

Explore the Difference between Single and Paired Samaras of Green Maple (*Acer serrulatum*) in the Maturation Process

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Introductions

The winged fruit (samara) of *Acer serrulatum* grow in pairs and detach after maturation.

Research questions

1. What are the differences of dissemination efficient between single and paired samaras?
2. What have the samaras changed in the maturation process?



Fig. 1 Single and paired samara of Acer serrulatum Hayata

Methods

Measuring horizontal displacement

- Use horizontal wind to simulate the transmission

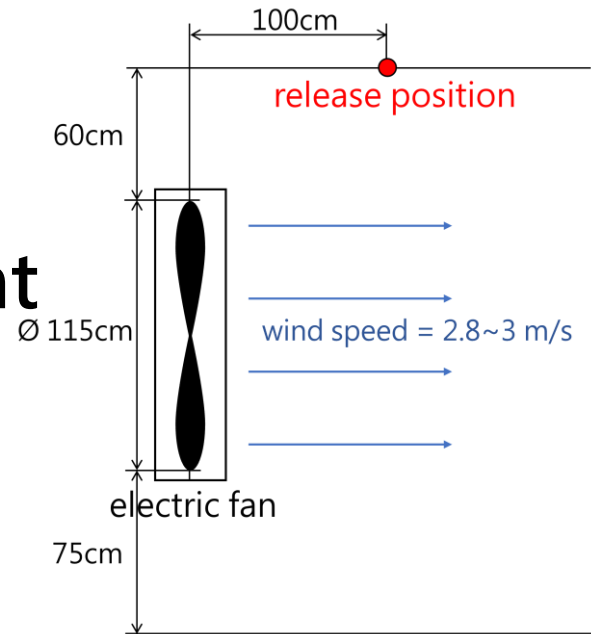


Fig. 2 The experimental installation of measuring horizontal displacement

Measuring time-of-dropping

- Remote-control releaser
- Drop single and paired samaras from 2.6 meters

Analyzing vertical motion

- Use Tracker to analyze the samaras' dropping process

Analyzing rotating motion

- High speed camera
- Convert the number of frames per round into the samara's rotational speed

Observing samaras' maturation process

- Take pictures of samaras
- Dissect and observe the samara's structure

Results

The differences of vertical and horizontal directions

- Horizontal displacement : **Single > Paired**
- Time duration in the air : **Single > Paired**

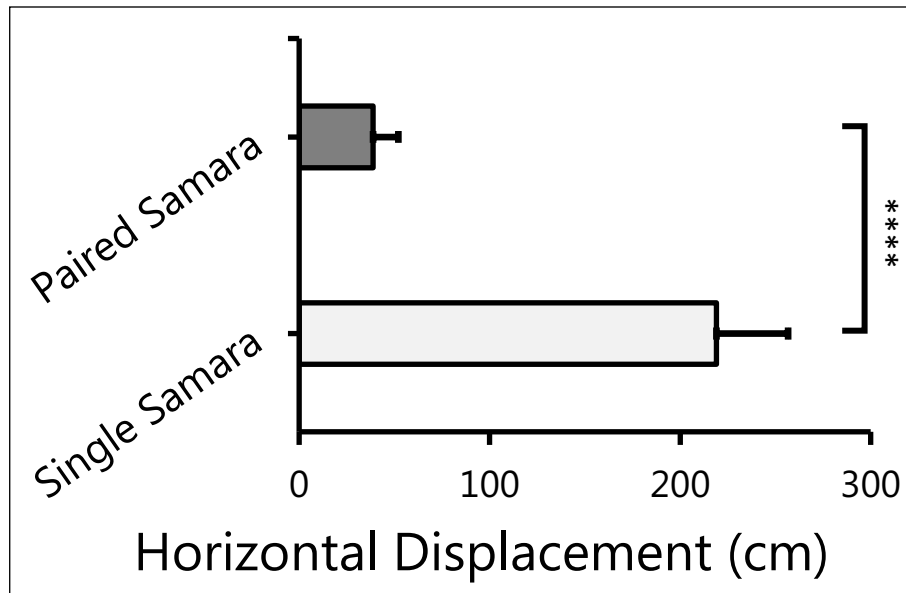


Fig. 3 The horizontal displacement comparison chart

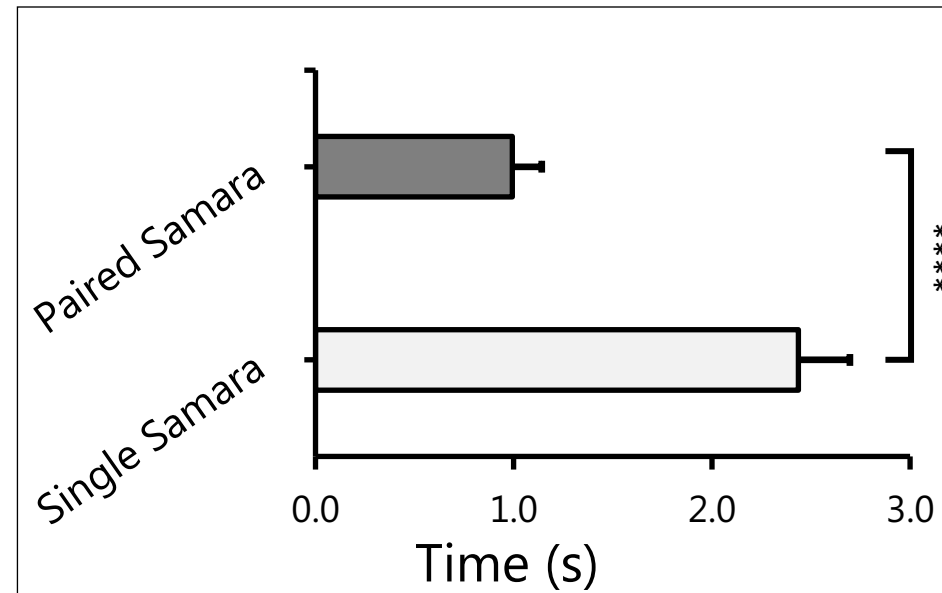


Fig. 4 The time duration comparison chart

Analysis of vertical motion

- Single samara : Free Fall → Deceleration → Terminal Velocity
- Paired samara : Uniform Accelerated Motion

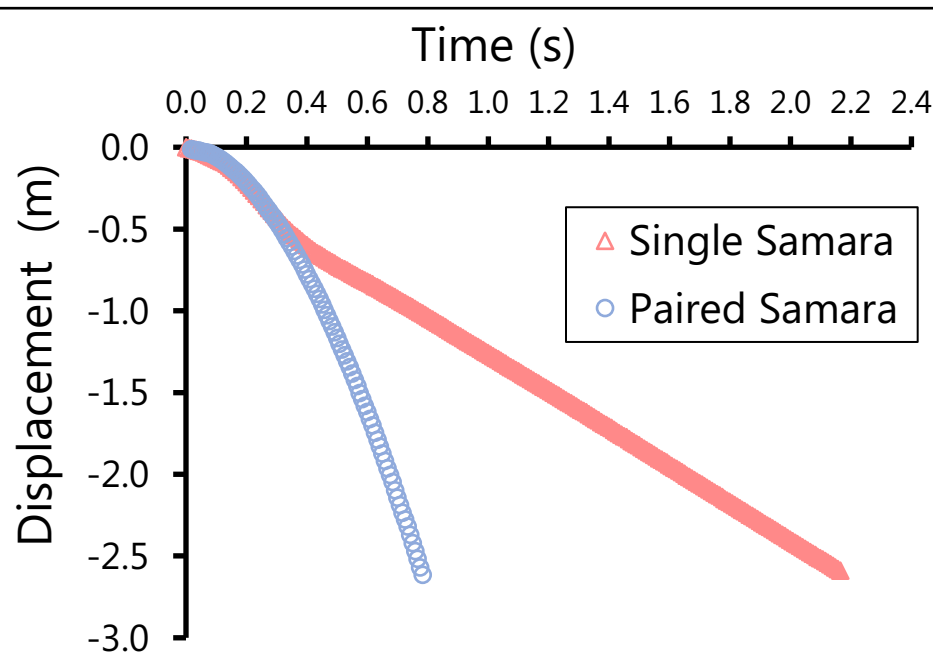


Fig. 5 The Displacement-Time chart of single and paired samara

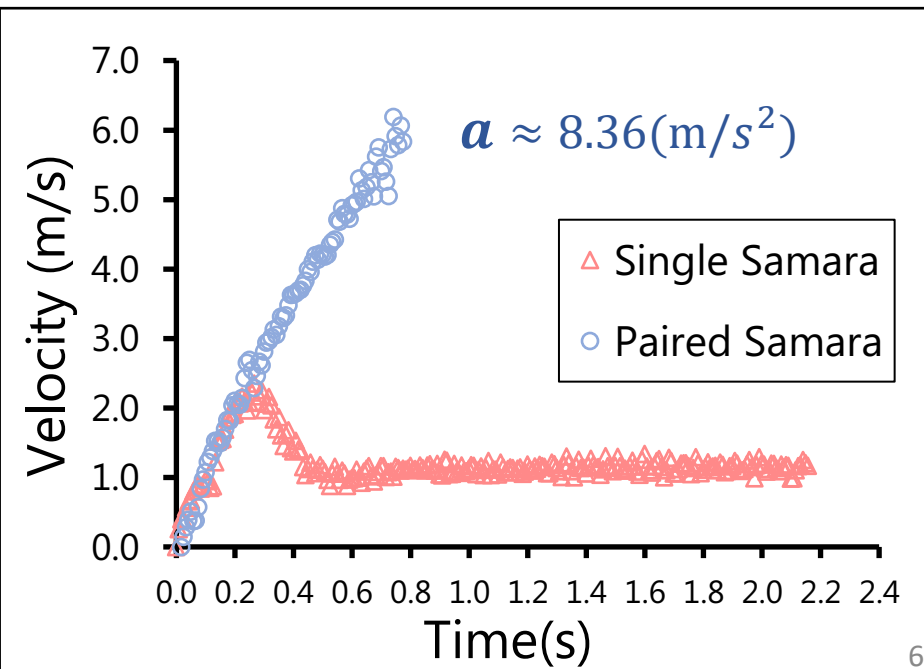


Fig. 6 The Velocity-Time chart of single and paired samara

Rotating motions analysis

- Rotational speed : Single > Paired

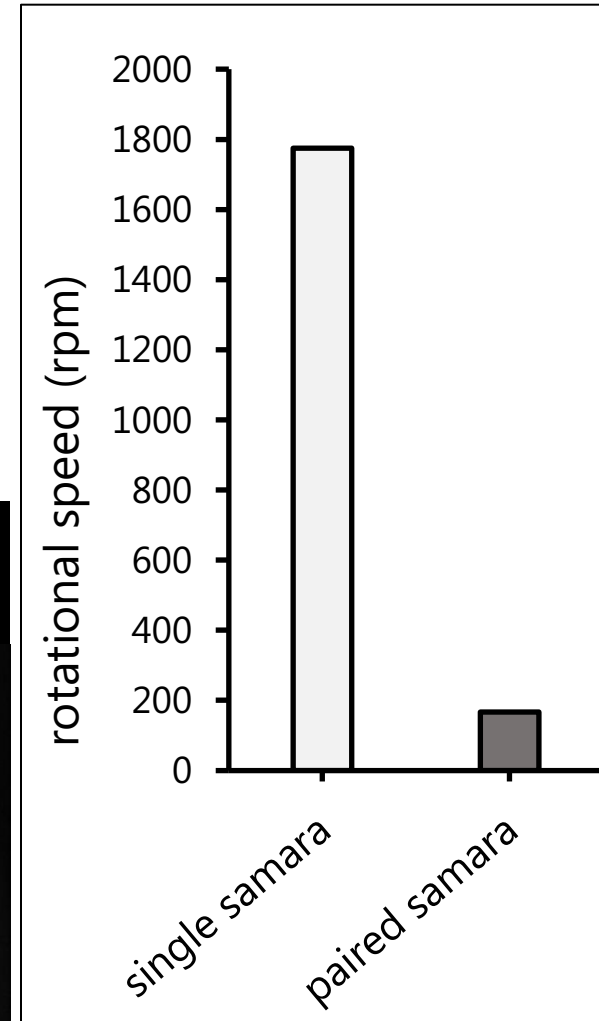
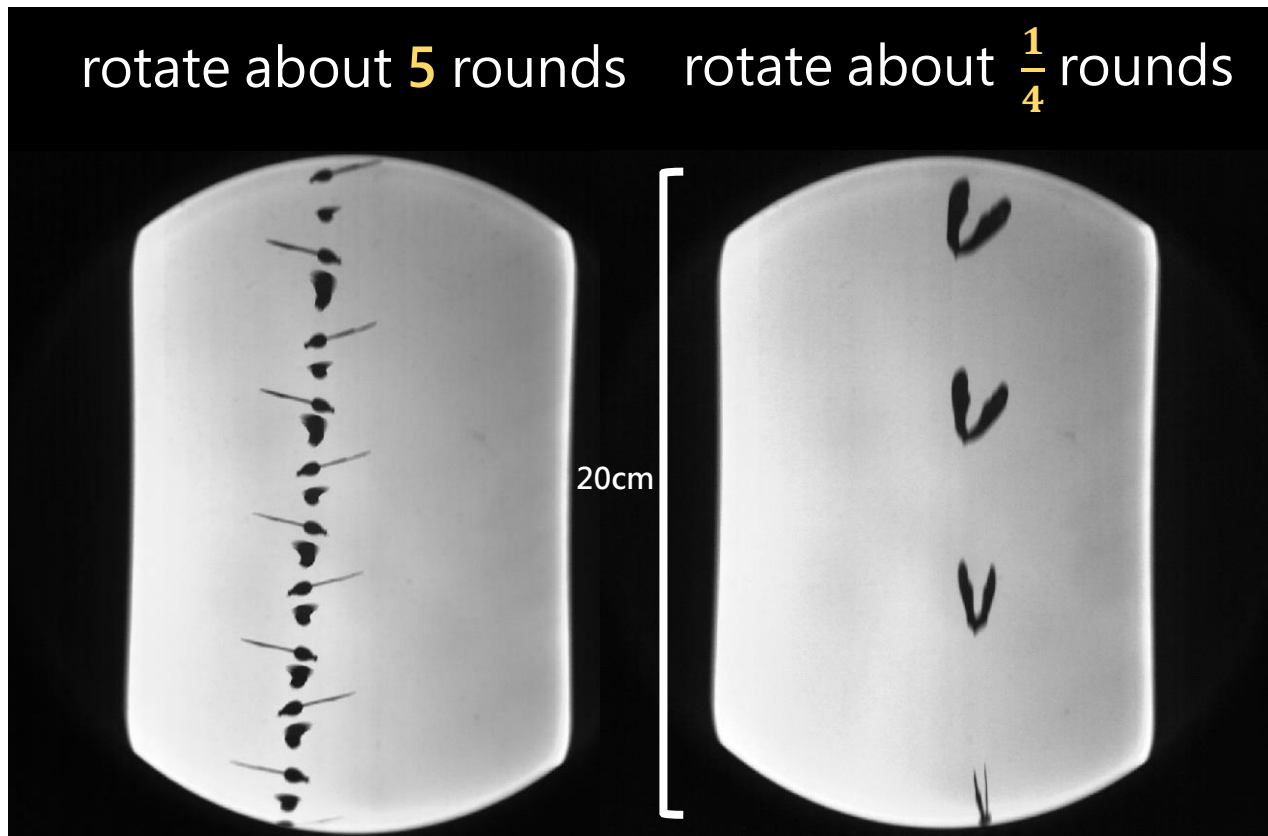


Fig. 7 The rotational speed comparison chart

Fig. 8 The overlay of images per quarter round

Mechanics analysis of samaras

- Single samara has obviously turning moment and affected by **Coandă Effect** to counterweigh the gravity.
- Paired samara is approximate symmetry.

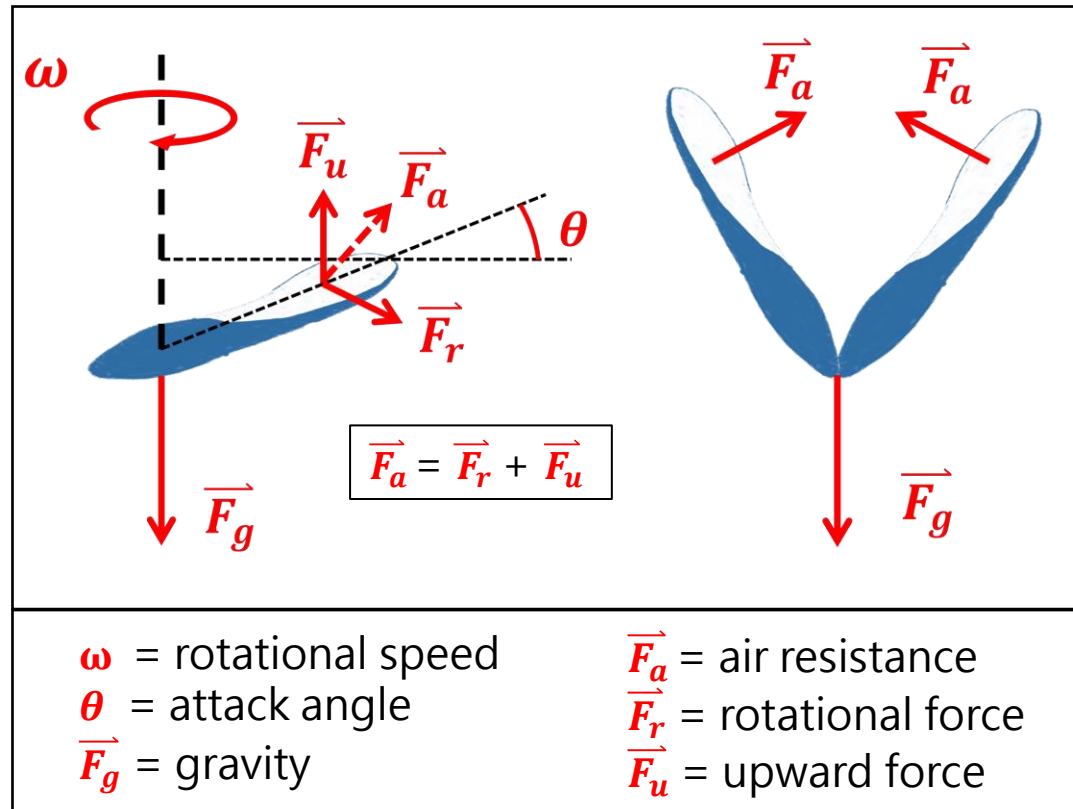


Fig. 9 The mechanical analysis chart of single and paired samara

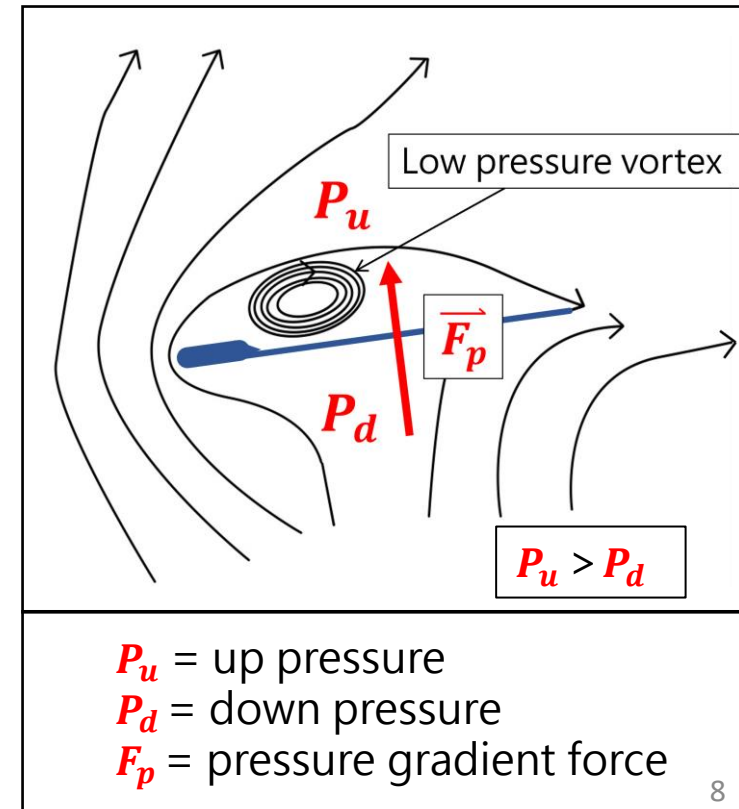


Fig. 10 The schematic diagram of Coanda Effect

Samaras' maturation process

- The fruit grow from **syncarpous pistil** in pairs Spjut, R. W. (1994)
- **Abscission layer** are generated after maturation, samaras only connect to the branch by a **gynophore** and the connection become **weak**.

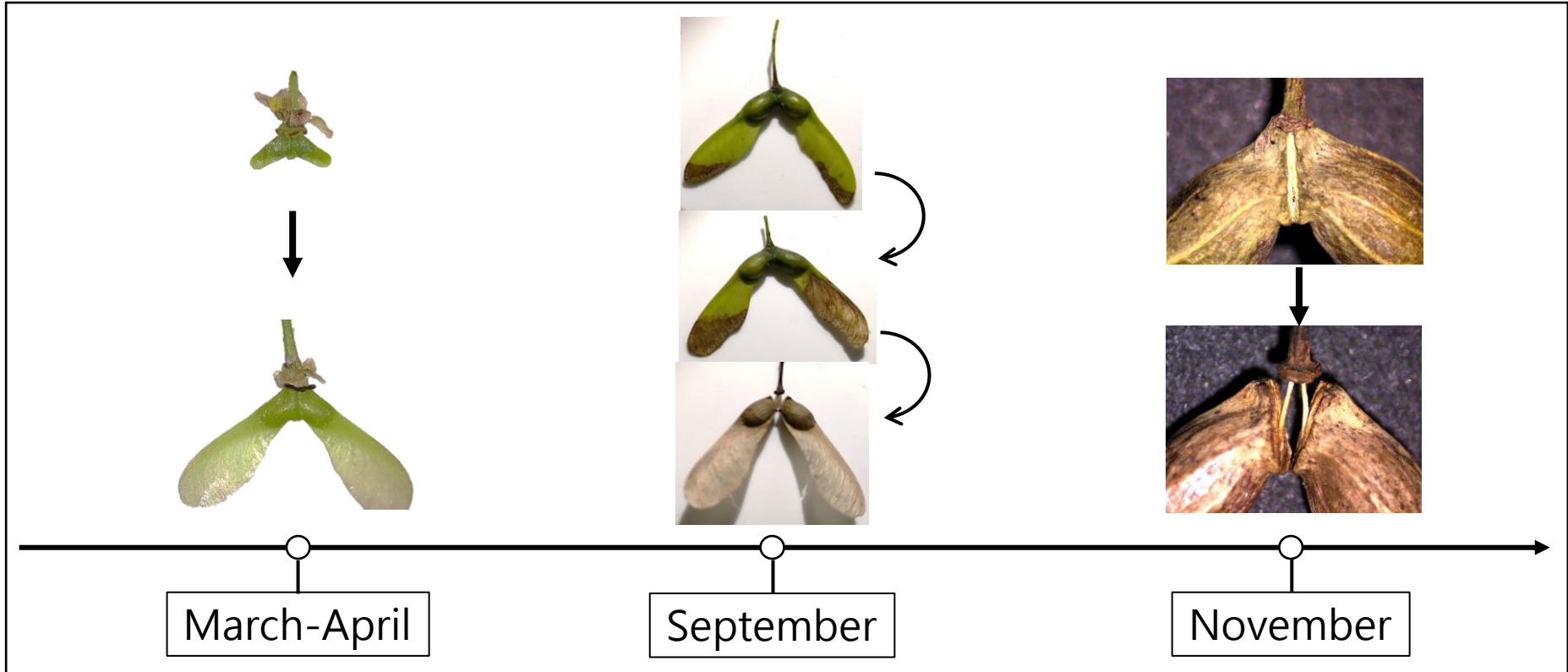


Fig. 11 The maturation period of samaras of Acer serrulatum Hayata

Discussions

- Four kinds of samaras belong to *Acer L.* in Taiwan have the same winged fruit type that are in **pairs**.
- Some kinds of winged seeds are covered in fruits that can be protected before maturation, such as *Swietenia macrophylla*.
- Due to the **lower rotational speed** and **symmetry structure**, paired samara receive lower torsional force, therefore, it can grow **stably** and difficult to be blew off before maturation .



Fig. 12 Four kinds of samaras belong to *Acer L.* 陳以臻 (2011)



Fig. 13 *Swietenia macrophylla* King

Conclusions

Maturation



Stable



Transmission



Efficient

The samaras in single and pairs have respective benefits.

References

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