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The flowers of *Heterostemma ficoides* (Apocynaceae, Asclepiadoideae) fool fig-pollinating wasps with their olfactory resemblance to figs

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INTRODUCTION

Fig-fig wasp interactions are highly specialized mutualisms. The specificity of pollinator attraction is mediated by Volatile Organic Compounds (VOCs) emitted by receptive figs. Pollinator access to the egg-laying site inside the figs depends on passage through the fig's sole entrance (ostiole)¹. Fig wasps should avoid non-host figs and even more non-*Ficus* flowers. *Heterostemma*, a genus of 30–40 liana species, includes a bizarre Thai endemic species, *Heterostemma ficoides*² bearing globose closed flowers that anyone can mistake for figs (syconia) of *Ficus* spp. **Could this 'anyone' include a fig wasp?**



FLOWER VISITORS OF *H. FICOIDES* AND CREEPY-CRAWLIES INSIDE FLOWERS

Methods:

- At 2 sites: Tak (in 2018) and Chiang Mai (in 2019, 2021, 2022), the numbers of insects and larvae in the blooming flowers were counted.
- The larvae were reared for identification to species.
- At 2 sites: Chiang Mai and Bangkok (plants grown in a private garden), insect visiting activities were monitored by recording with cameras.

Year	Average number (± SE); % flowers with fig wasps inside	
	N	Fig wasps
2018	10	0.2 ± 0.1; 20%
2019	204	0.03 ± 0.02; 1.9%
2021	298	0.04 ± 0.01; 3.7%
2022	273	0.02 ± 0.01; 1.5%



- Adult insects obtained from rearing are flies from 4 families: Phoridae, Loncheidae, Cecidomyiidae and Chloropidae.
- Female fig wasps were found inside flowers in all sites and years. They belong to a single species of *Kradibia*, a specific pollinator of *Ficus heterophylla* throughout Thailand. Some individuals carried a pollinarium on their legs. Video recordings showed that they regularly visited flowers of *H. ficoides* in all sites. They usually entered flowers by pushing themselves through the fissures between corolla lobes.

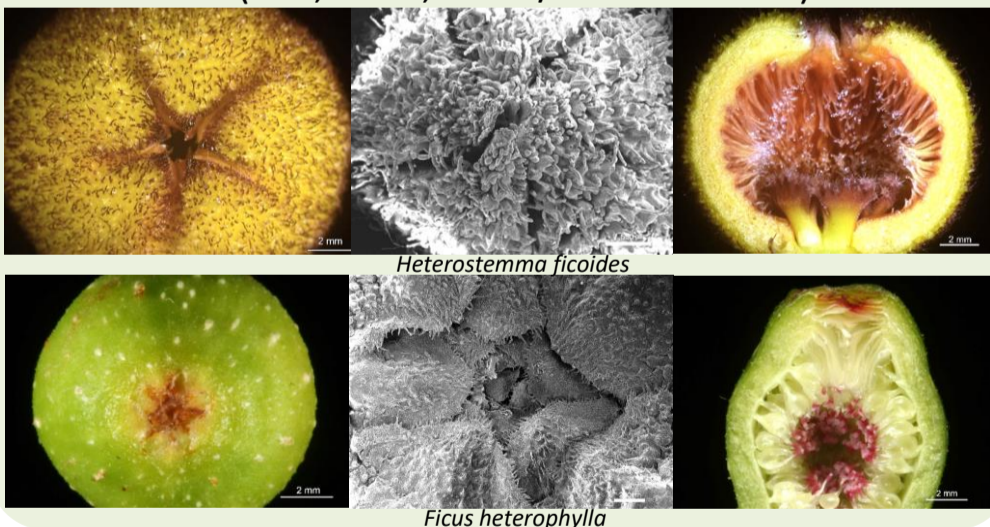
Results:

- 58.8% of the flowers studied were infested by insect larvae (2 ± 0.2 per flower).

PHYSICAL RESEMBLANCE

Methods: Morphology and ultrastructure of flowers of *H. ficoides* and those of figs of *F. heterophylla* were examined using light microscopy and SEM.

Results: Flowers/figs of the two species are similar in general appearance, i.e. a (semi)globose closed form with minute pore, but there is no apparent similarity in other details (size, color, outer/inner surfaces)

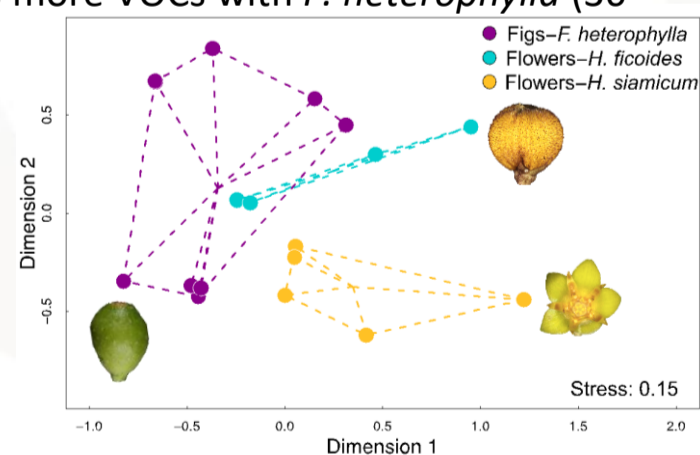


OLFACTORY RESEMBLANCE

Methods: VOCs of receptive figs of *F. heterophylla* and those of blooming flowers of *H. ficoides* and a congener, *H. siamicum*, were analyzed using gas-chromatography coupled with mass spectrometry.

Results:

- In the 3 species, a total of 57 VOCs (most of which are mono- and sesquiterpenes) were identified.
- *H. ficoides* shares more VOCs with *F. heterophylla* (36 out of 45) than with *H. siamicum* (19).
- Relative proportion of VOCs are different among species (PERMANOVA, $p = 0.002$)

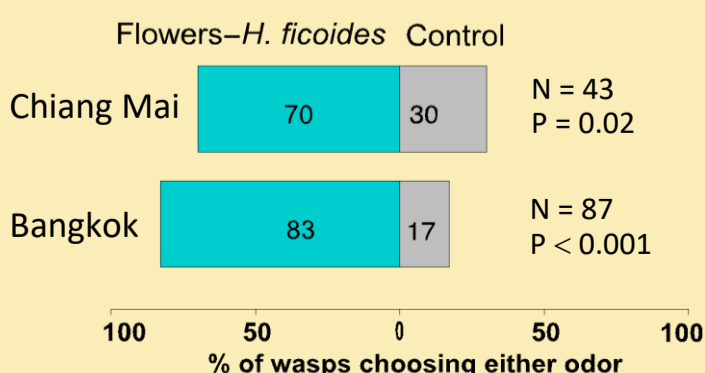


ATTRACTION BY VOCs OF *H. FICOIDES*

Methods: Attraction of *Kradibia* wasps to the VOCs emitted by flowers of *H. ficoides* was investigated using Y-tube olfactometer tests at 2 sites.

Results:

• *Kradibia* wasps were significantly attracted by the odor of blooming flowers of *H. ficoides* at both sites.



CONCLUSION AND PERSPECTIVES

- *H. ficoides* deceives *Kradibia* females by producing odors similar to those of the wasp's host plant, *F. heterophylla*. The wasps are stimulated by the sutures at the flower mouth to force their passage into the flower as if they were passing through the ostiole of the fig.
- Flies of different families also visited and laid eggs inside the flowers of *H. ficoides*. Are some of them specialists of *F. heterophylla* figs lured by *H. ficoides* odors?
- The fig-like flower of *H. ficoides* could be pollinated by deceit by insects developing in *F. heterophylla* figs, in a new case of pollination by mimicry.

REFERENCES

- ¹ Hossaert-McKey, M, Proffit, M, et al. (2016) How to be a dioecious fig: chemical mimicry between sexes matters only when both sexes flower synchronously. *Sci Rep* 6, 21236.
² Kidyoo A. (2019) *Heterostemma ficoides* (Apocynaceae: Asclepiadoideae), a new species with fig-like flowers from Northern Thailand. *Kew Bull* 74,2.

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