. Joe McDaniel

Arnold Arboretum - Harvard 1981

Arnold Arboretum - Harvard 1981

Arnold Arboretum - Harvard 1981

Magnolian Grove Arboretum (MGA)

- **GOAL: grow and study as many species as possible!**
- **Established at Pomona NY (1980 – 2002)**
- **Transitioned to Pickens SC (1992 – 2002 – present)**
- **55 spp.** (47 spp. blooming age)* **from 9 clades** (Sects./Subsects.)

* 3 tropical spp. are over-wintered indoors.

Ex-situ cultivation of magnolias in South Carolina (MGA) facilitates the study of transient and elusive morphological characters in *Magnolia:*

Especially the *nastic-like* tepal movements during their 24 hour protogynous flowering cycles.

Richard B. Figlar

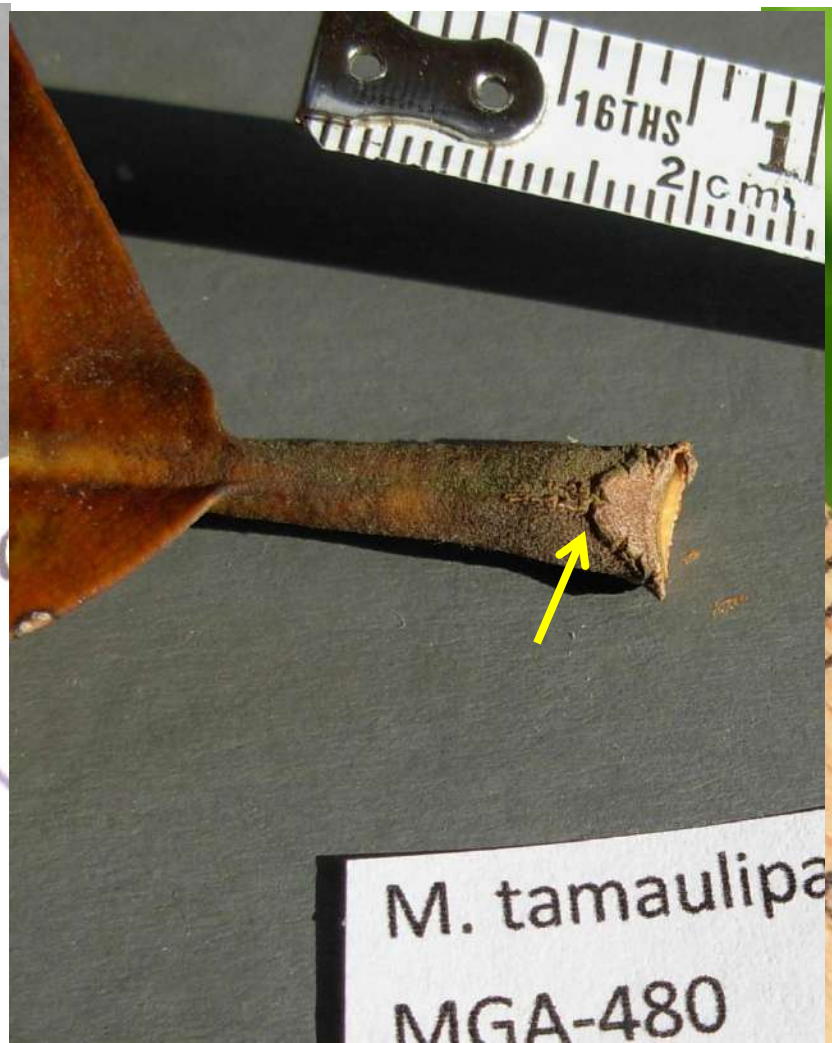
What are transient and elusive morphological characters?

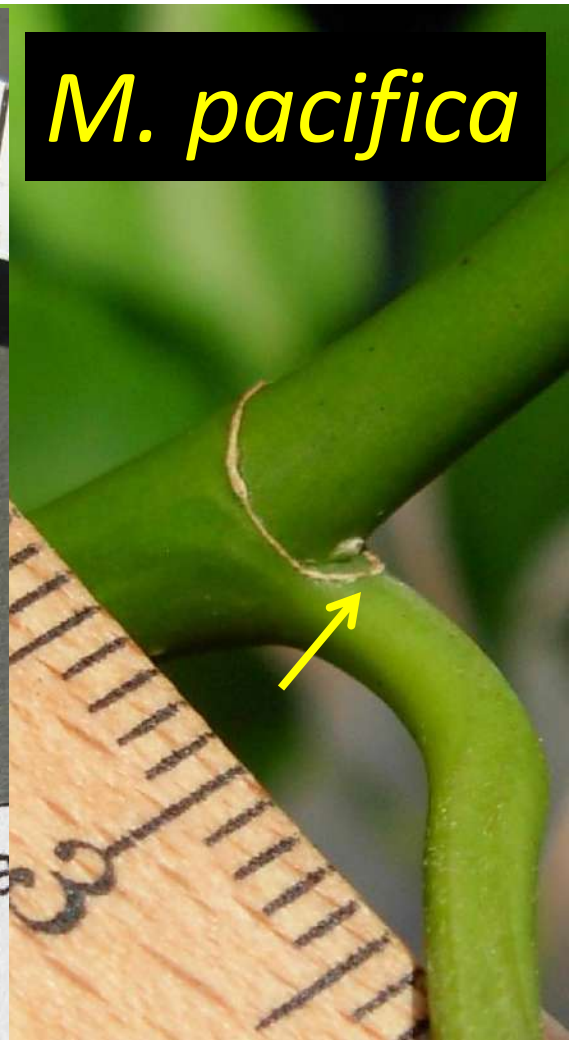
- **Too difficult to observe (obstructions, etc.).**
- **Not preserved in herbarium specimens.**
- ***Behavioral* – occur only briefly during the growing season or at particular time of day.**
- **All of the above.**

Characters - mostly obscured:

Tiny stipule scars (0-2mm) on petioles of species that . . .

“Aren’t supposed to have them”





Eduardo Calderón made similar observations in:

2 spp. of Subsection *Chocotalauma*

M. striatifolia

M. neomagnifolia

In contrast to spp. in Subsections (and Section):

Cubenses, Dugandiodendron & Gynopodium

Which seem to consistently have FREE STIPULES:

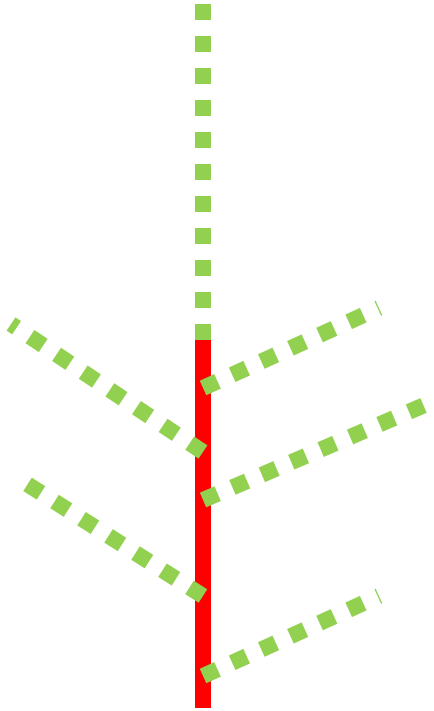
M. splendens

M. yarumalensis

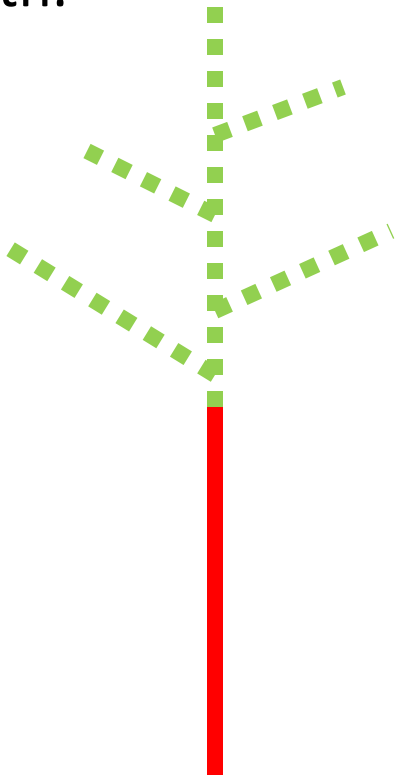
M. lotungensis

Behavioral characters . . .

Prolepsis – branches produced from buds of previous year's growth.

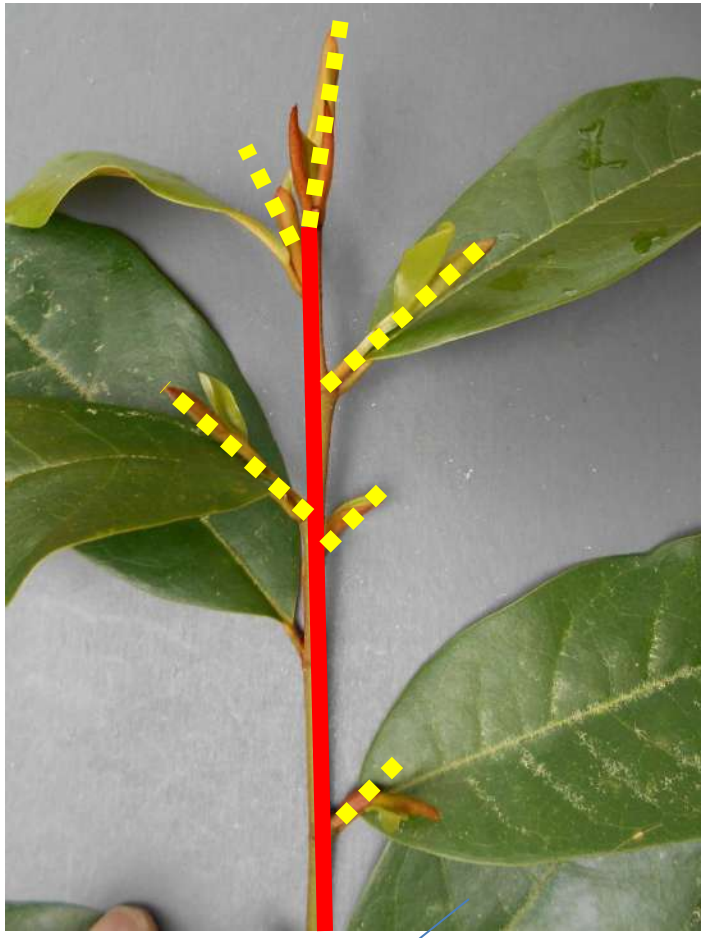


Syllepsis – branches produced from buds of current year's growth.

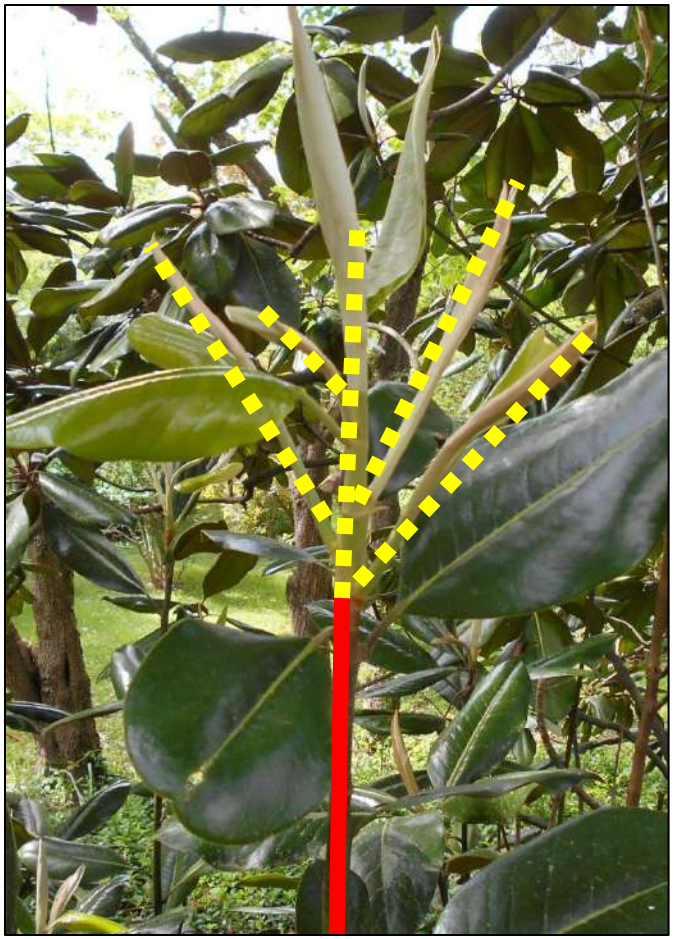


Behavioral characters . . .

Prolepsis – Sect. *Michelia* sp.



Syllepsis – Sect. *Magnolia* sp.



To observe – **one must be in the right place, at the right time!**

Prolepsis – Sect. *Michelia* sp.

Syllepsis – Sect. *Magnolia* sp.

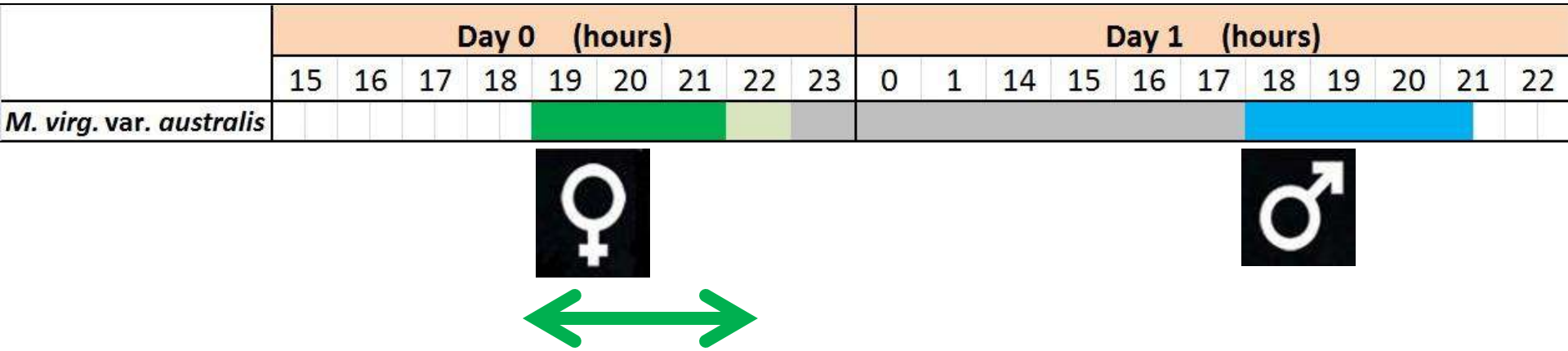
Nastic-like tepal movements:

"Tepals open and close rapidly in apparent circadian response to complex set of external stimuli and internal coordination"

1. On-set of: darkness **(Nyctinasty)**
   daylight **(Photonasty)**

2. Coordination with changes in stigmatic secretions [AGPs] **(Chemonasty)** **Losada et al. 2014**

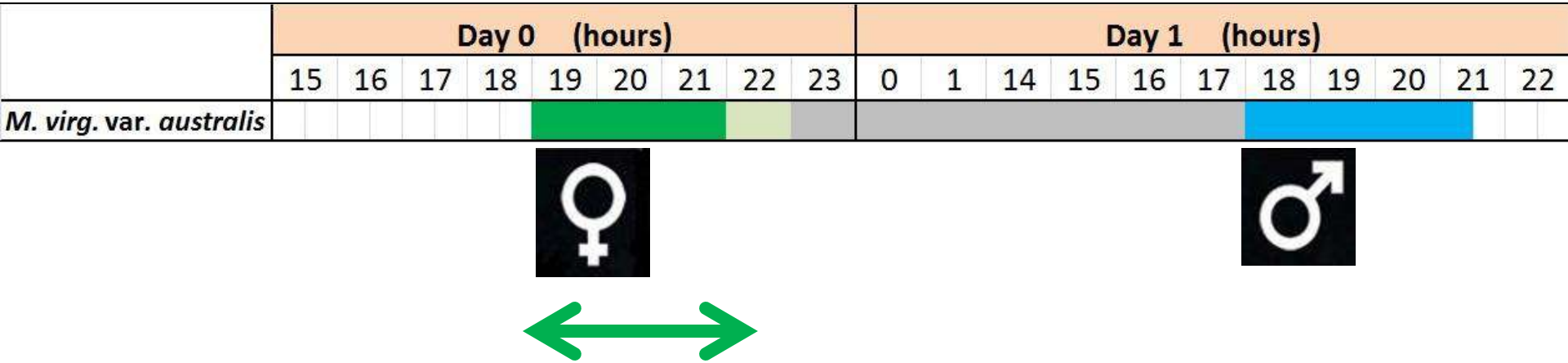
Flower 24 hour "opening-closing-reopening" cycle
M. virginiana var. *australis*
per Losada et al. (2014)



- During this 3 to 4 hour window:
- **Detected pollen germination, and two AGPs** (arabinogalactan proteins) **on the stigmatic surfaces.**

Only while the flower was open.

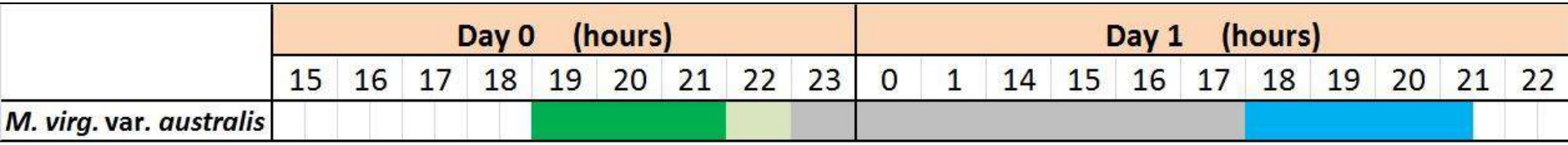
Flower 24 hour "opening-closing-reopening" cycle
M. virginiana* var. *australis
per Losada et al. (2014)



"indicating a coordination between floral movements and receptivity" per Losada et al. (2014)

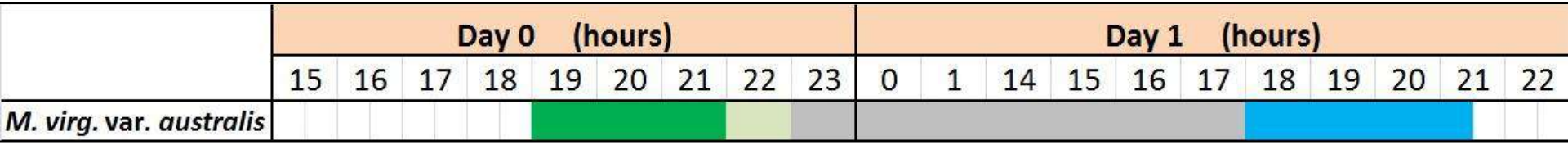
Flower 24 hour "opening-closing-reopening" cycle
M. virginiana var. *australis*

per Losada et al. (2014)



Tepals **open** 20 min
Stigmas receptive.
AGPs: **ON**

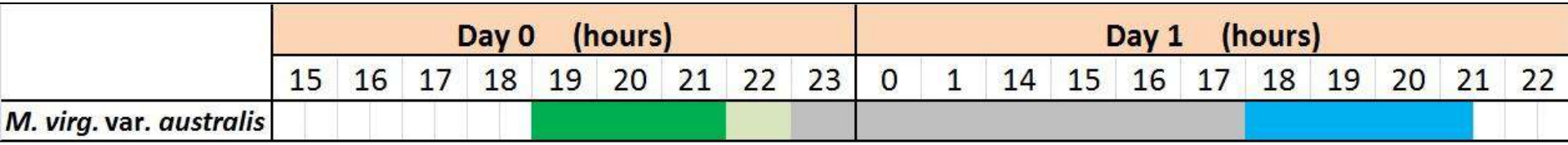
Flower 24 hour "opening-closing-reopening" cycle
M. virginiana var. *australis*
per Losada et al. (2014)



Tepals **open**
Stigmas receptive.
AGPs: **ON**

Tepals **close (except 3 outer tepals)**
Stigmas no longer receptive.
AGPs: **OFF**

Flower 24 hour "opening-closing-reopening" cycle
M. virginiana var. *australis*
per Losada et al. (2014)

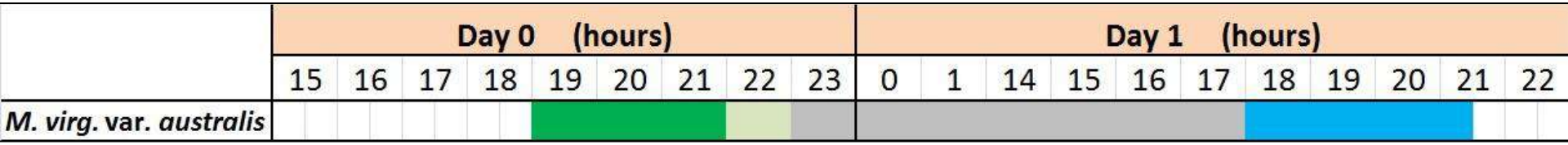


Tepals **open**
Stigmas receptive.
AGPs: **ON**

And stay closed next 18-20 hrs.

Tepals **close (except 3 outer tepals)**
Stigmas no longer receptive.
AGPs: **OFF**

Flower 24 hour "opening-closing-reopening" cycle
M. virginiana var. *australis*
per Losada et al. (2014)



Tepals **open**
Stigmas receptive.
AGPs: **ON**

INTER-PHASE
next 18-20 hrs.

Tepals **close (except 3 outer tepals)**
Stigmas no longer receptive.
AGPs: **OFF**

Tepals **re-open**
Stamens dehisce and detach.

24-hour template for:

Evening opening model

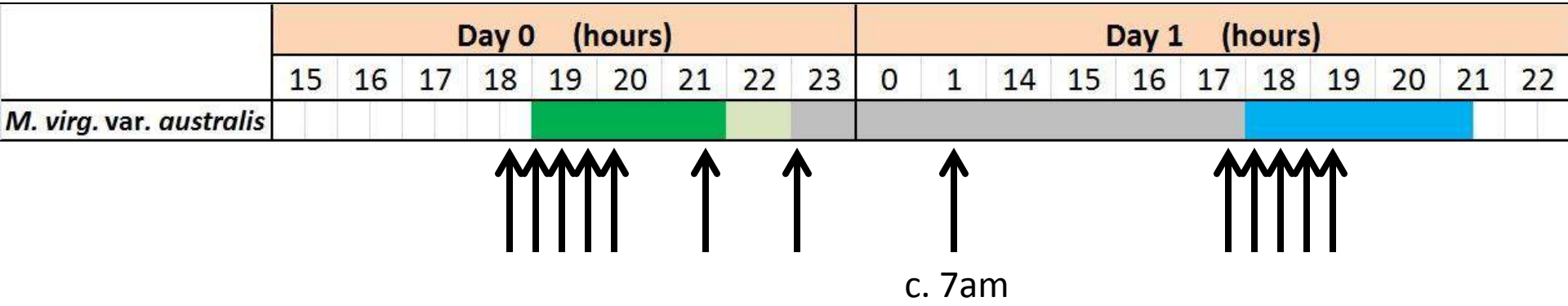
Photo-frame sequences (5 species)

	Day 0 (hours)									Day 1 (hours)										
	15	16	17	18	19	20	21	22	23	0	1	14	15	16	17	18	19	20	21	22
M. virg.* var. *australis																				

24-hour template for:

Evening opening model

Photo-frame sequences (5 species)

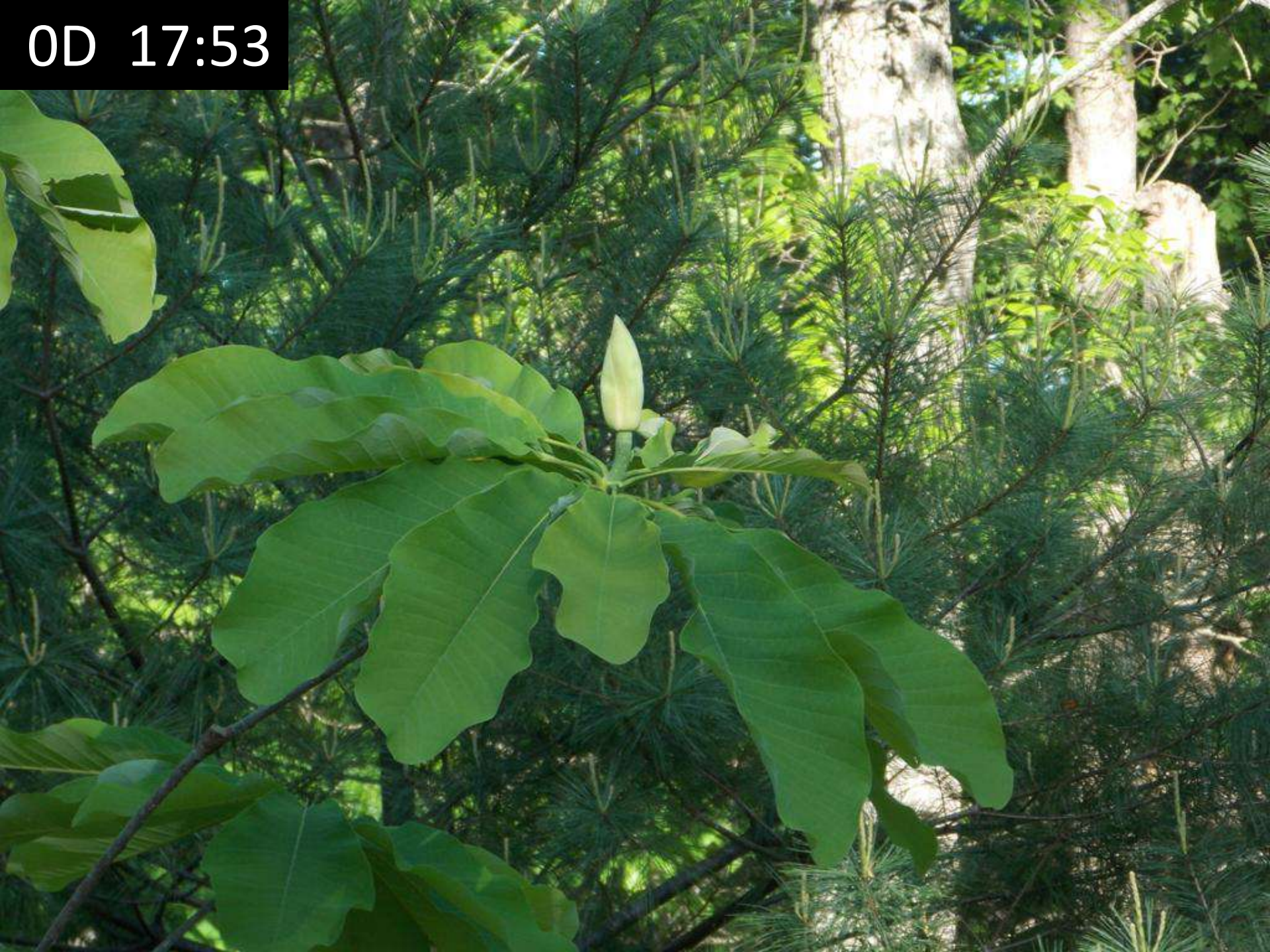


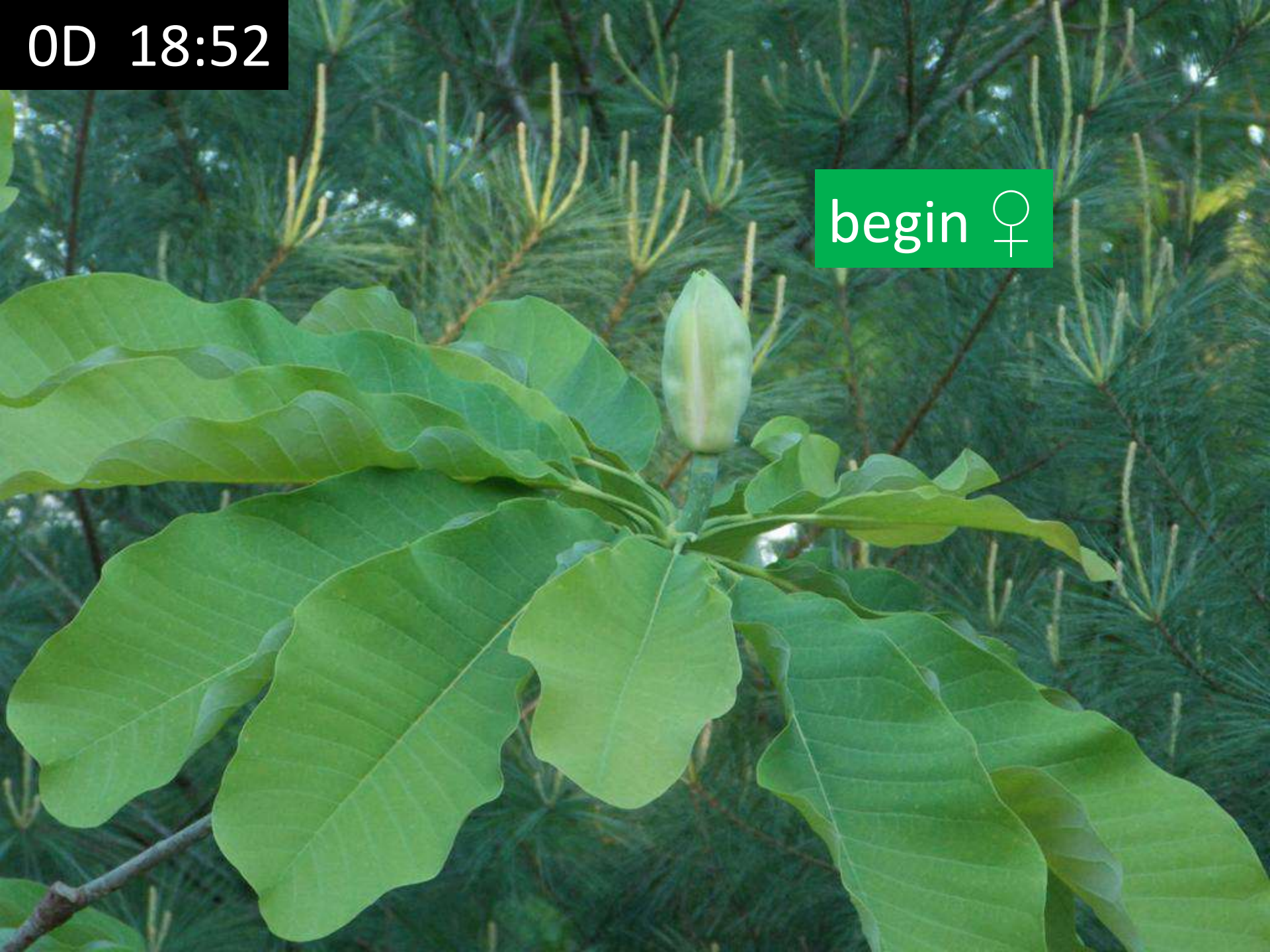
c. 7am

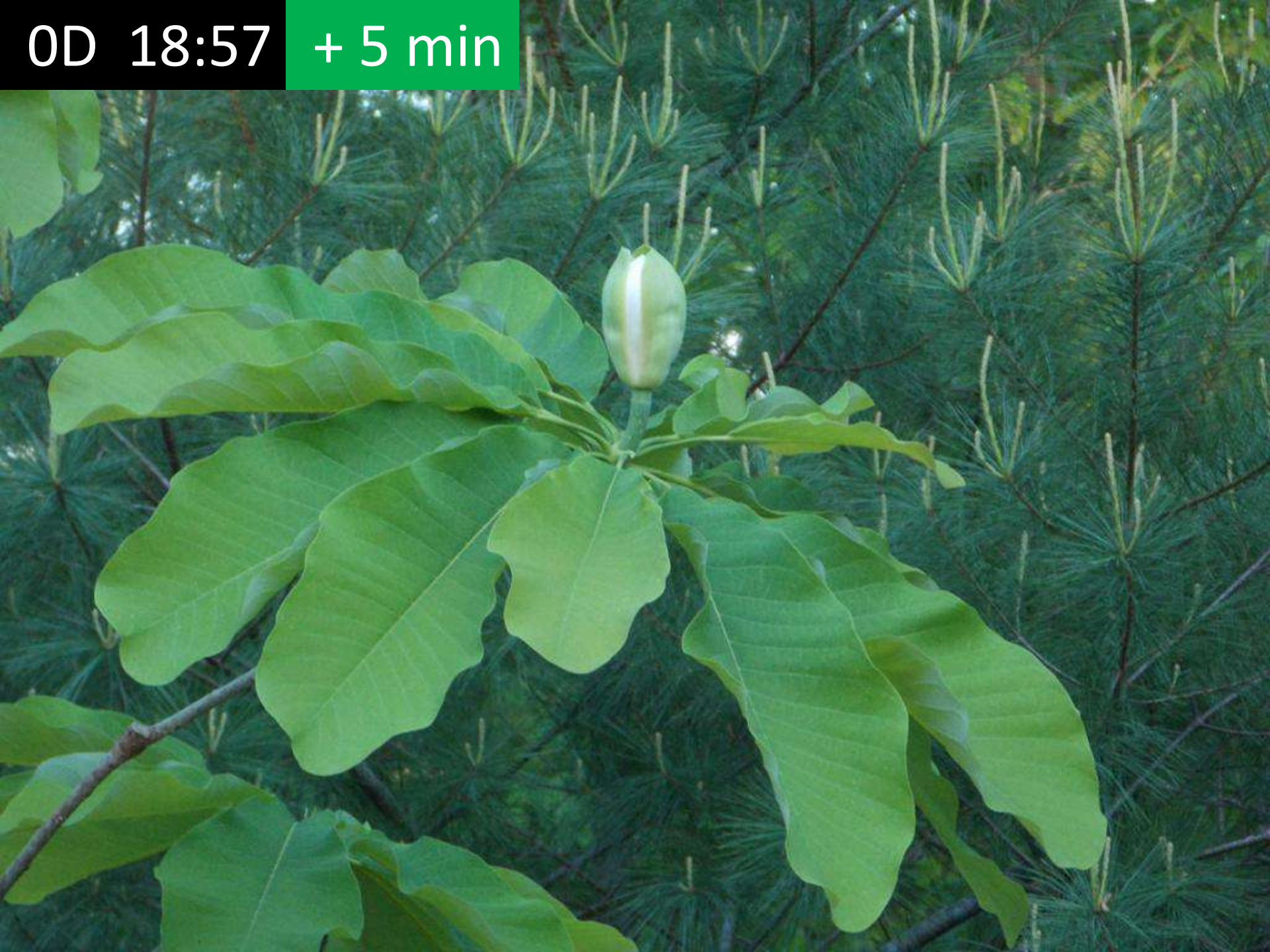
Photo frames are clustered mainly just before/after ♀ and ♂ begin.

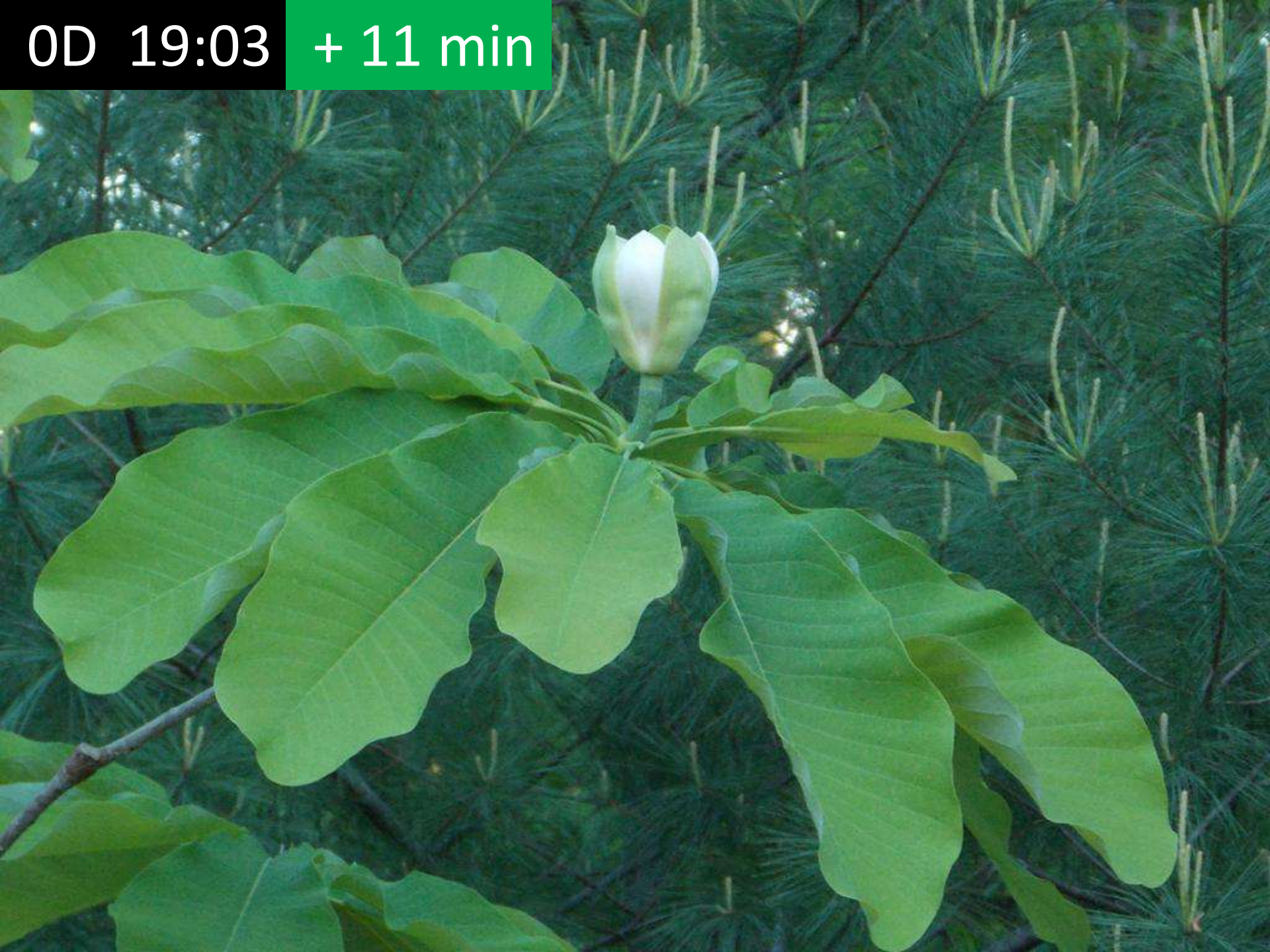
Magnolia officinalis
Section Rhytidospermum

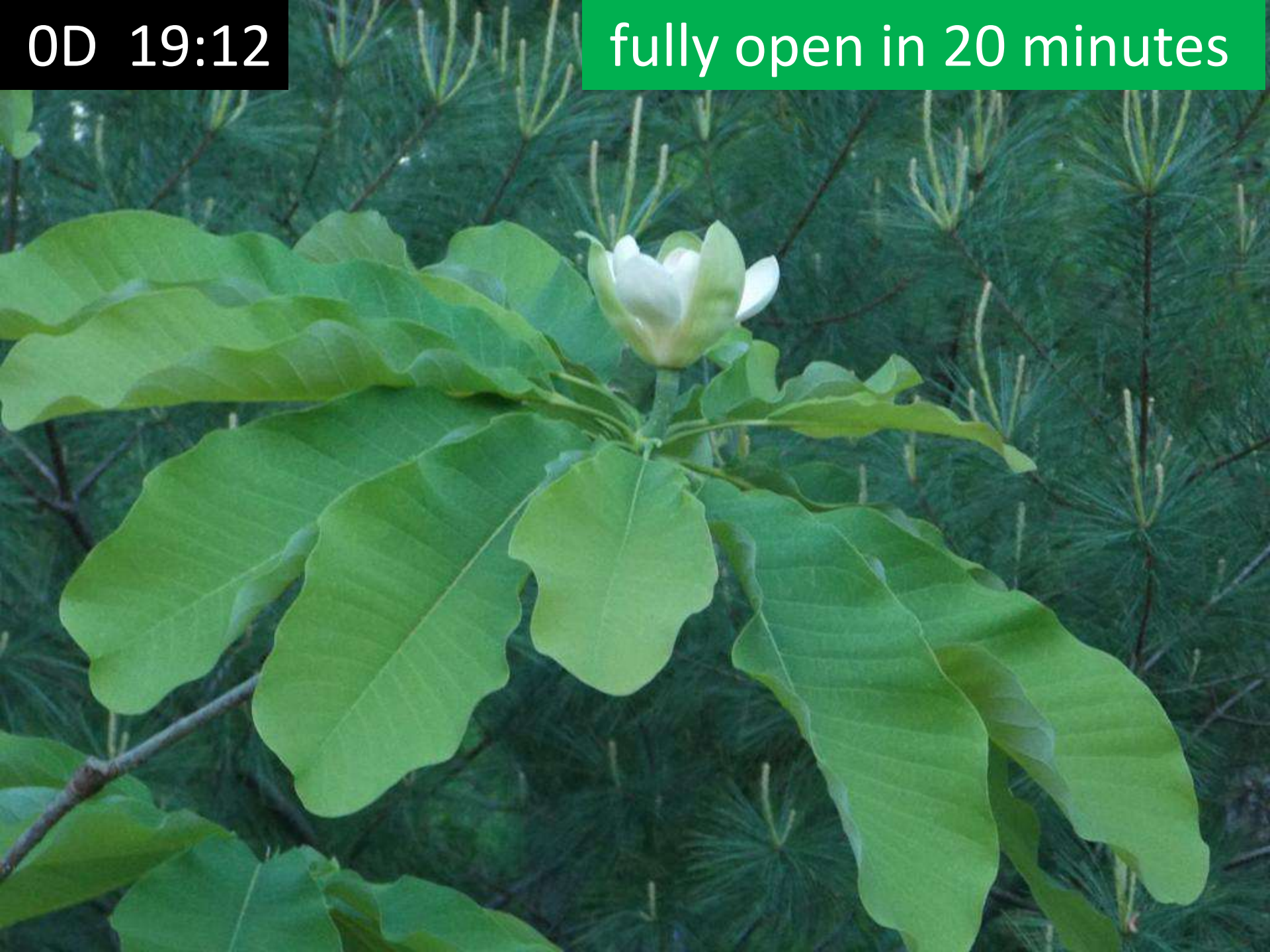
(Eastern Asia)

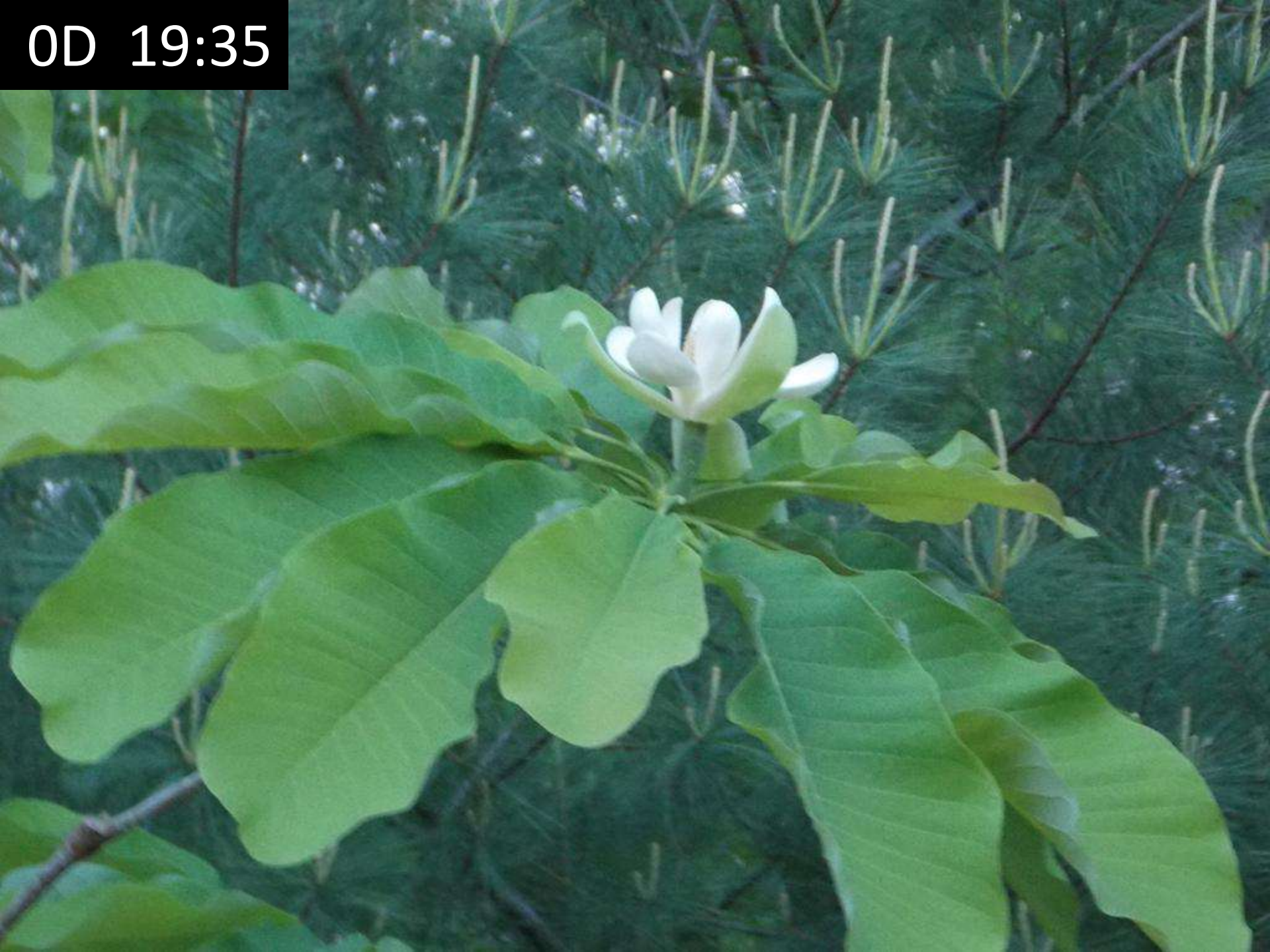

0D 17:53

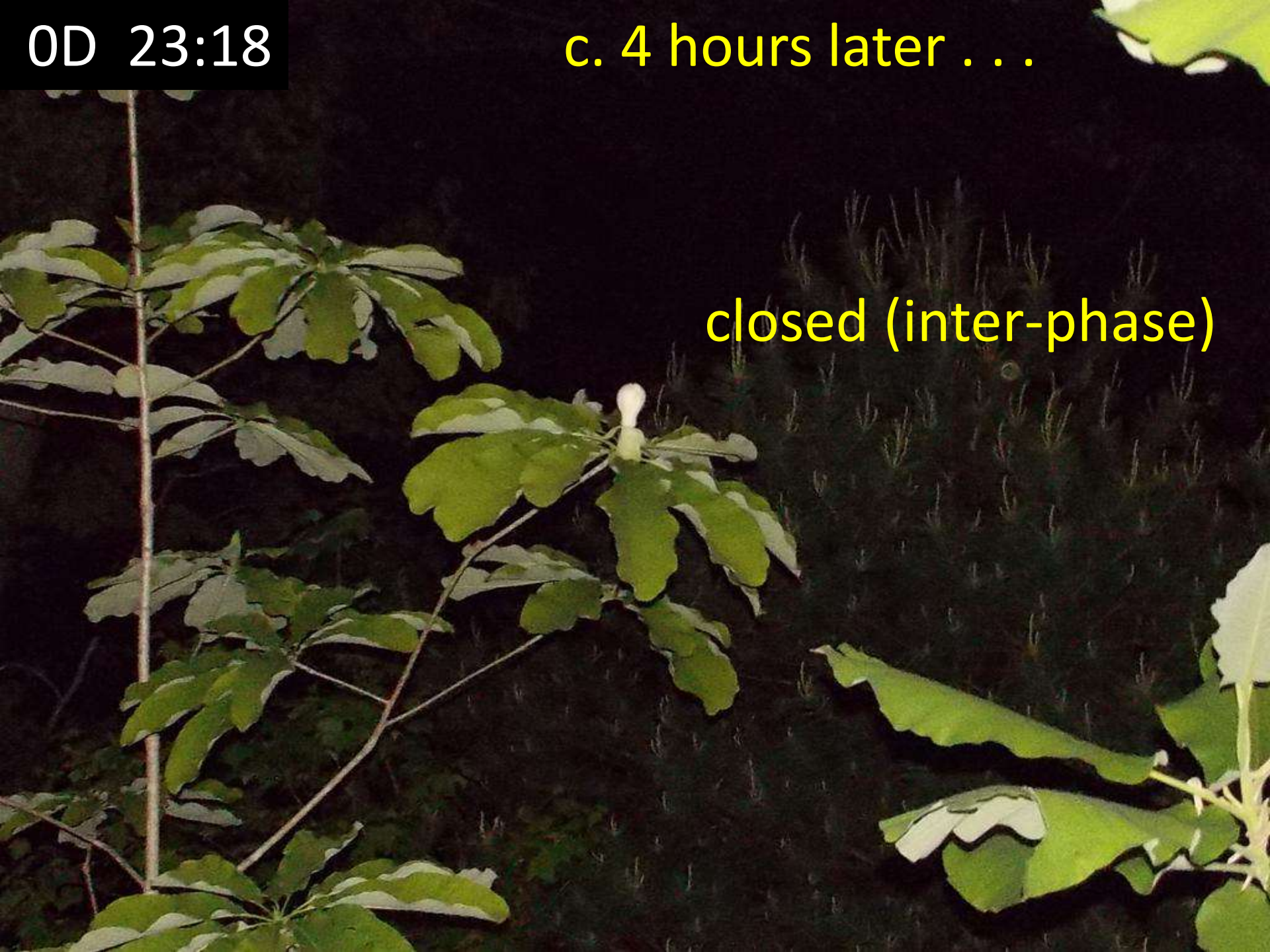

0D 18:52
begin ♀


0D 18:57
+ 5 min


0D 19:03
+ 11 min

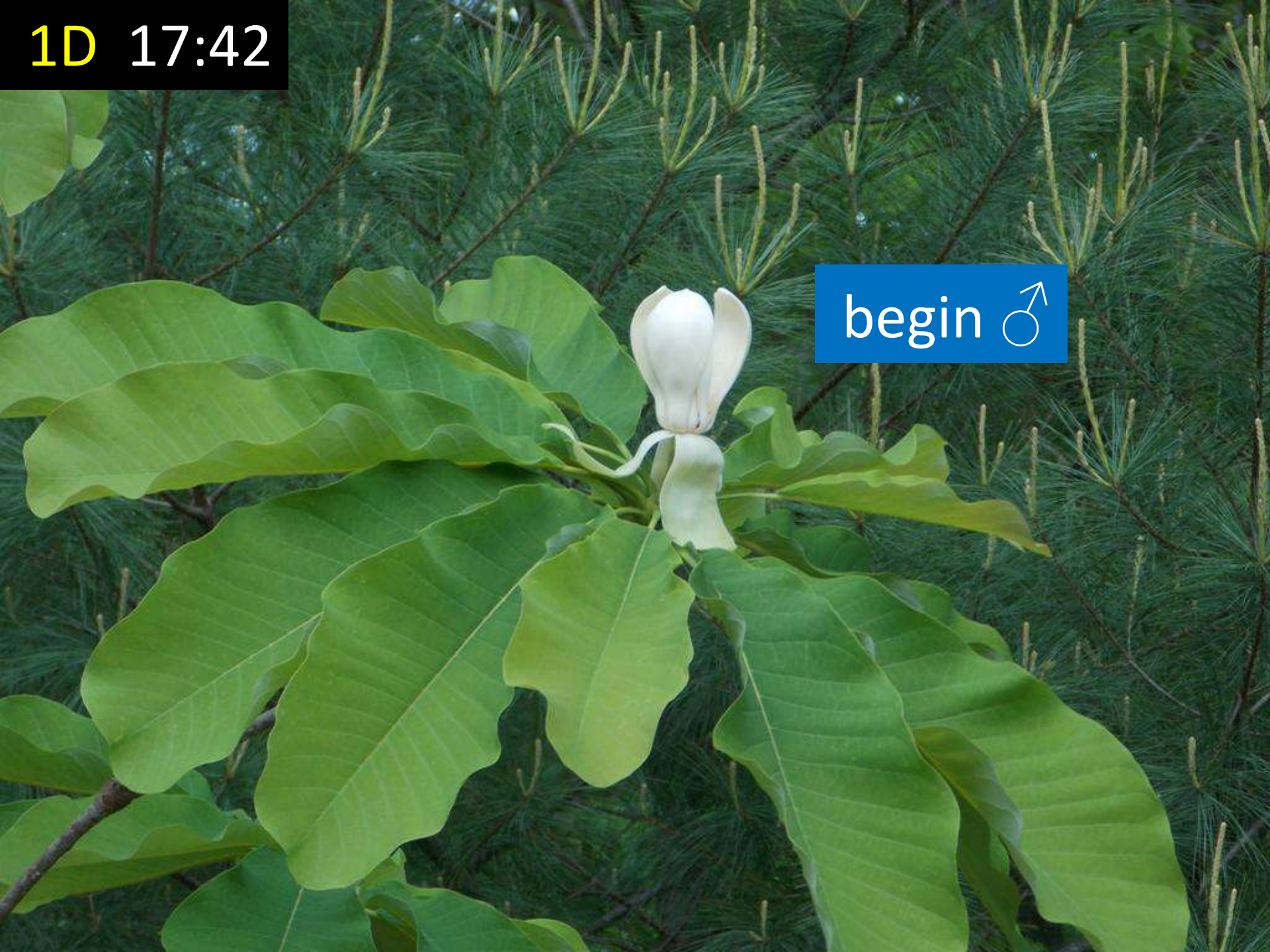

0D 19:12
fully open in 20 minutes

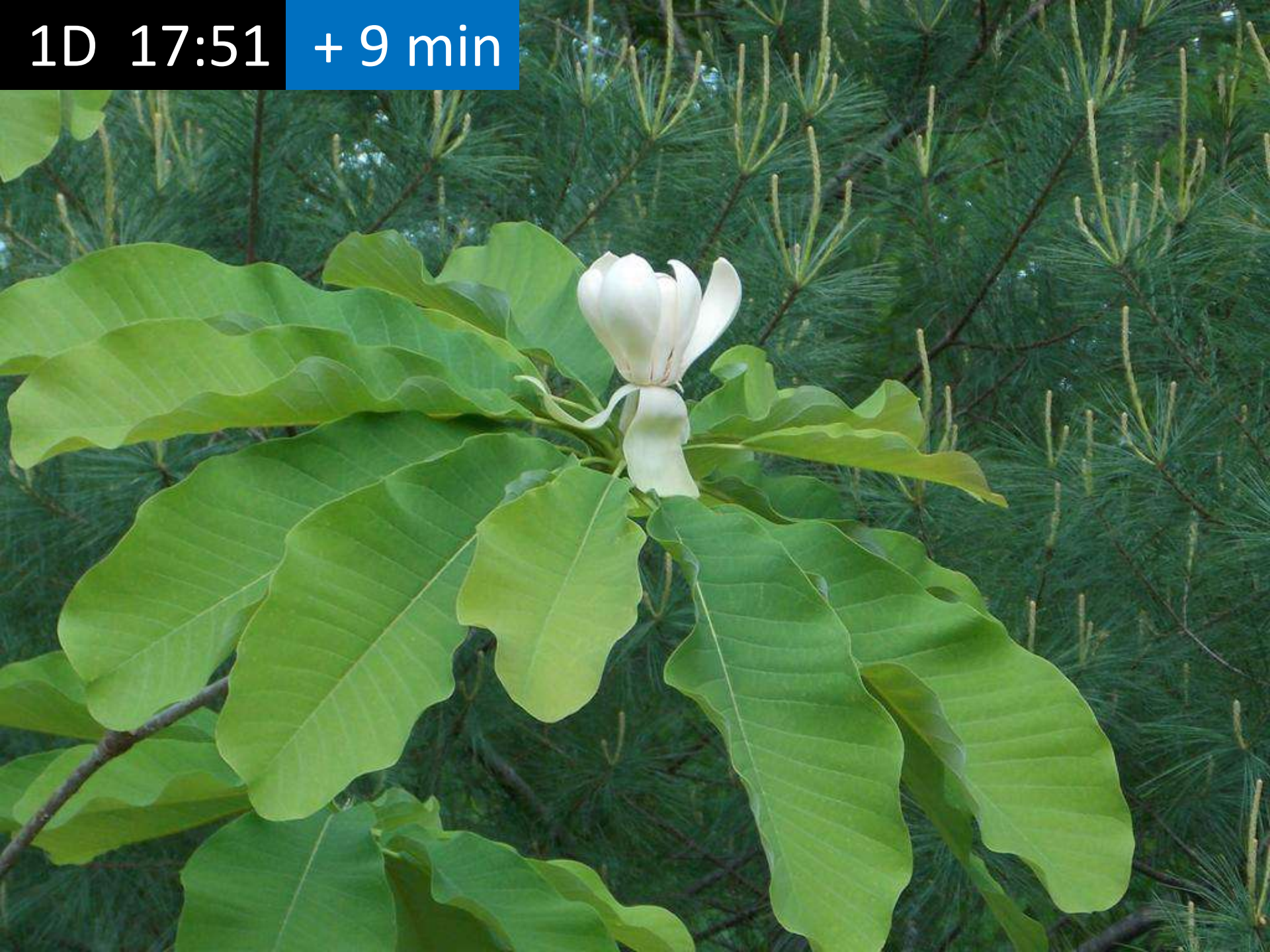

0D 19:35

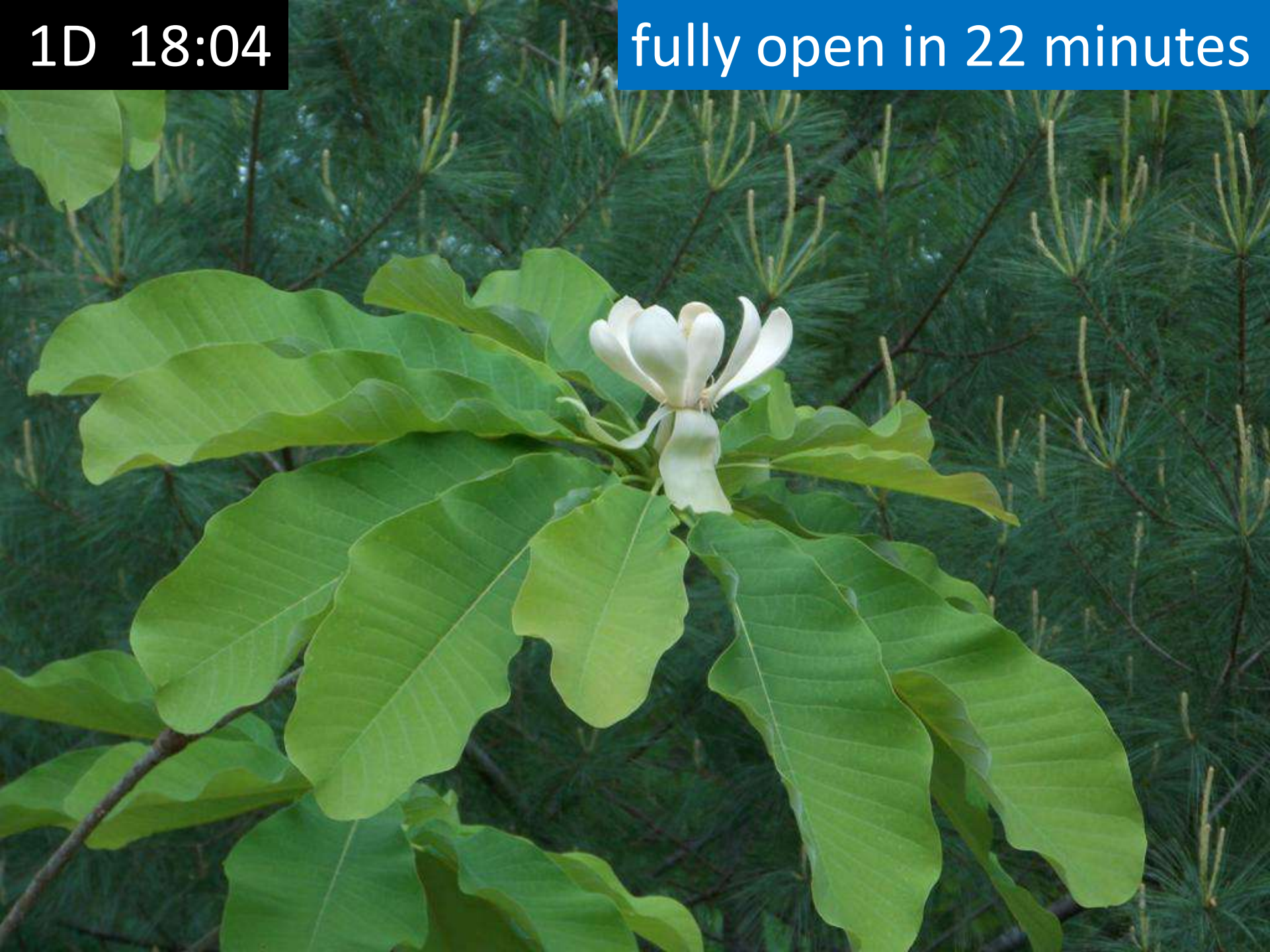

0D 23:18
c. 4 hours later . . .
closed (inter-phase)


1D 6:29
. . . still inter-phase


1D 17:36
. . . still inter-phase


1D 17:42
begin ♂


1D 17:51
+ 9 min

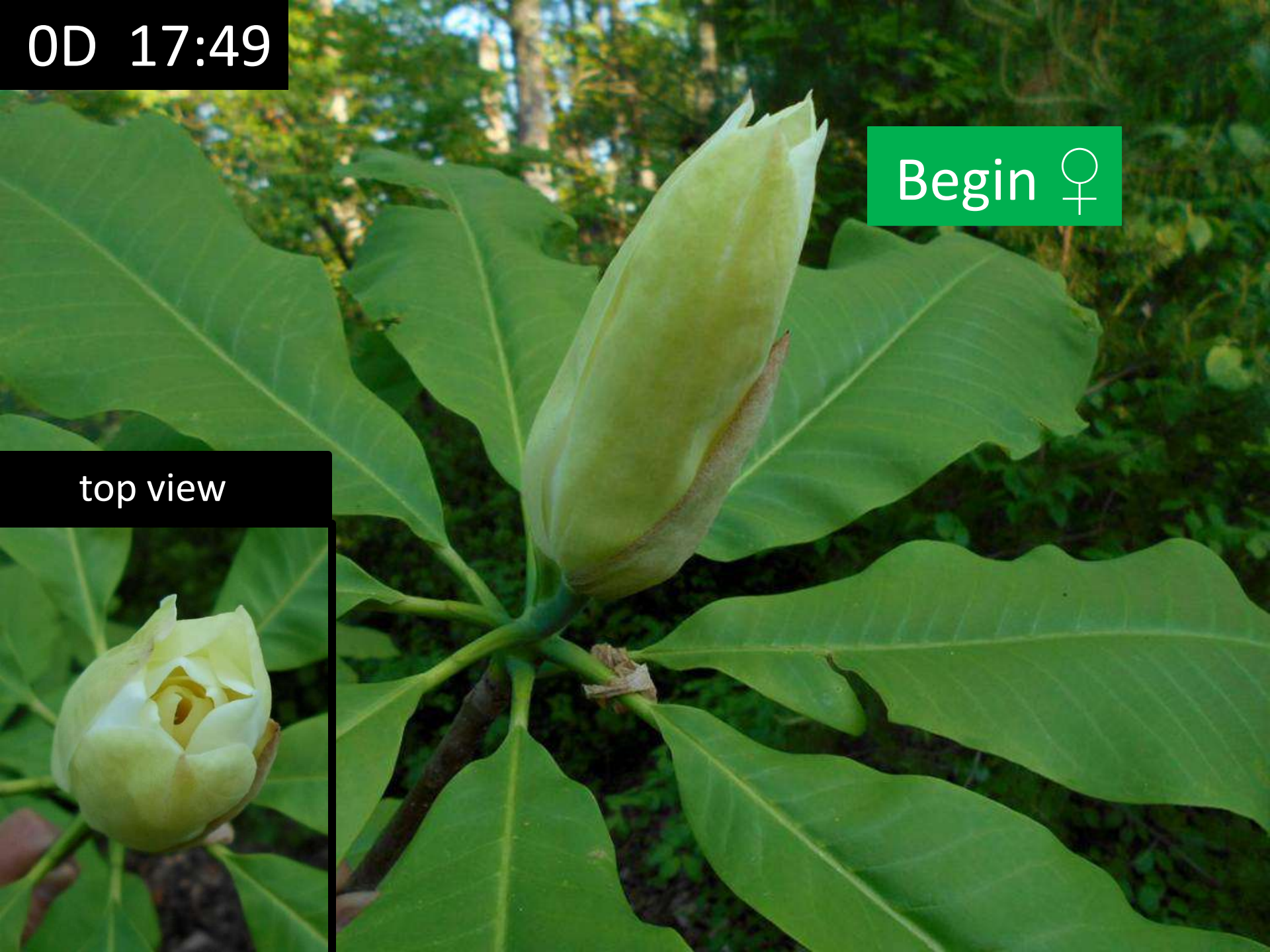

1D 18:04
fully open in 22 minutes

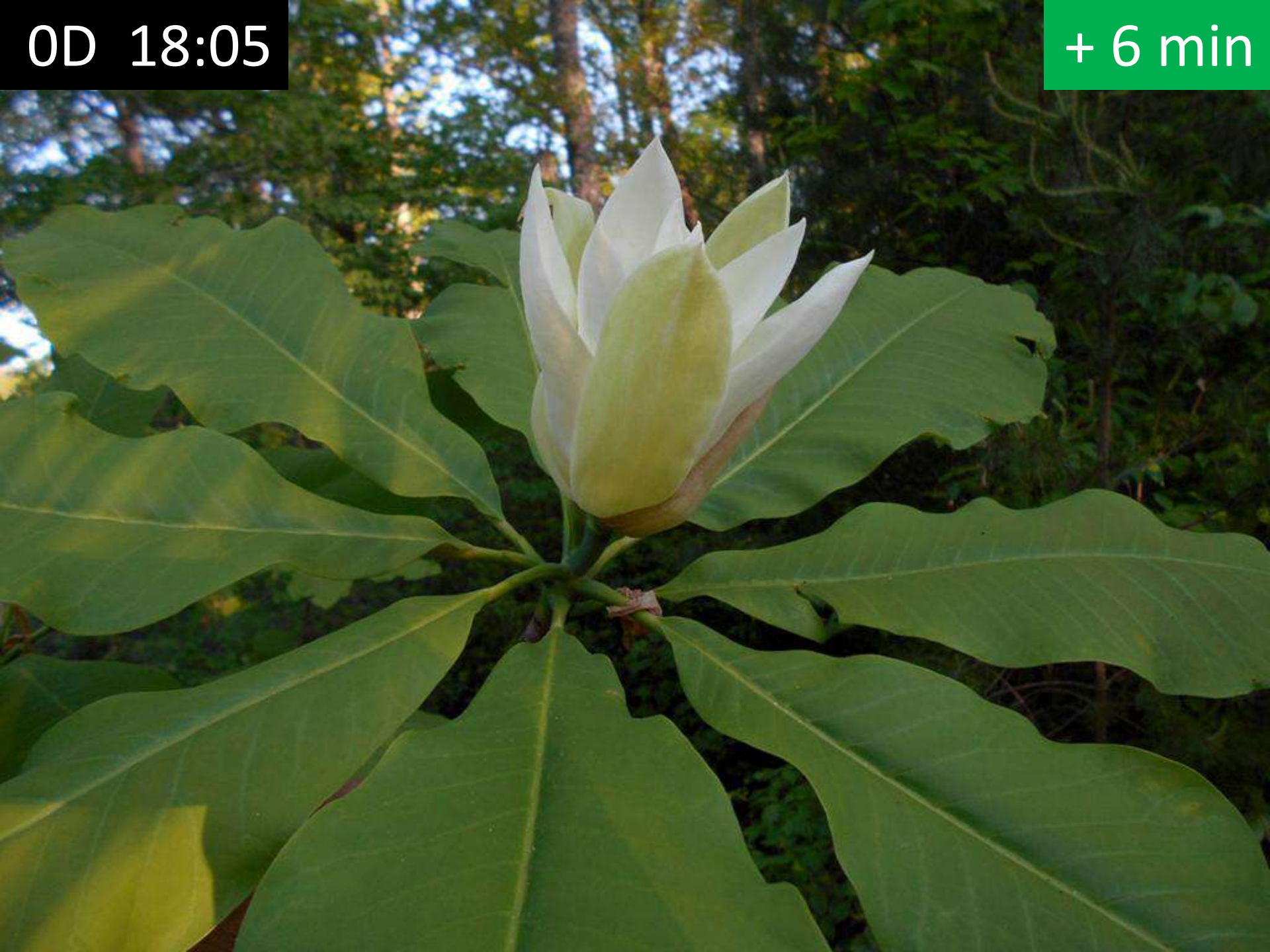
Magnolia tripetala
Section Rhytidospermum

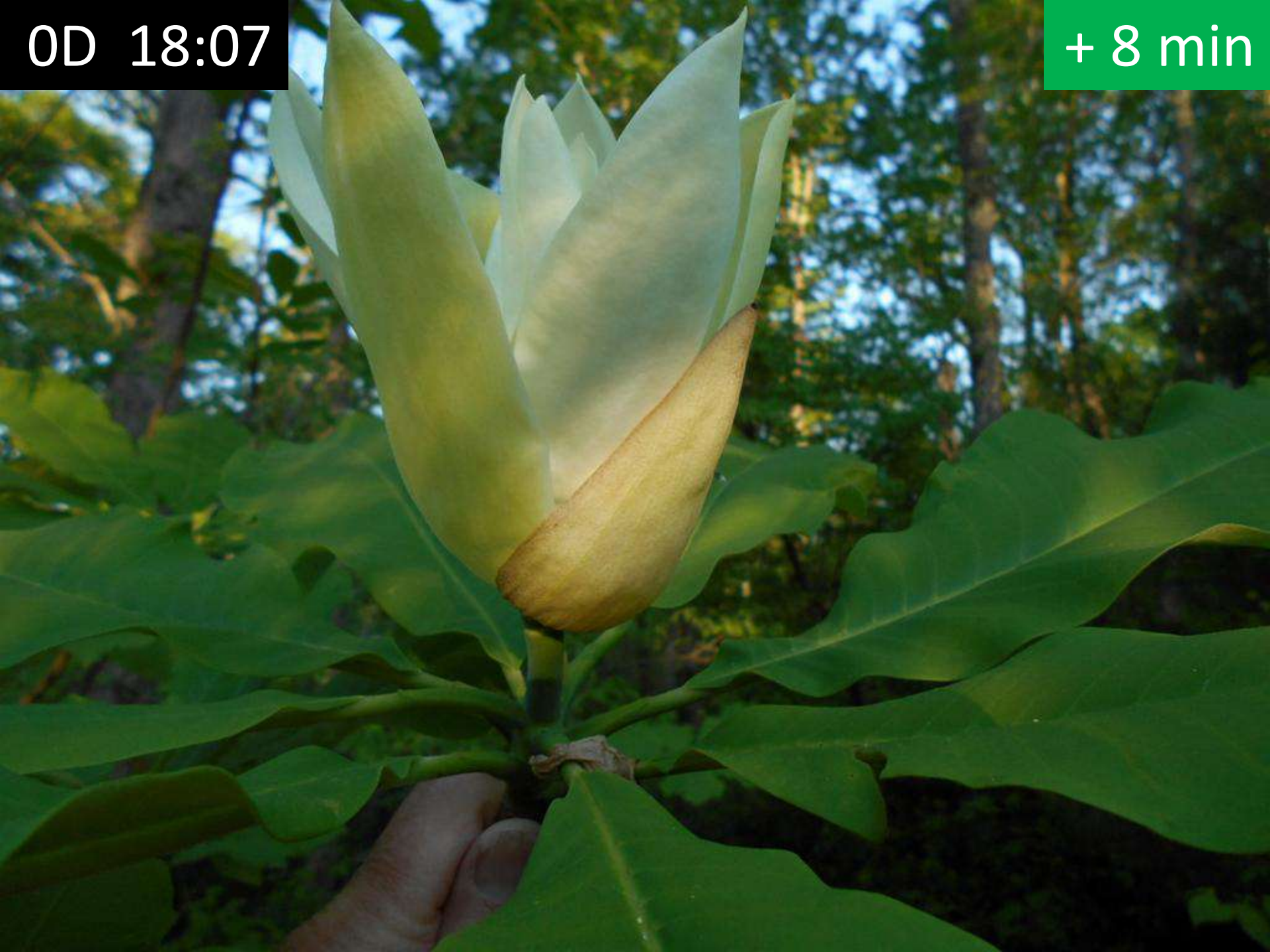
E North America


0D 17:35


0D 17:49


0D 17:49
Begin ♀
top view


0D 18:05
+ 6 min


0D 18:07
+ 8 min


0D 18:23
+24 min

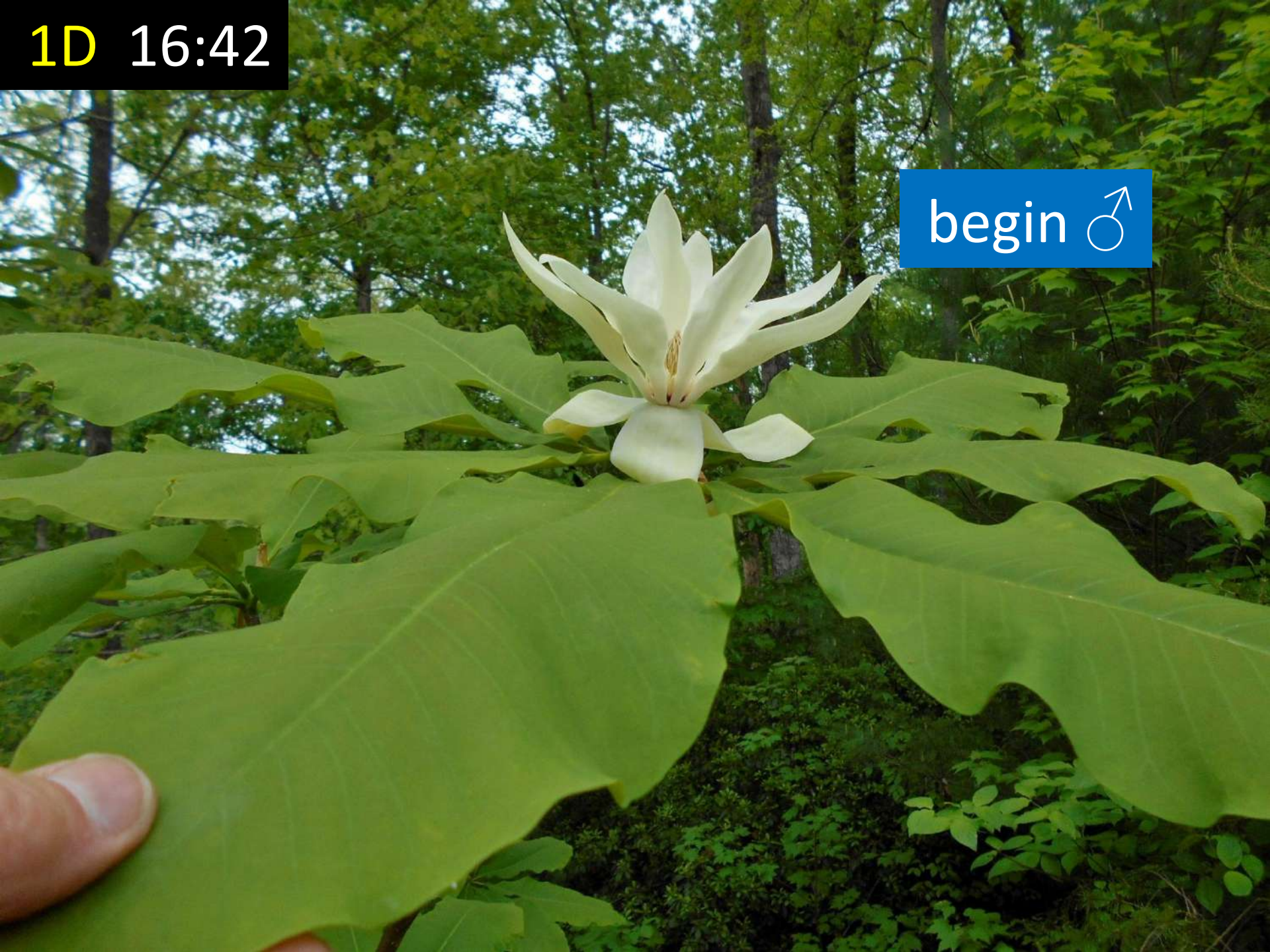

0D 19:04


0D 19:04
Stigmas: pale/re-curved


0D 21:31
Tepals begin to close . . .


1D 8:07
. . . still inter-phase


1D 12:50
. . . still inter-phase


1D 16:42
begin ♂


1D 16:42
Stigmas: no longer pale/re-curved
Stamens:
begin to detach/dehisce


1D 17:42

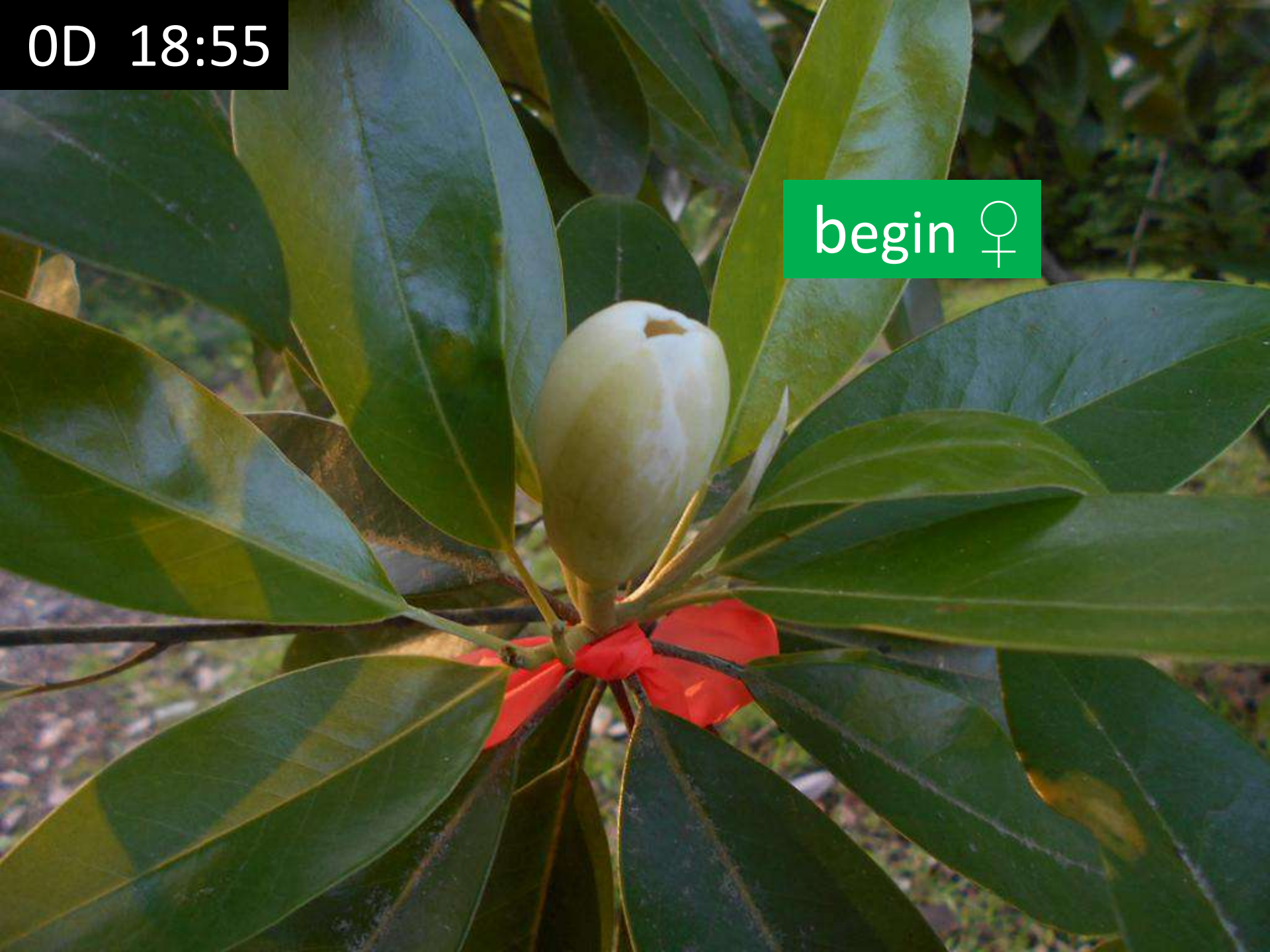

1D 17:42

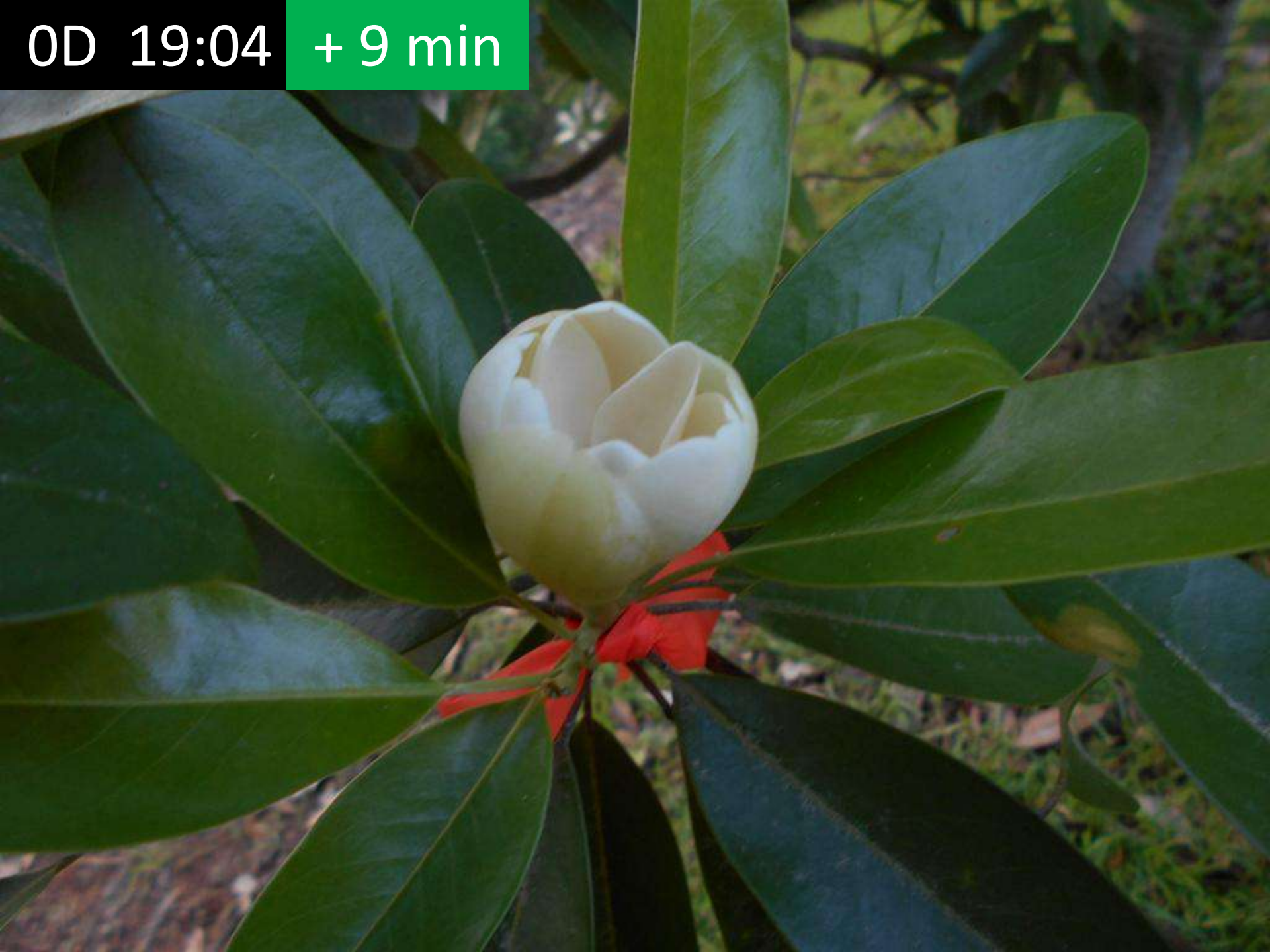
M. virginiana* var. *australis

Section *Magnolia*

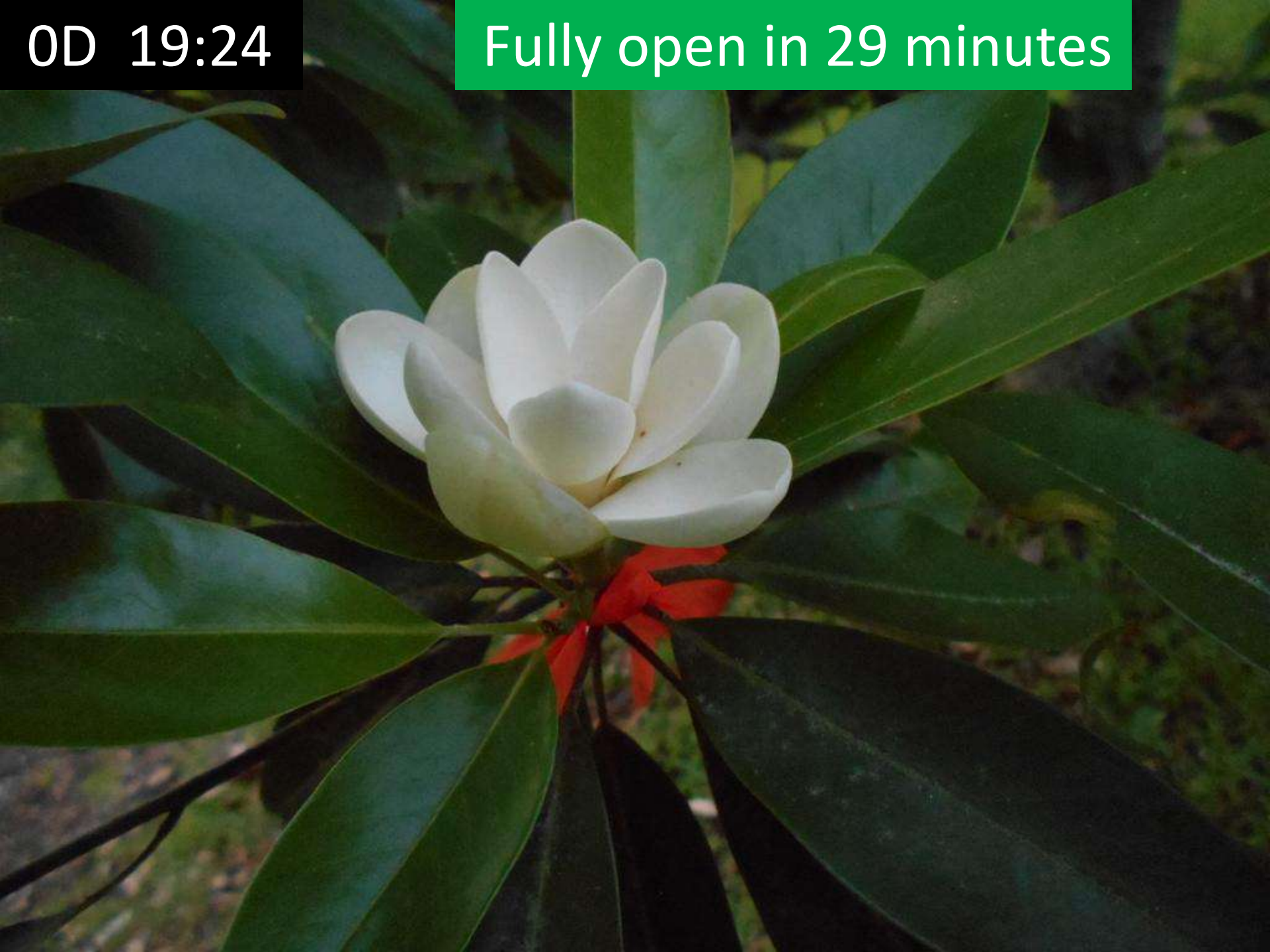
SE North America (incl. Cuba)


0D 17:59


0D 18:55
begin ♀


0D 19:04
+ 9 min


0D 19:13
+ 13 min

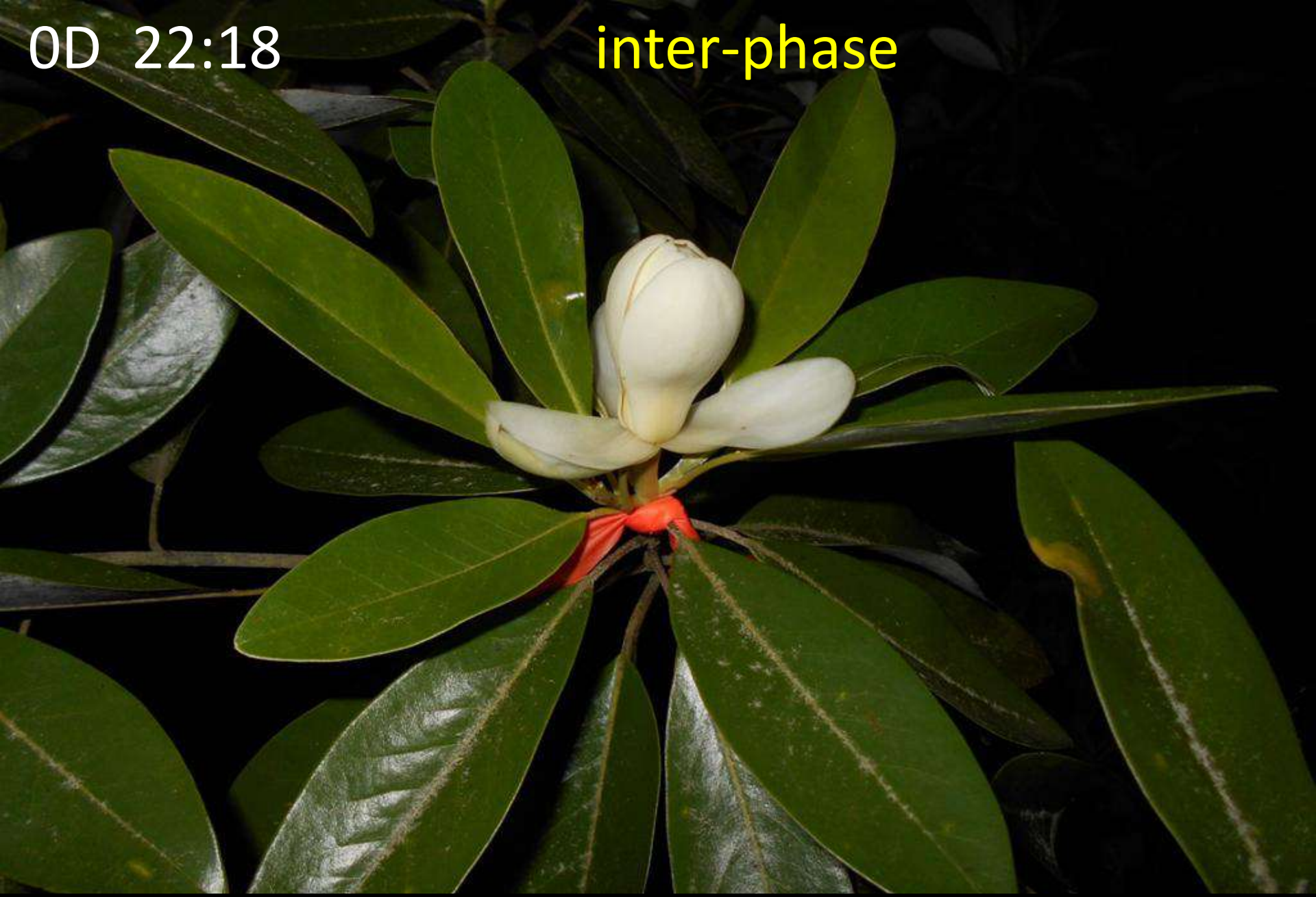

0D 19:24
Fully open in 29 minutes


0D 19:41


0D 19:52


0D 21:49
tepals begin to close

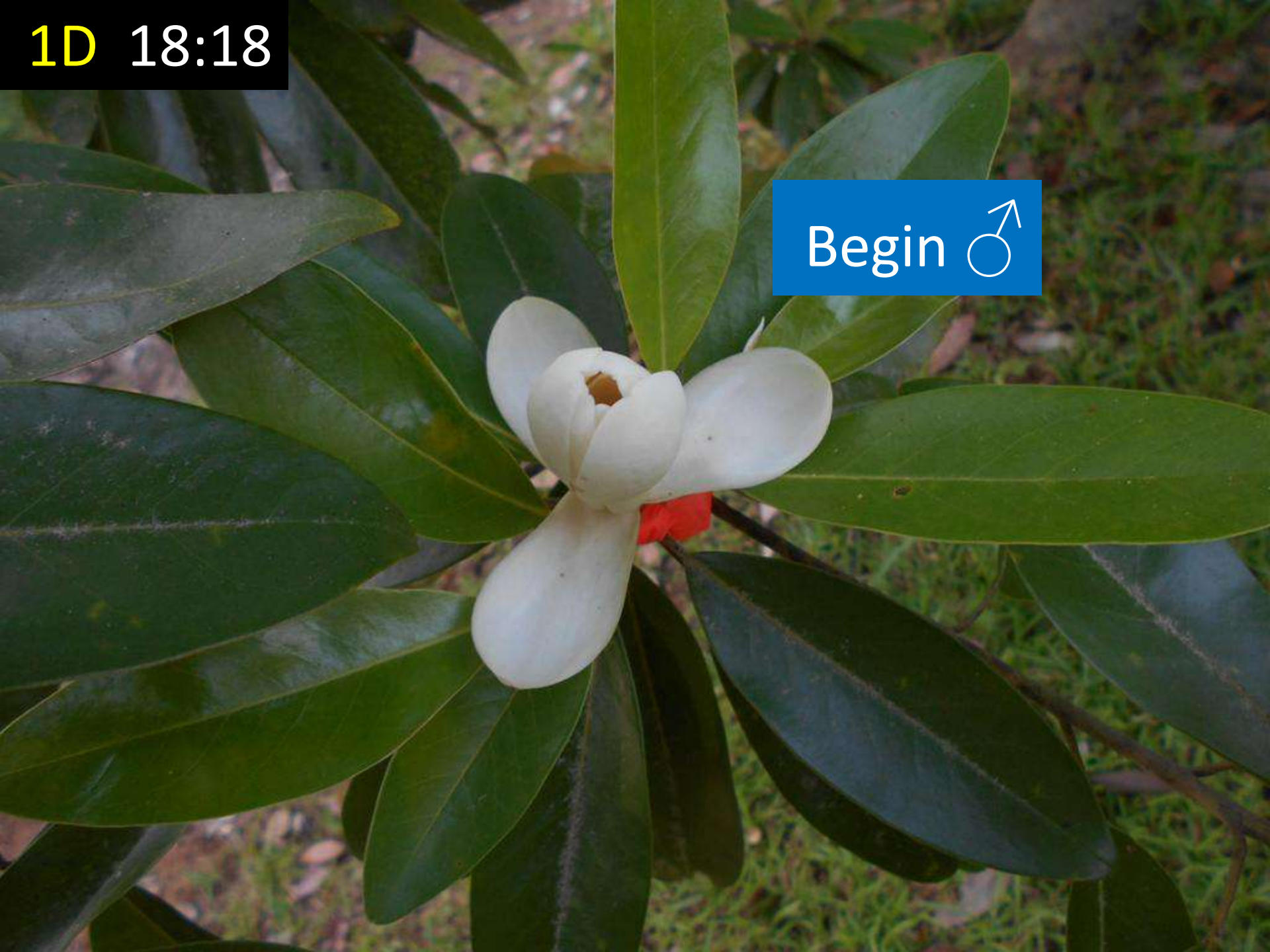

0D 22:18
inter-phase

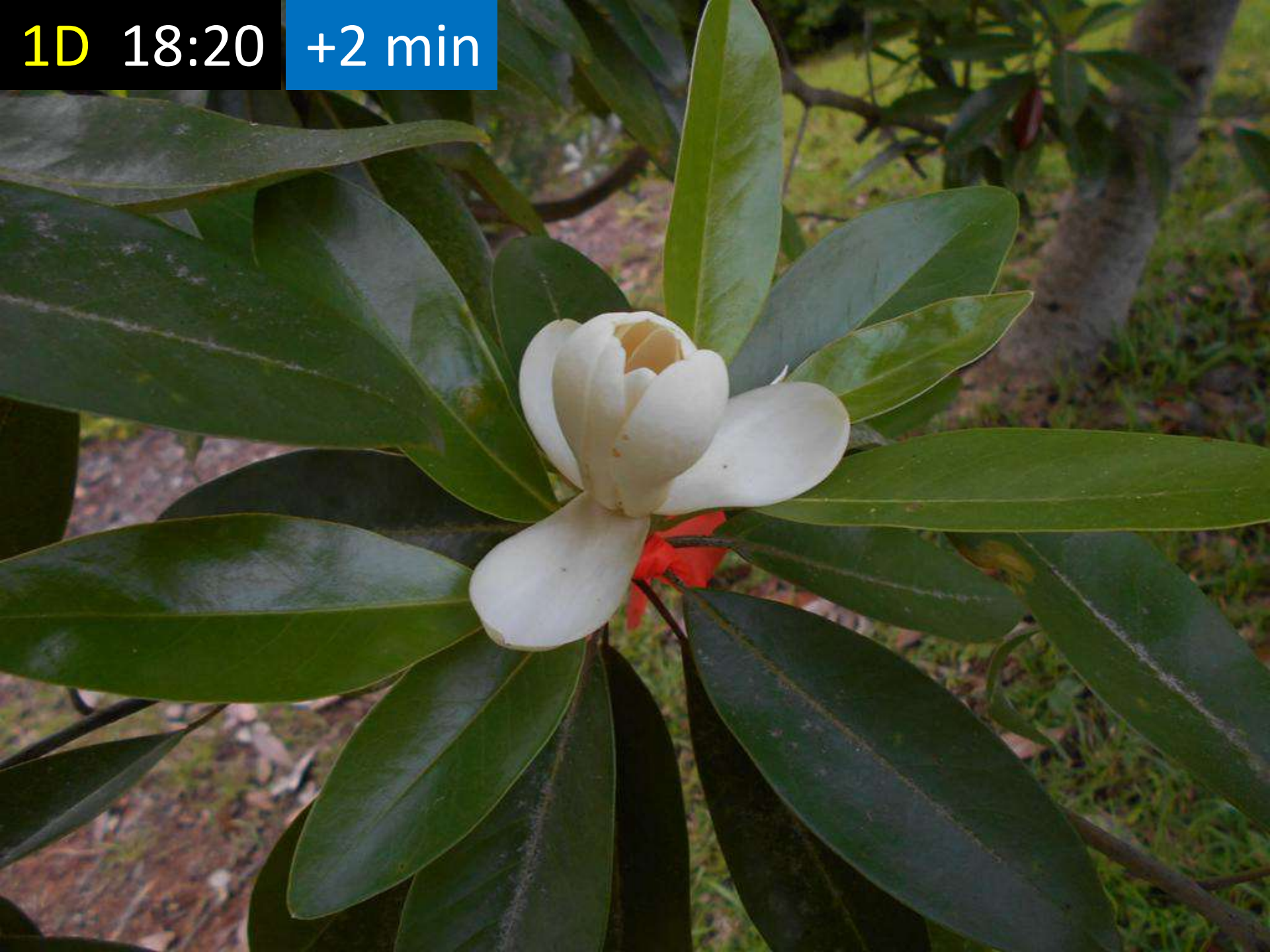


will remain UNCHANGED for c. 20 hrs.

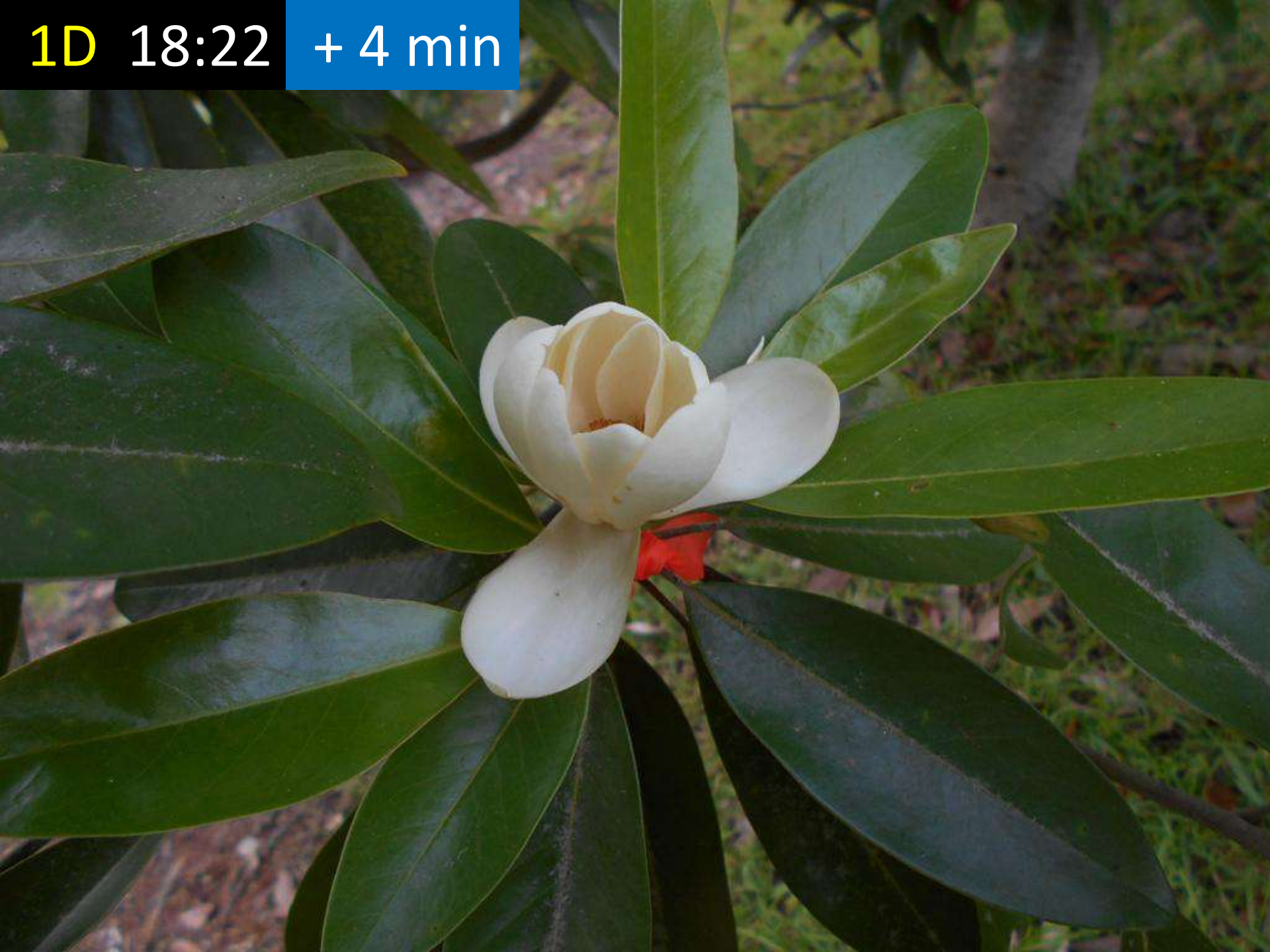

1D 6:07
. . . still inter-phase

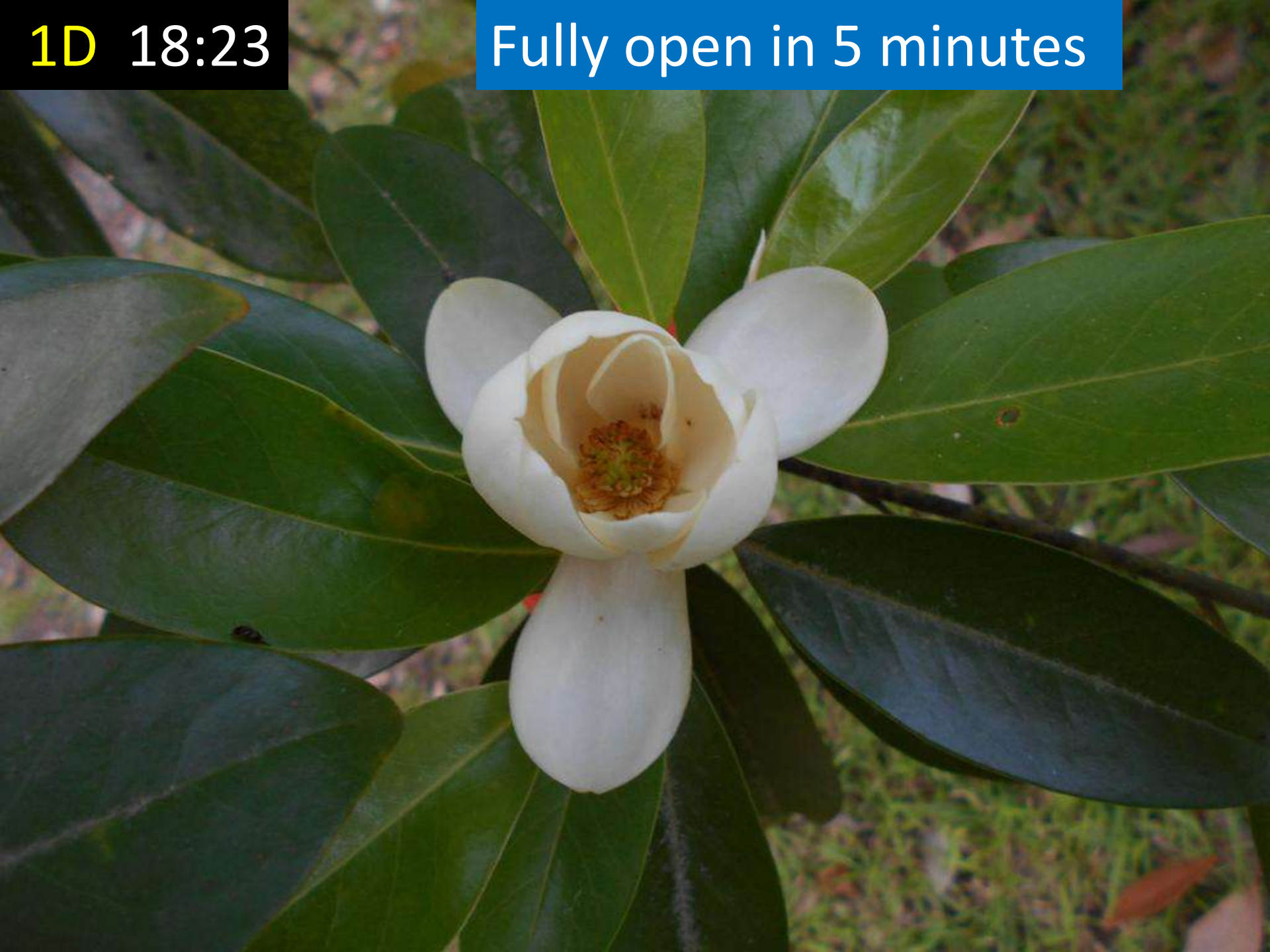

1D 18:14
. . . another 12 hrs later: same


1D 18:18
Begin ♂


1D 18:20
+2 min


1D 18:21 + 3 min

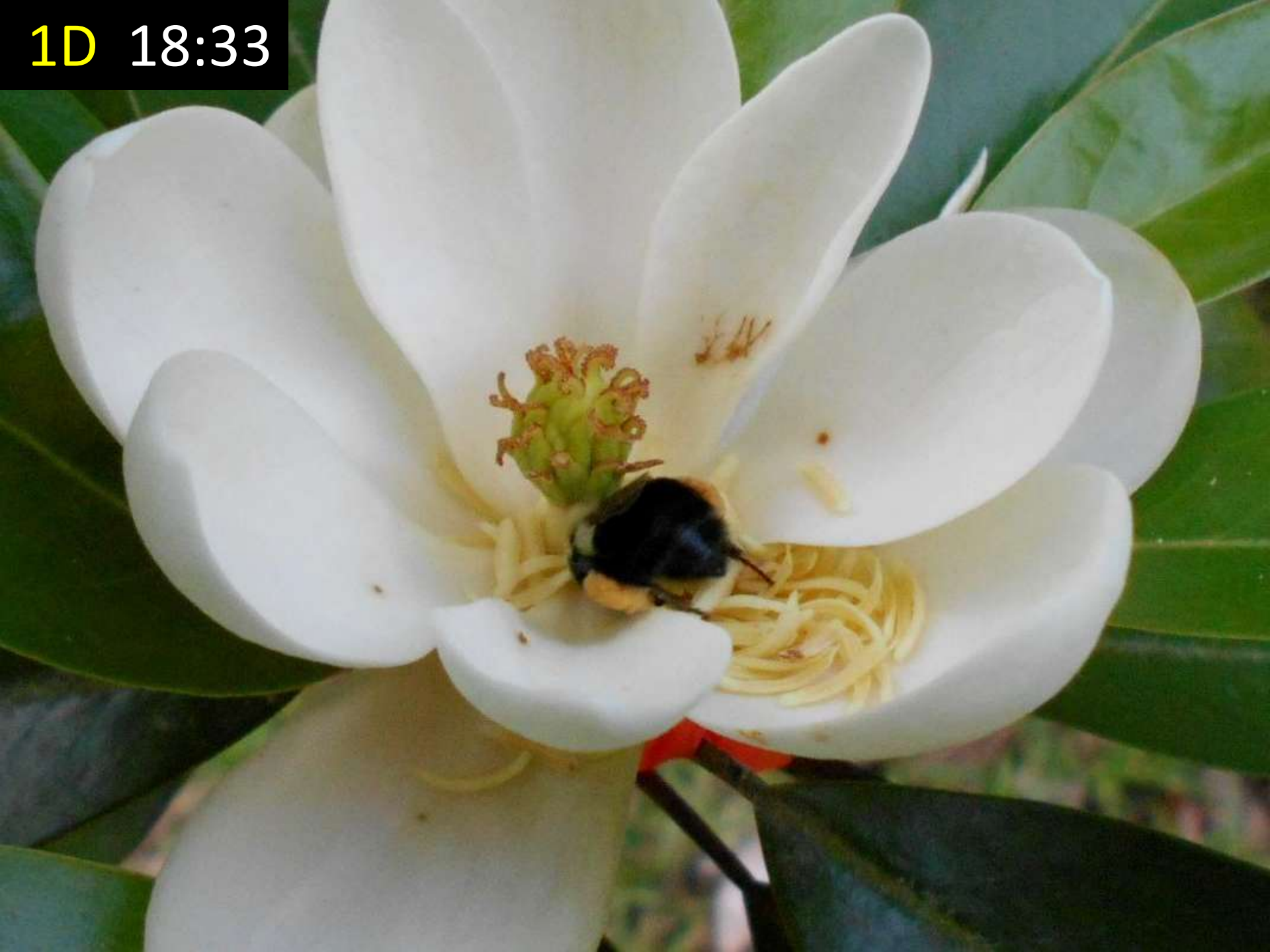

1D 18:22
+ 4 min

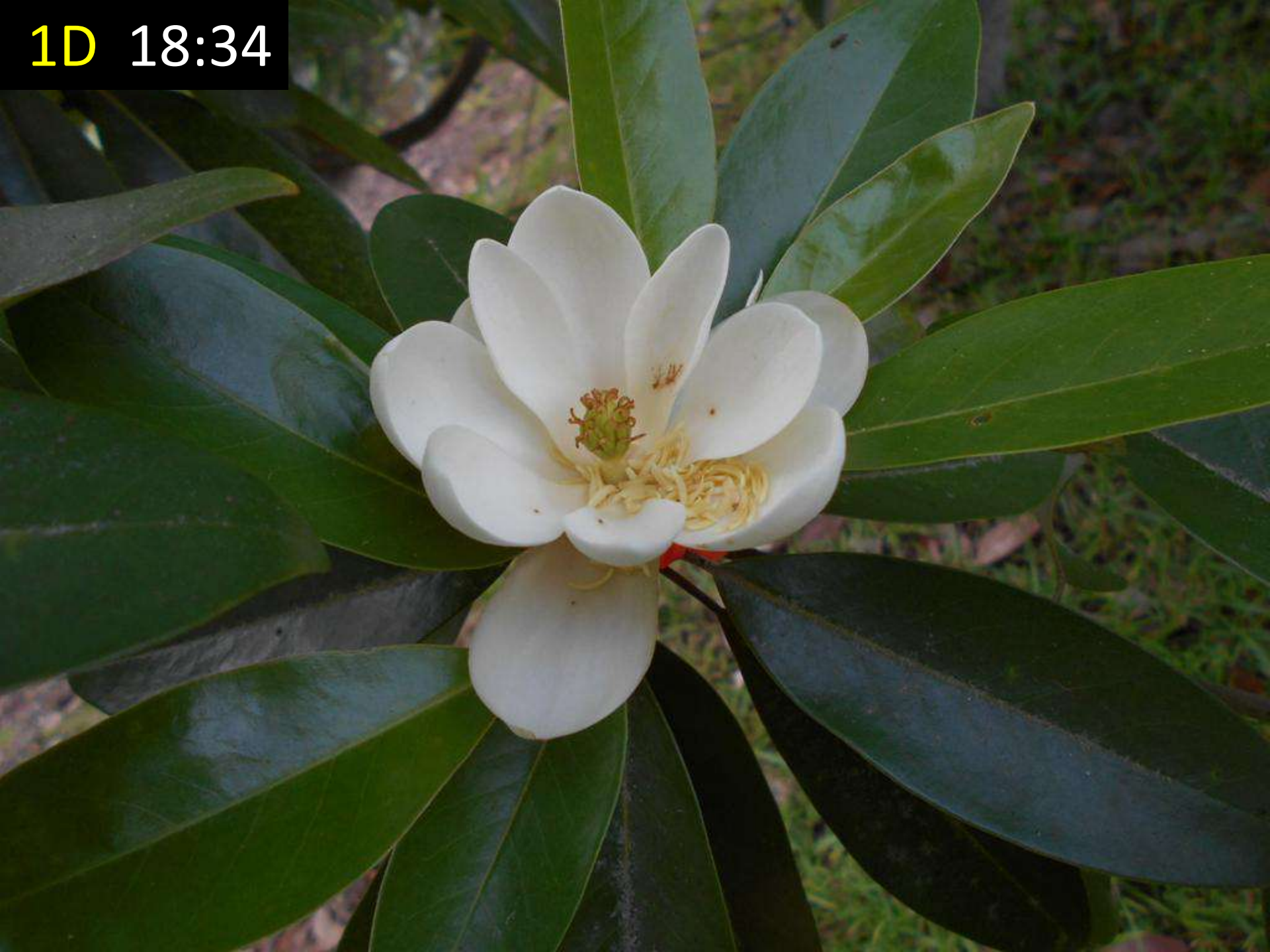

1D 18:23
Fully open in 5 minutes


1D 18:27
Bumble-bee

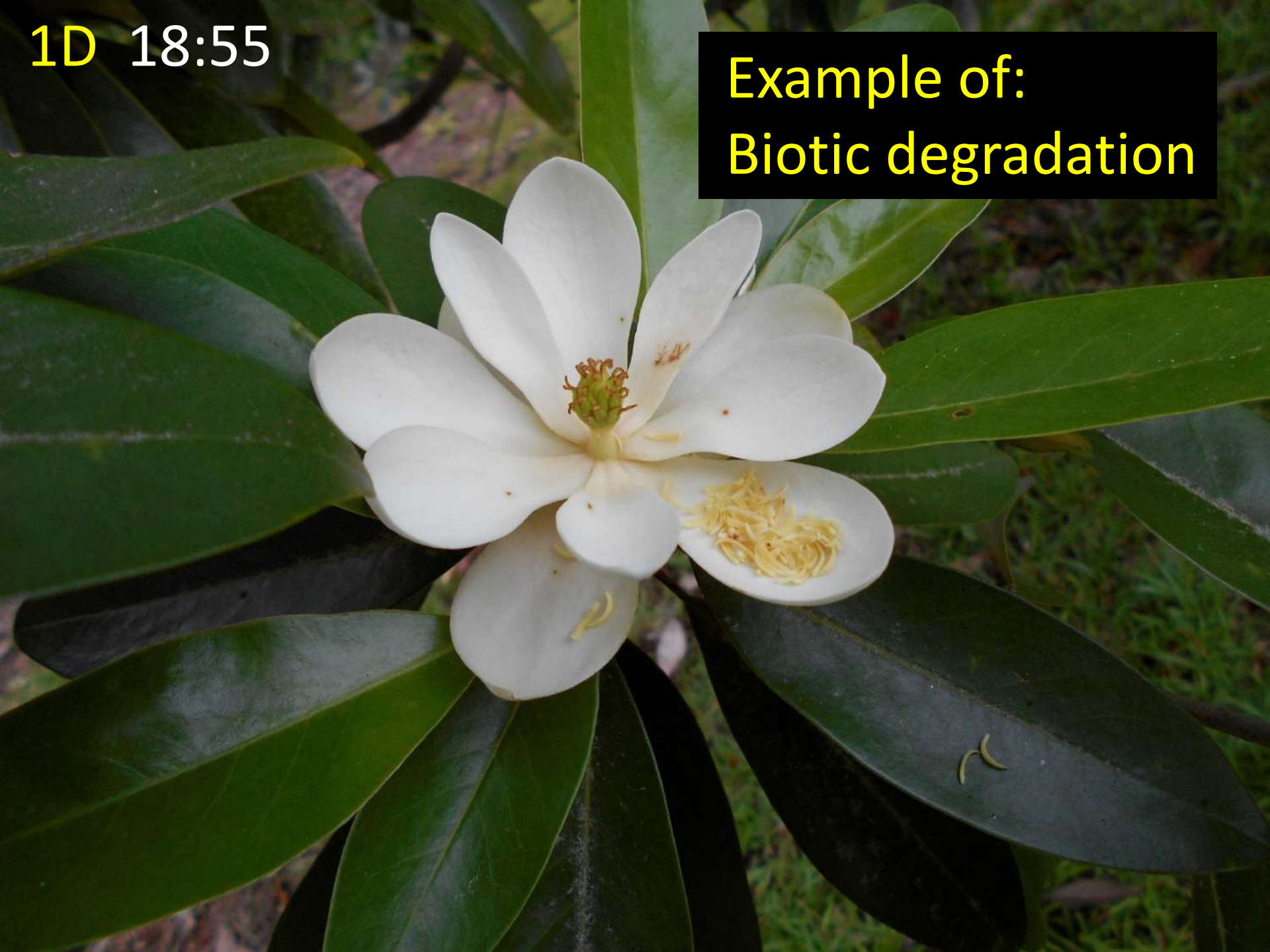

1D 18:27


1D 18:33


1D 18:33


1D 18:34

In just 30 min – stamens/pollen nearly gone


1D 18:55
Example of:
Biotic degradation

Magnolia insignis

Section Manglietia

(SE Asia)

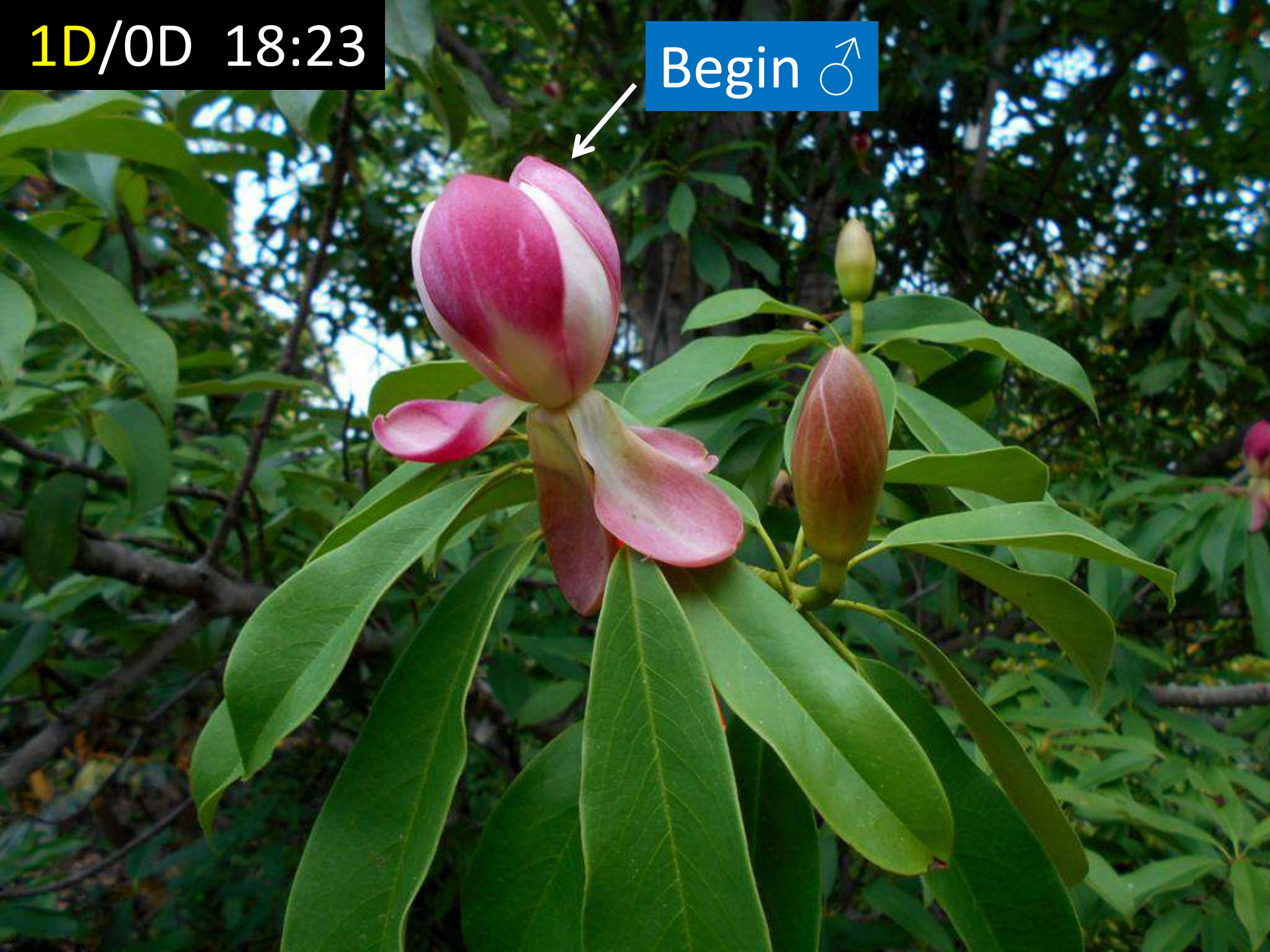

1D 6:01

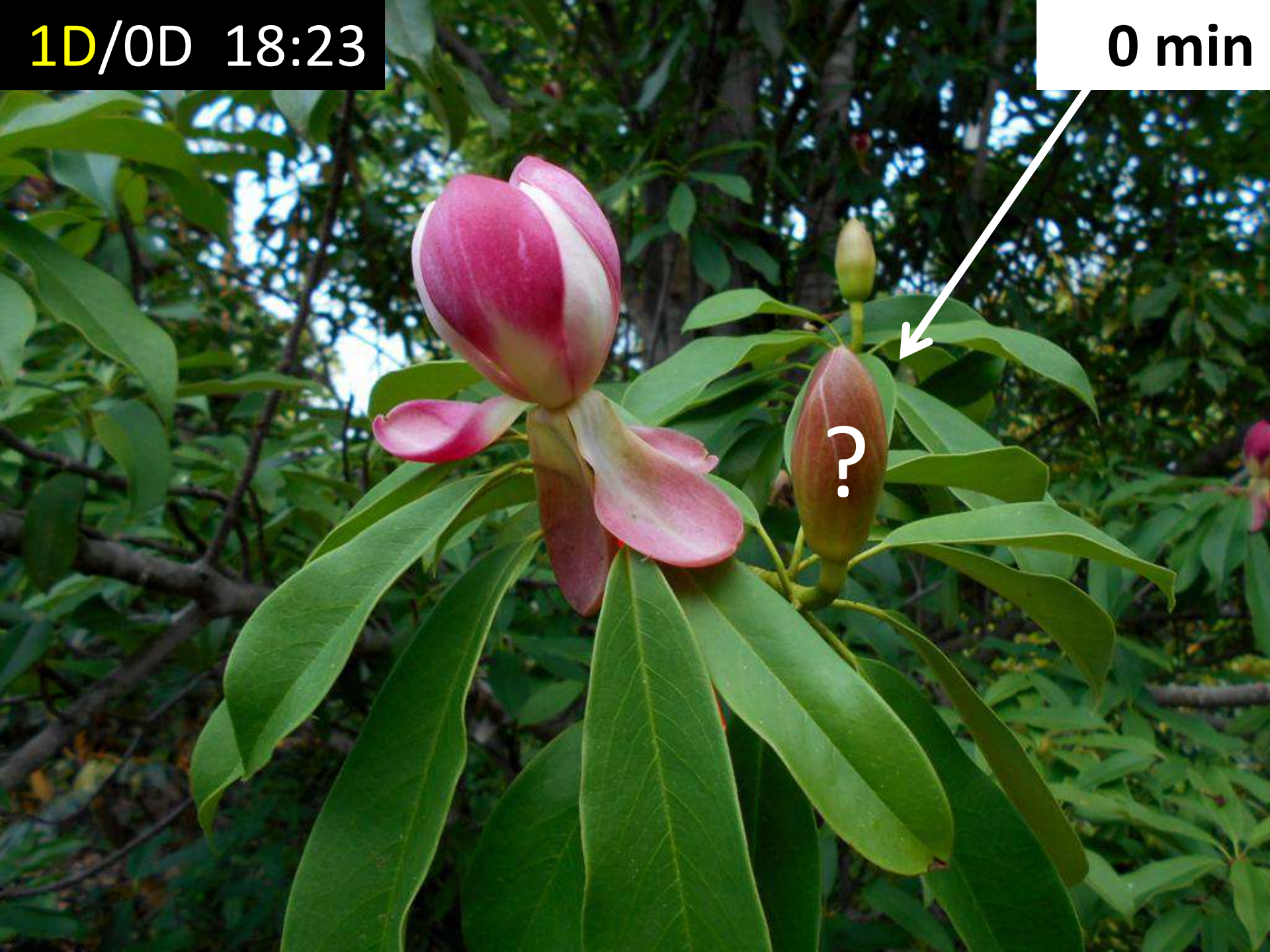

1D 6:01
will open ♂ tonight

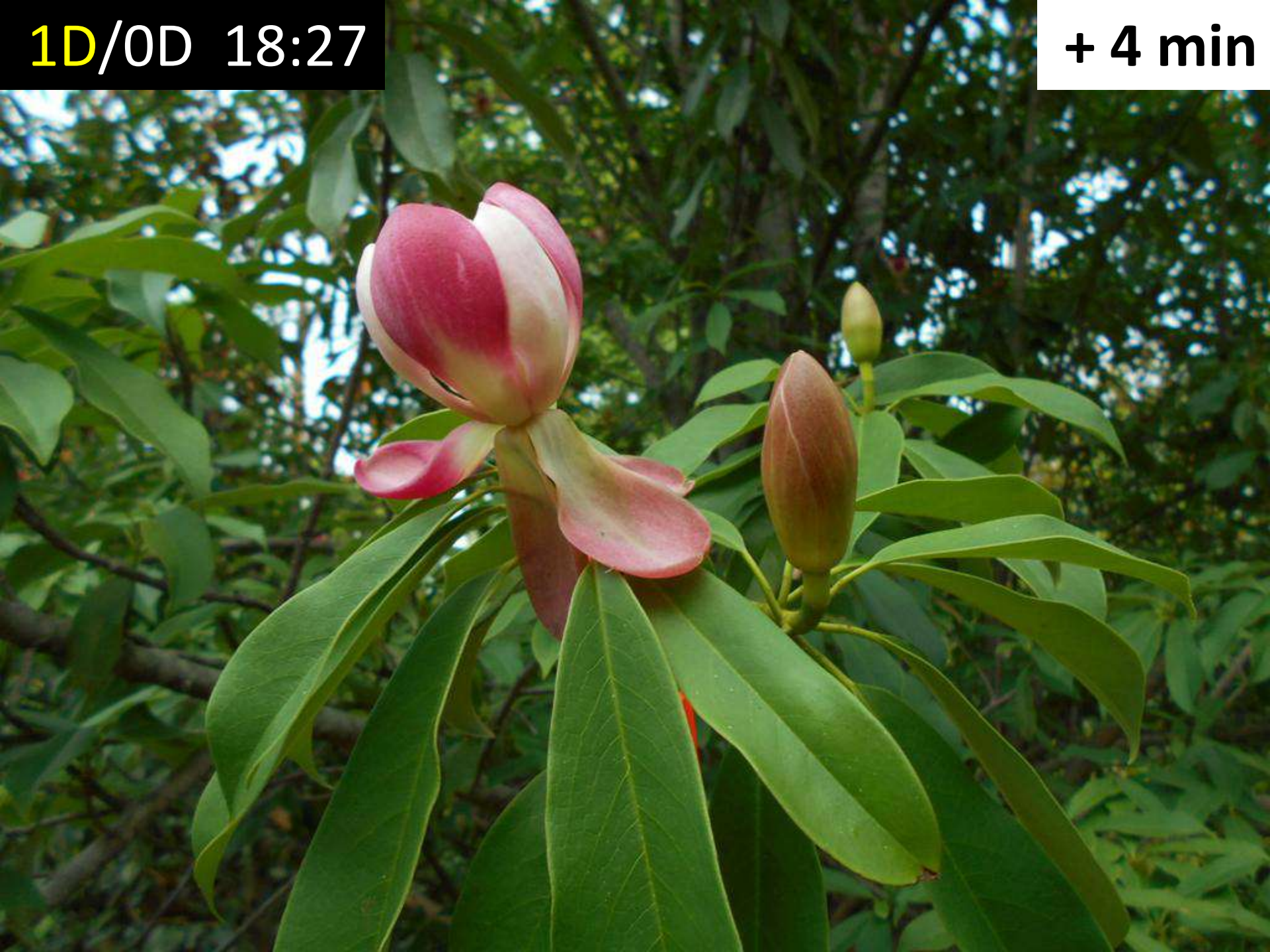

1D/0D 6:01
♀ tonight ?

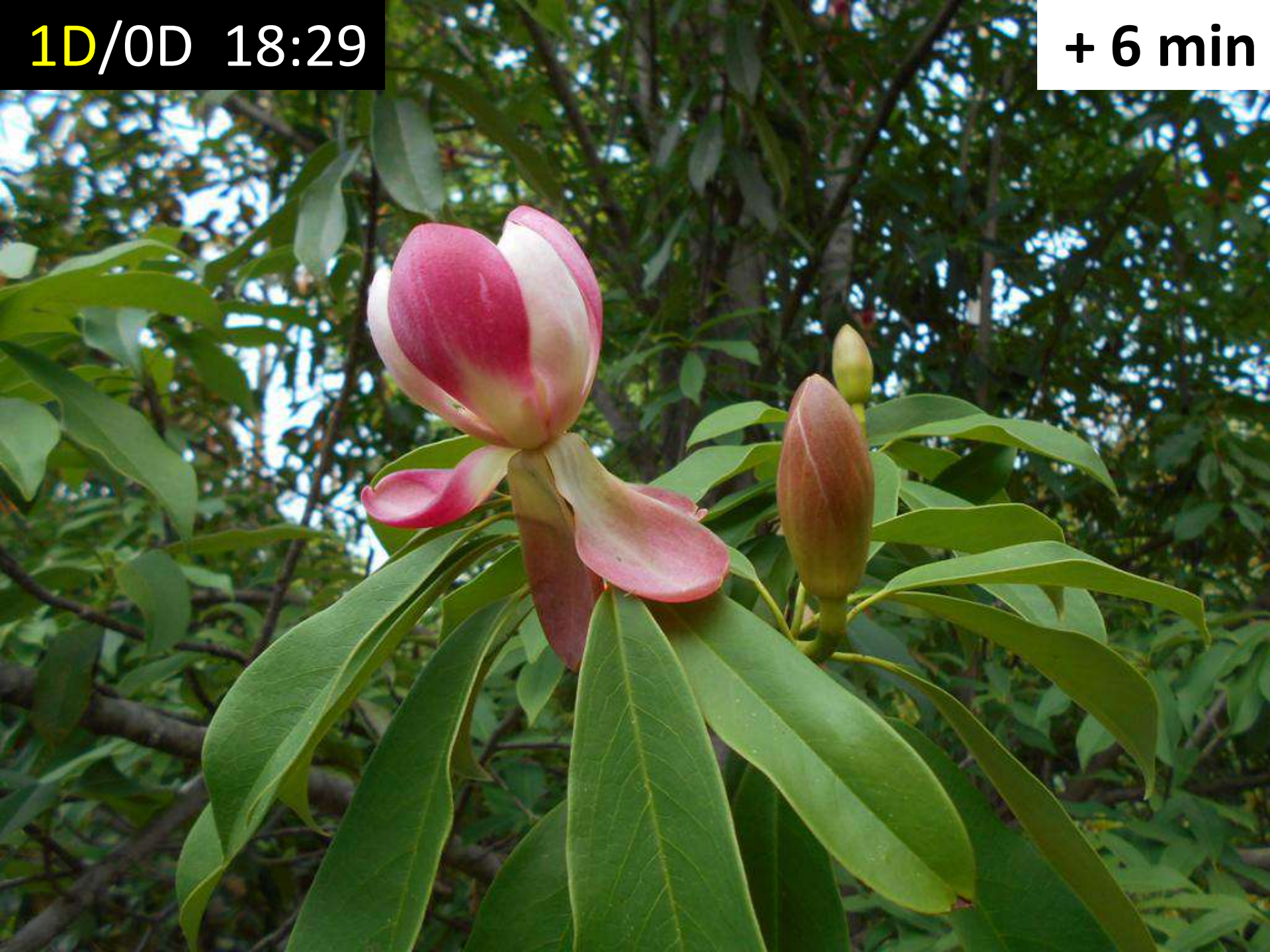

1D/0D 17:51
12 hrs. later – no change


1D/0D 18:15

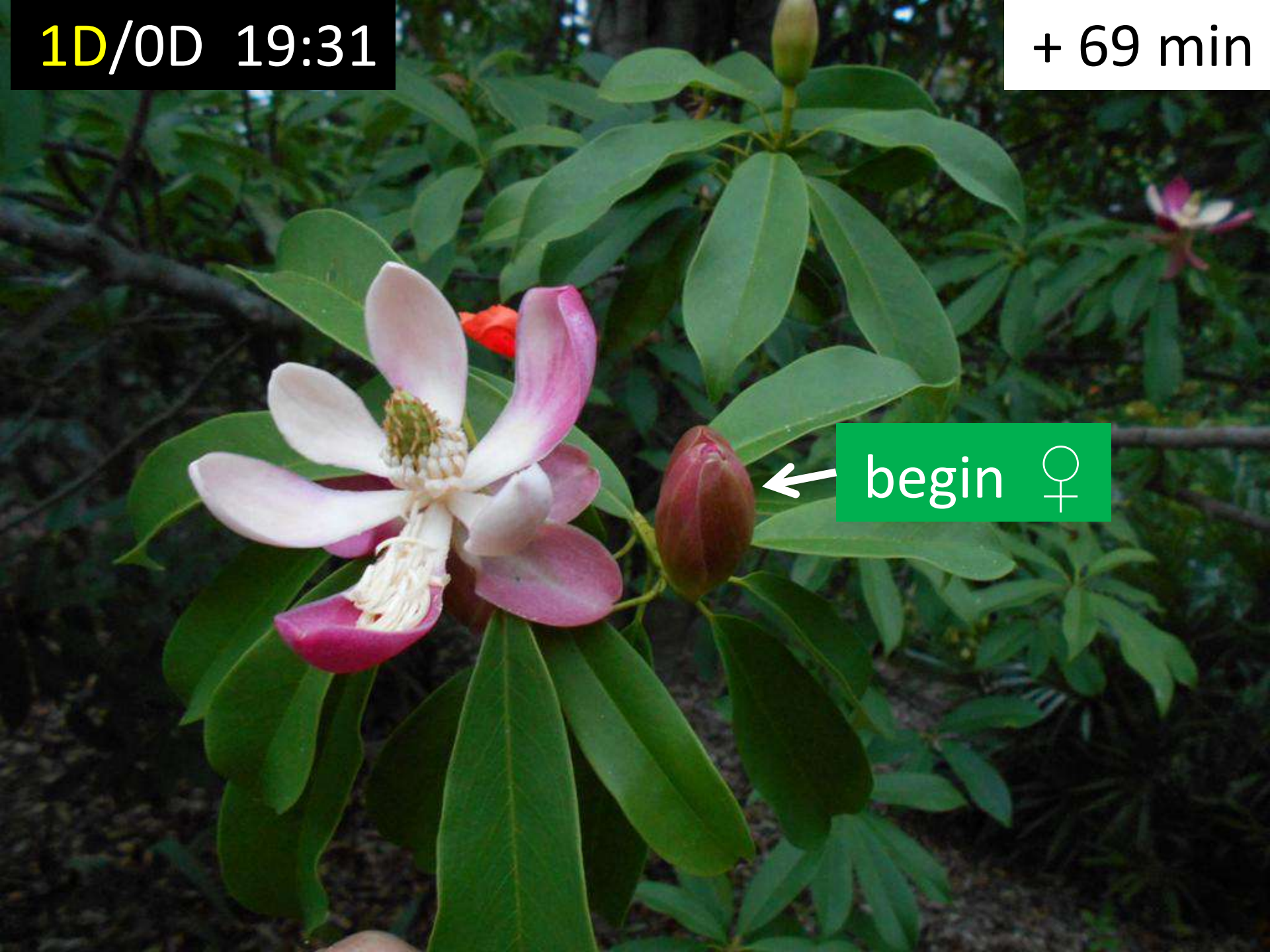

1D/0D 18:23
Begin ♂


1D/0D 18:23
0 min
?


1D/0D 18:27
+ 4 min

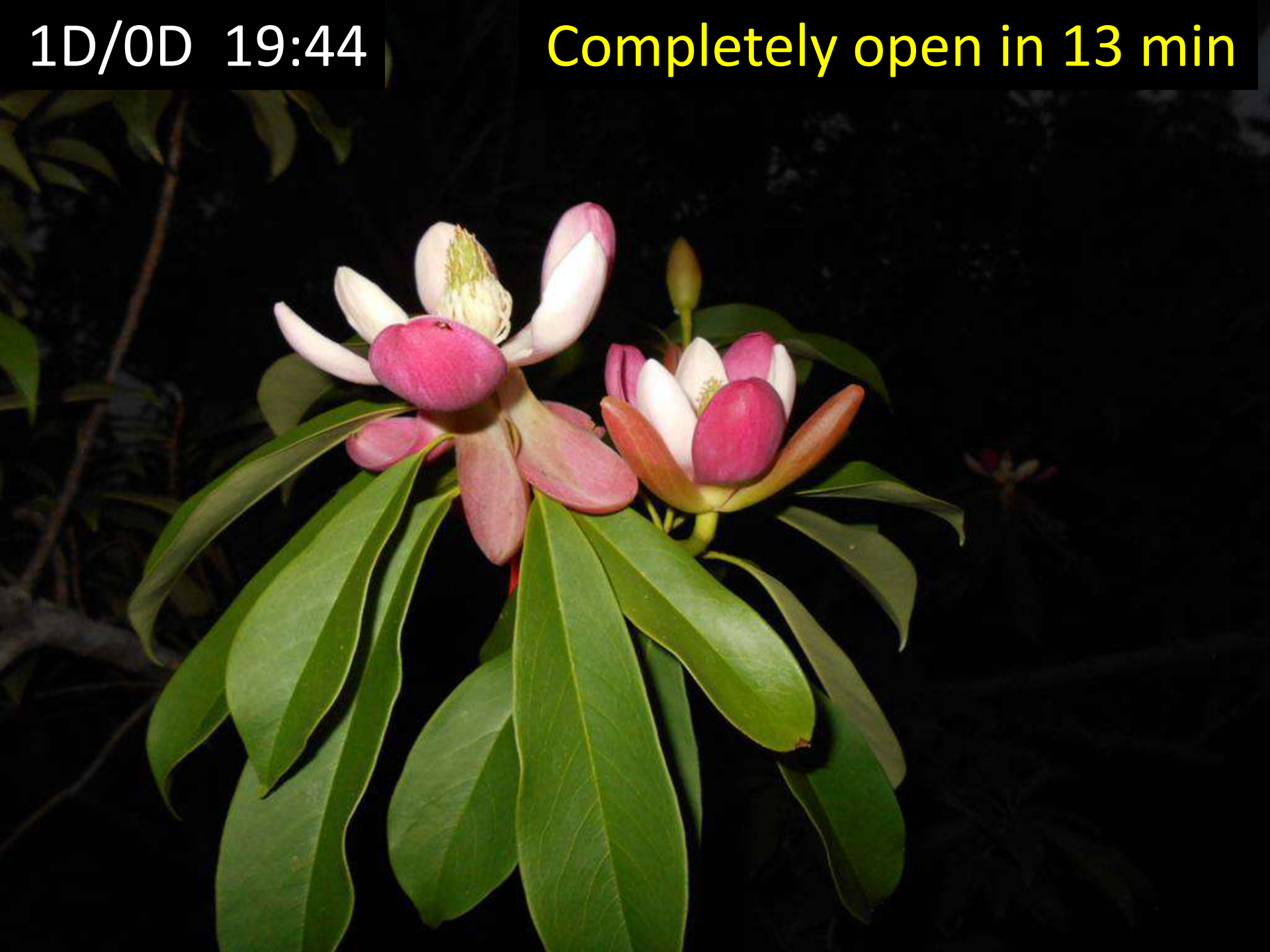

1D/0D 18:29
+ 6 min


1D/0D 18:52
+ 29 min


1D/0D 19:31
+ 69 min
begin ♀


1D/0D 19:36


1D/0D 19:41


1D/0D 19:44
Completely open in 13 min


1D/0D 19:45
♂ and ♀ in same frame


2D/1D 6:22
next morning . . .


2D/1D 6:22
next morning . . .
Inter-phase


2D/1D 6:22
next morning . . .
Inter-phase
post-functional