BIOTIC INTERACTION AND MICROCLIMATE EFFECTS OF *Rhyncostylis retusa* (L.) Bl. FLOWER IN THE URBAN HABITAT

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INTRODUCTION

Indonesia is one of the richest nations in the world in term of the orchid biodiversity. *Rhynchostylis retusa* (L.) Bl. is one of the native orchids that can be found both in the natural and urban habitats. Even being able to grow both in natural and urban habitats, *R. retusa* biotic interaction in the urban area needs to be investigated to keep it survives. However, the information about its biotic interaction and microclimate effects to the flowering of *R. retusa* in the urban habitat is lacking.

Urban areas tend to have higher temperature and sunlight exposure (Adebayo, 1987; Chow & Roth, 2006) that also influence the orchid flowering. Altered environment is not only directly affecting orchid flowering, but also influencing visiting insects of orchids. In general, insects in the urban area are less abundant than those in the natural habitat due to several factors (Ye et al., 2013).

Since the orchid survival is also determined by insects that interacting with it, anthropogenic disturbance in the urban area may also influence the interactions between visiting insects and *R. retusa* during flowering season. The objectives of this study are to know the biotic interaction of *R. retusa* during flowering period in the urban area and to determine the microclimate effects on the flowering and fruit forming of *R. retusa*.

MATERIALS AND METHODS

Studies on the biotic Interaction and microclimate effects to the flowering of *R. retusa* were conducted in the urban area within Gadjah Mada University campuses, Yogyakarta, Indonesia. The observation sites were separated into two, sunny habitat and shaded habitat. All observed individuals were grown in the branches of *Cupressus* sp. trees. Inflorescences of *R. retusa* were observed regularly since budding period so the anthesis from the group of inflorescences in both habitats can be determined. There are 29 individuals in the shaded site and 19 individuals in the sunny habitat. On each site, light intensity and temperature were recorded in snapshot in the sunny day. Visiting insects were observed and photographed in the sunny day from early of January to the early of February 2018. Bagging inflorescences was also done to confirm the self-pollination mechanism. Number of flowers in florescence and number of fruits formed were also counted.

RESULTS AND DISCUSSION

The observation resulted the data of insects visiting *R. retusa* during flowering period in the urban area, pollination mechanism of *R. retusa*, and how microclimate affects the fruit formation.

Visiting insects

The results show that flowers of *R. retusa* are visited by various insects, such as carpenter bee *(Xylocopa*) as the only biotic pollinator, ants (Formicidae), and *Orchidophilus* as flower- and fruit-eating phytophage (only in the shaded habitat). Two species carpenter bees of Genus Xylocopa were observed as the only pollinators of *R. retusa* in natural and cultivation habitat in India. Similarly, the only pollinators of *R. retusa* in the urban area of Yogyakarta is carpenter bee. It was indicated by numerous pollinarias of *R. retusa* attached on the forehead of Xylocopa. The ecological function of Observed ants (Formicidae) on the flowers of *R. retusa* is uncertain. *Orchidophilus* individuals as flower- and fruit-eating phytophage were only found in the shaded habitat.

Figure 1. Visiting insects of *Rhyncostylis retusa*. A. *Xylocopa* with mass of pollinaria attached on the forehead. B. *Orchidophillus* attacking *R. retusa* flowers. C. *Orchidophillus* attacking fruits and the damage on the fruit surface. D. Foraging *Xylocopa.* E. Ants walking around *R. retusa* flowers.

Pollination mechanism and effects of microclimate to the fruit forming

Table 1. Results of natural pollination by Carpenter bees on the fruit forming in shaded and sunny habitats of Yogyakarta urban area.

Habitat	Number of flowers	number of fruits formed	fruit formed percentage	average
Shaded	54	41	75.92592593	74.37281
	68	46	67.64705882	
	44	35	79.54545455	
Sunny	79	70	88.60759494	86.02083
	56	47	83.92857143	
	76	65	85.52631579	

Flower bagging experiment revealed that *R. retusa* does not have the self-pollination mechanism, indicated by no fruit formed on the bagged inflorescences. Flowers in the shaded habitat started blooming later than those in the sunny habitat. Lower temperature and light intesity were influencing the *R. retusa* flowering by delaying and extending the anthesis period. Number of fruits formed in the sunny habitat is more than those in the shaded habitat with average fruit forming percentage in the sunny and shaded habitats are 74,37% and 86,02% respectively. Therefore, conserving pollinators is needed to keep *R. retusa* sustain in the urban area.

REFERENCES

Article within a journal

Adebayo, Y. R. 1987. A note on the effect of urbanization on temperature in Ibadan. *International Journal of Climatology* 7:2 185-192

Arathi, H. S. 2012. A Comparison of Dispersal Traits in Dandelions Growing in Urban Landscape and Open Meadows. *Journal of Plant Studies*; Vol. 1, No. 2

Bainard, L. D., J. Klironomos, A. M. Gordon. 2011. The mycorrhizal status and colonization of 26 tree species growing in urban and rural environments. *Mycorrhiza* 21(2):91-6

Bates, A.J., Sadler, J.P., Fairbrass, A.J., Falk, S.J., Hale, J.D. & Matthews, T.J. 2011. Changing bee and hoverfly pollinator assemblages along an urban-rural gradient. *PLoS ONE*, 6: e23459.

Bentley, B. L. 1977. Extrafloral Nectaries and Protection by Pugnacious Bodyguards. *Annual Review of Ecology and Systematics* Vol. 8, pp. 407-427

Buragohain, B., S. K. Chaturvedi & N. Puro, 2015. Biotic Pollination in *Rhynchostylis retusa* (L.) Bl. (Orchidaceae). *The International Journal of Plant Reproductive Biology* 7(1) pp.78-83.

Chen, X., J. J. Wood. "*Rhynchostylis retusa* (Linnaeus) Blume, Bijdr. 286. 1825". Flora of China. Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA.

Chow, W. T. L. & M. Roth. 2006. Temporal dynamics of the urban heat island of Singapore. *Int. J. Climatol.* 26: 2243–2260

Grimm, N. B., D. Foster, P. Groffman, J. M. Grove, C. S. Hopkinson, K. J. Nadelhoffer, D. E. Pataki, & D. P.C. Peters. 2008. The changing landscape: ecosystem responses to urbanization and pollution across climatic and societal gradients. *Front Ecol Environ* 2008; 6(5): 264–272

Leong, T. M. & Y. C. Wee. 2013. Observations of pollination in the pigeon orchid, *Dendrobium crumenatum* Swartz (Orchidaceae) in Singapore. *Nature in Singapore* 6: 91–96

Liu, K. , Z. Liu, L. Huang, L. Li, L. Chen, G. Tang. 2006. Self-fertilization strategy in an orchid. *Nature* Vol 441

Mau, R.F.L.. 1983. Development of the orchid weevil, *Orchidophilus aterrimus* (Waterhouse). *Proceedings of the Hawaiian Entomological Society*, 24, 293–297

McCormick, M. K. & H. Jacquemyn. 2014. What constrains the distribution of orchid populations?. *New Phytologist* . 202: 392–400

Paradiso, R. & S. D. Pascale. 2014. Effects of Plant Size, Temperature, and Light Intensity on Flowering of *Phalaenopsis* Hybrids in Mediterranean Greenhouses. *Scientific World Journal*. 2014; 2014: 420807.

Prena, Jens. 2008. A synopsis of the orchid weevil genus *Orchidophilus buchanan* (Curculionidae, Baridinae), with taxonomic rectifications and description of one new species. *Zootaxa* 1783: 18-30

Ye, S., Y. Fang, K. Li. 2013. Impacts of urbanization process on insect diversity. *Biodiversity Science* 21:3 260-268.

Yen, C. Y., T. W. Starman, Y. Wang, G. Niu. 2008. Effects of cooling temperature and duration on flowering of the Nobile *Dendrobium* Orchid. *HortScience* 43(6):1765–1769.