The effect of changes in light conditions on the biological clock of *Mimosa pudica*

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Science & Math Course, Science Research Group 7

Contents

What is *Mimosa pudica?*

It is known as the touch-me-not.

Nyctinastic leaf movement

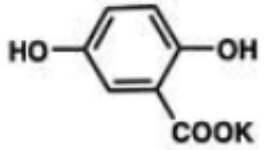
The opening and closing of the leaves according to their biological clocks and light stimulation

Pictures: opened leaves (left) and closed leaves (right)

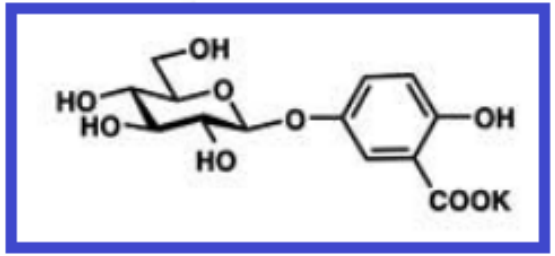
Nyctinastic leaf movement

Biological clock

starting substance



Leaf-closing substance



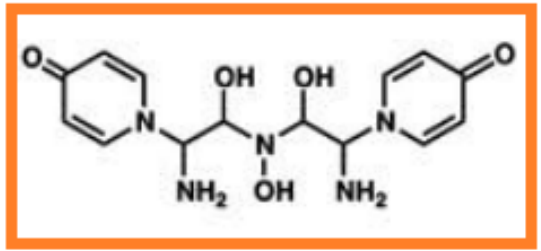
night

>

<

day

Leaf-opening substance



increase at night

close

constant amount

open

Purpose of our research:

To learn about the nature of the biological clock of *M. pudica*

Preliminary Experiment Ⅰ Preparation

Purpose

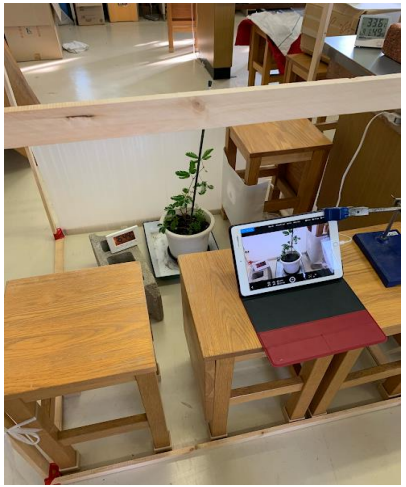
To set up an experimental environment and procedure

Method

We took a photo of *M. pudica* every five minutes on an iPad, and continued observations for 3 days.

Plant

We used one large plant.



Picture: experimental set-up

Preliminary Experiment 1 Preparation

Result

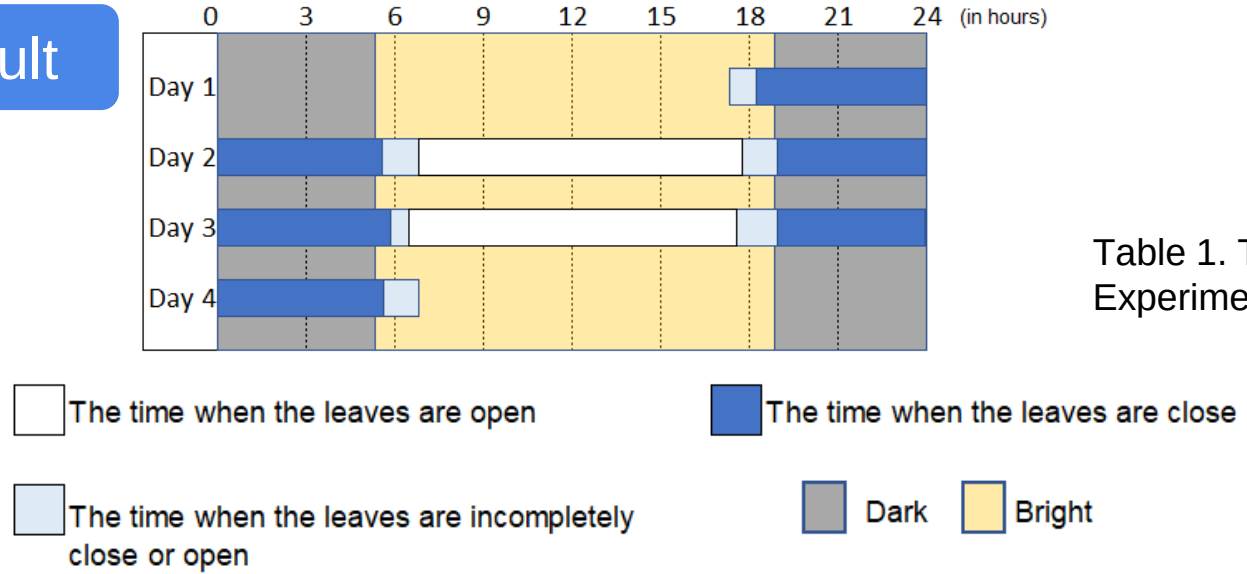


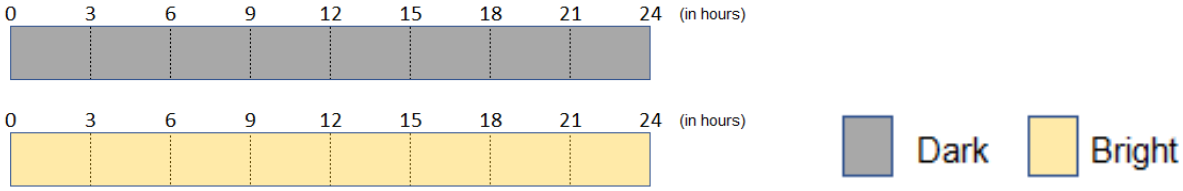
Table 1. The result of Preliminary Experiment 1

⇒The leaves of *M. pudica* moved in a cyclical motion in accordance with sunrise and sunset.

Are light conditions affecting nyctinastic leaf movement?

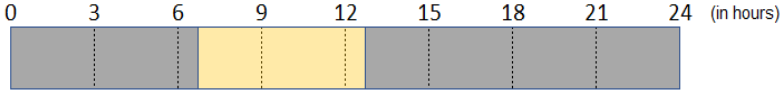
Preliminary Experiment 2

Continuous dark and bright periods



Plant — We used one large plant for each.

6 hours of brightness



bright：dark ＝ 1 ： 3 （6 hours bright, 18 hours dark）

We used one large plant.

Plant — We used five small plants.

Preliminary Experiment 2

Result

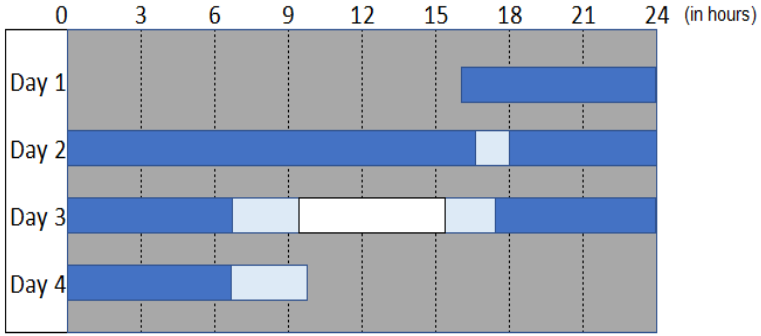


Table 2. The result of a continuous dark period

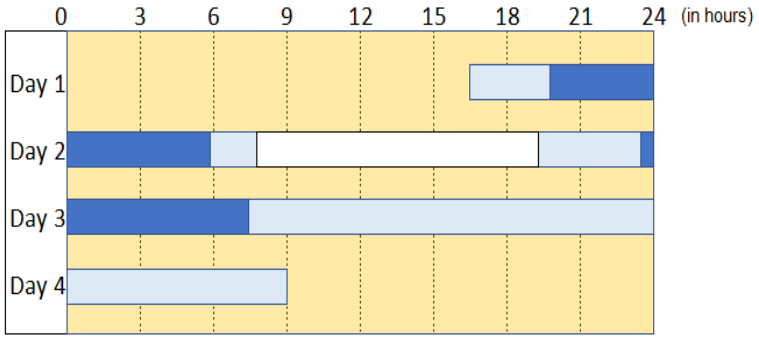


Table 3. The result of a continuous bright period

Study

The light conditions caused differences in the biological clock, but the plant still showed cyclical movements in spite of the changes.

Preliminary Experiment 2

Result

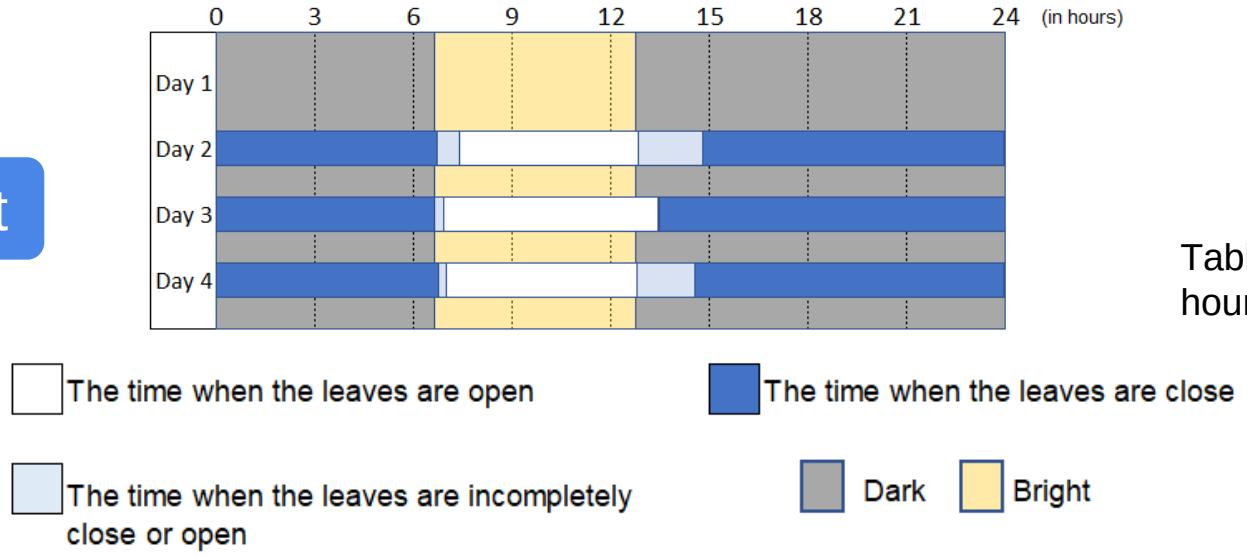


Table 4. The result of 6 hours of brightness

Study

Leaves moved according to the changed light stimulation.

How do these plants adapt their biological clocks to changes in light stimulations?

Experiment 1　Reversing day and night

Hypothesis

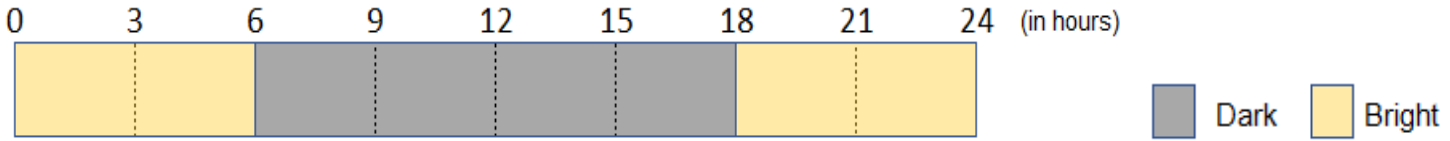
The movement will be adjusted to the light conditions as the days go on.

Period

6:00～18:00　dark　18:00～6:00　bright

Plant

We used two small plants.



Result

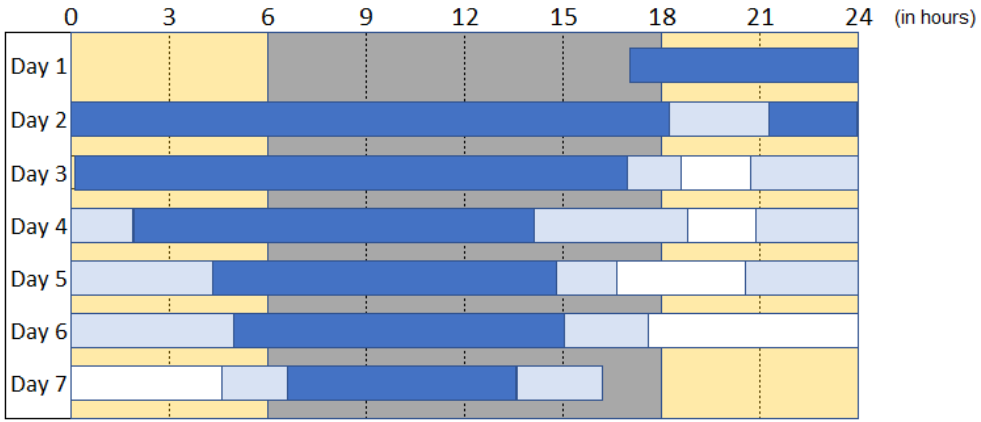


Table 5. The result of Experiment 1

Study

- We found that they adjusted to the light condition as the days went by.
- *M. pudica* adjusts to abrupt changes in the light conditions by “closing→opening”.

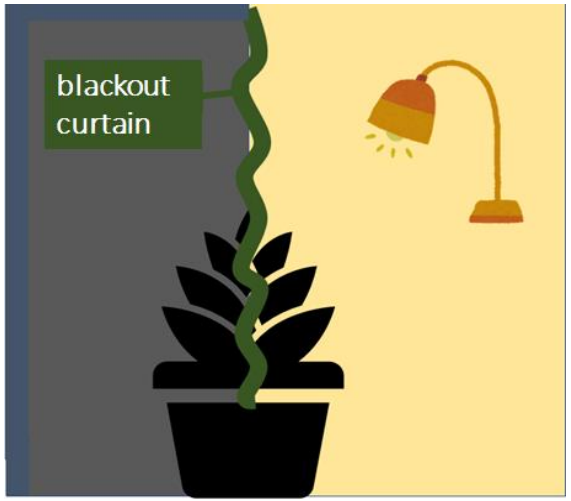
Why was the same individual plant moving differently, leaf-by-leaf?

Experiment 2 Observing different light conditions on the same plant

Hypothesis

The movement is regulated on a leaf-by-leaf basis.

Method



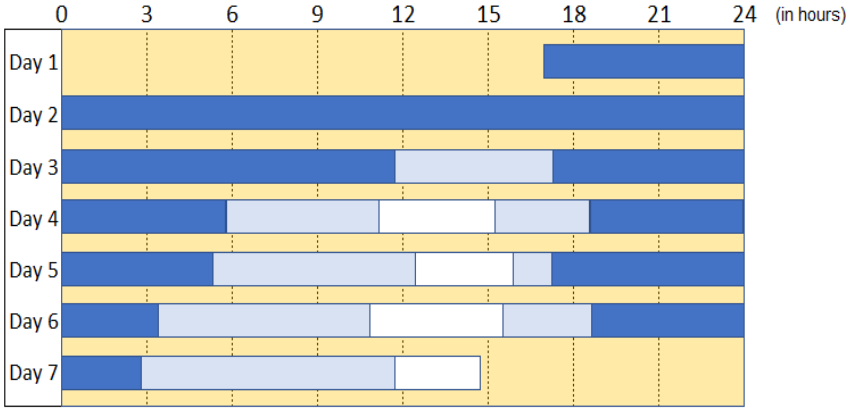
Experiment 2 set-up

Plant

We used one large plant.

Result

＜Bright Side＞



＜Dark Side＞

⇒The leaves were always closed.

Table 6. The result of Experiment 2

Study

It was found that the nyctinastic leaf movement is not synchronized throughout the plant body, but is adjusted by individual plant parts. ⇒It is thought that the leaf closing substance is produced in each leaf (or in each side's branches).

Conclusion

- When there are abrupt changes in the light conditions….

  the sleeping state ⇒ the awake state

- The movement is adjusted by individual plant parts.

Future prospects

- Experiment with temperature and humidity regulation
- Conduct an experiment focusing on starch accumulation

References

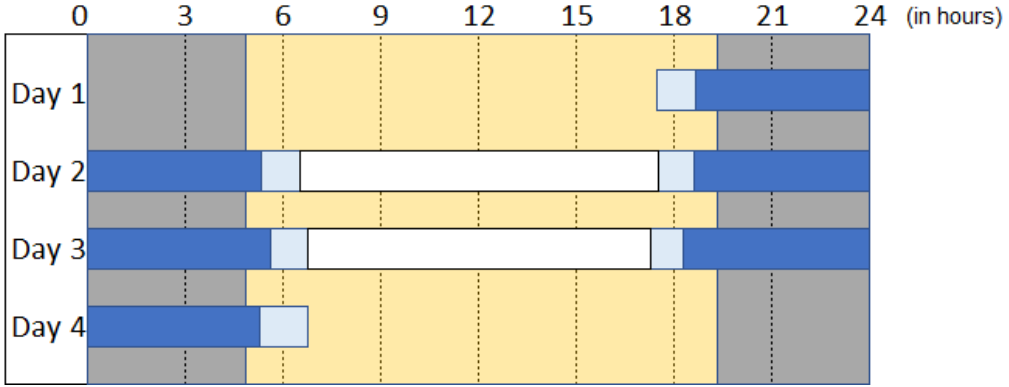
Bioactive Substance Controlling Nyctinastic Leaf-Movement of Leguminous Plant. Minoru UEDA, Takanori SUGIMOTO, Noboru TAKADA, Shosuke YAMAMURA,. Faculty of Science and Technology, Keio University,. Chemistry and Biology (in Japanese)Vol. 40, No. 9. 2002

Chemical studies on nyctinastic leaf-movements and trap-snapping of Venus's flytrap. Minoru Ueda. Department of Chemistry, Tohoku University. 2014

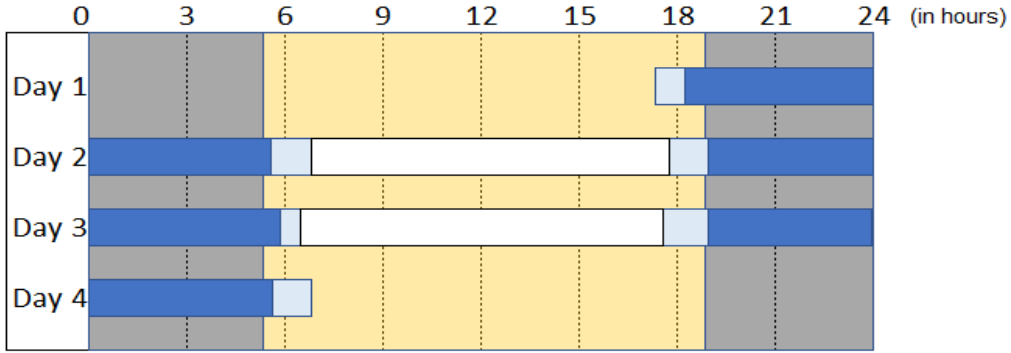
Takayuki Ohara. Mathematical models of the plant circadian clock: impact of phase regulation by sugar on plant growth. Hokkaido University. 2018

Q&A

Neutral



Dim light



The time when the leaves are open.

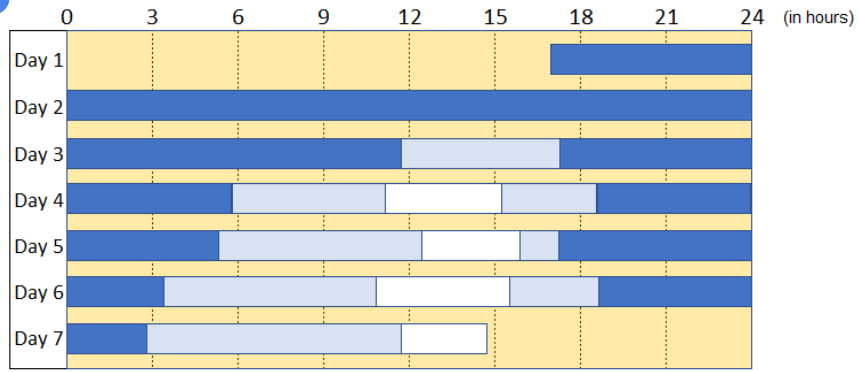
The time when the leaves are incompletely close or open.

The time when the leaves are close.

Dark Bright

Result

＜Bright Side＞



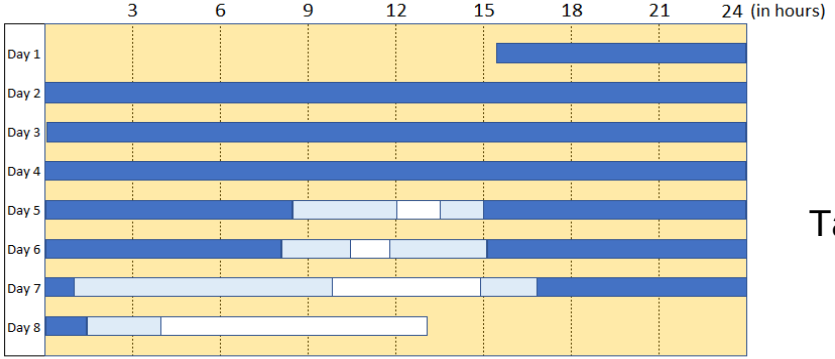
＜Dark Side＞

⇒The leaves were always closed.

Experiment 2

Table 7　The result of Experiment 2

＜Continuous Bright Period＞



＜Continuous Dark Period＞

⇒The leaves were always closed.

Additional Experiment

Table 8　The result of the Additional Experiment