

PHYSIOLOGY AND BIOCHEMISTRY OF SELECTED PARASITIC PLANTS IN BRUNEI DARUSSALAM

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ABSTRACT

Parasitic plants are distributed in all climatic zones and observed in nearly all ecosystems. An angiosperm parasite can develop intimate connection with different host species to exploit materials needed *via* haustoria. Thus, parasitic plants have to confront stress induced by both varying environmental factors and differences in defense and immune systems of host species. Parasites overcome these constraints by adjusting their physiological and biochemical performances to be distinct from hosts. Patterns of parasite-host relations in many aspects such as mineral and water or photosynthesis and transpiration have been generalized from studies conducted in temperate areas. However, studies on parasite-host relations in this context under tropical climates are scarce.

This thesis presents a series of studies conducted in tropical Brunei Darussalam in relation to impacts of varying host specificity and environmental factors on the performances of aerial stem hemiparasite *Dendrophthoe curvata* (Blume) Miquel, effects of the aerial stem holoparasite *Cuscuta australis* R. Brown infection under environmental stress conditions (drought) on the host *Mikania micrantha* H.B.K., and species delimitation and medicinal values of sterile *Cuscuta* sp., widely observed in Brunei Darussalam.

In the study of foliar traits and photosynthesis of *D. curvata* and associated hosts (*Acacia auriculiformis* A. Cunn. Ex Benth, *Andira inermis* (W. Wright) DC., *Mangifera indica* L. and *Vitex pinnata* L.) outlined in Chapter 2, the mistletoe *D. curvata* showed variation in foliar traits (specific leaf area, leaf chlorophyll content and chlorophyll *a/b* ratio) and photosynthetic

parameters (light saturated photosynthesis, CO₂ assimilation rates, stomatal conductance, transpiration rates and water use efficiency) when parasitize different host species. This indicated that host nature has significantly influenced mistletoe physiology to modulate parasite-host relations.

Then, photosynthesis of *D. curvata* in response to changes of environmental factors (light intensity, temperature and CO₂ concentration) is reported in Chapter 3. Results showed that photosynthesis of *D. curvata* was co-limited by both light and temperature at the levels experienced at mid-canopy in tropical heath forest (500 μmol m⁻² s⁻¹ and 25 °C, respectively) and did not saturate at natural CO₂ concentration (380 ppm). The incremental magnitude of *D. curvata* photosynthesis induced by increased light intensity, temperature and CO₂ concentration also varied according to parasitized hosts. This indicated that host specificity also modulated the eco-physiological responses of the mistletoe.

In Chapter 4, interactive effects of *C. australis* and drought stress on the performance of the host *M. micrantha* are reported. The concomitant presence of *C. australis* infection and drought significantly impacted foliar traits, gas exchange and Chl *a* fluorescence of *M. micrantha*. However, single stress factor (*C. australis* infection or drought) only significantly affected foliar traits and gas exchange of *M. micrantha*. These results suggested that combined additive effects of *C. australis* infection and drought significantly suppressed the photosynthesis of *M. micrantha* due to both stomatal and non-stomatal limitation of host photosynthesis.

Lastly, the species identity using the sequences of internal transcribed spacers (ITS) of nuclear ribosomal RNA genes and chloroplast *trnL-F* intergenic spacers and medicinal value evaluation based on total phenolics, flavonoids and antioxidant activity of *Cuscuta* sp. growing in Brunei Darussalam are reported in Chapter 5. Sterile *Cuscuta* sp. recorded in Brunei Darussalam well over 4 years showed a variation in the DNA sequence with the pre-identified *C. campestris* but similarities with the pre-identified *C. australis*. This confirmed the fact that sterile stands of *Cuscuta* in Brunei Darussalam are *C. australis*. Sterile *C. australis* stems exhibited significantly higher total phenolics, flavonoids and antioxidant capacities than fertile *C. australis* indicating that sterile *C. australis* had a higher medicinal value.

This study provided some new insights into the understanding of parasite-host relationships in relation to variations of a range of environmental factors in tropics. This

investigation also revealed the variations in biochemical profiles between sterile and fertile *C. australis* growing in Brunei Darussalam. However, the reasons for the existence of two distinct *C. australis* strands with different proliferative modes (i.e. sterile and fertile) in Brunei Darussalam are still unclear, and should be properly evaluated over many years under different habitat conditions and climatic regimes.

Related Publications

1. **Quang-Vuong Le**, Kushan U Tennakoon, Faizah Metali, Linda BL Lim, and Jay F Bolin, 2015. The impacts of *Cuscuta australis* R. Brown infection on the photosynthesis of the invasive host *Mikania micrantha* H.B.K. under drought condition. *Weed Biology and Management*. 15(4): 138-146.
2. **Quang-Vuong Le**, Kushan U Tennakoon, Faizah Metali, Linda BL Lim, and Jay F Bolin, 2016. Ecophysiological responses of mistletoe *Dendrophthoe curvata* (Blume) Miquel (Loranthaceae) to varying environmental parameters depend on host associations. *Journal of Tropical Forest Science*. 28: 59-67.
3. **Quang-Vuong Le**, Kushan U Tennakoon, Faizah Metali, Linda BL Lim, and Jay F Bolin, 2016. Host specific variation in photosynthesis of an obligate xylem-tapping mistletoe *Dendrophthoe curvata* (Blume) Miquel in Bornean heath forest. *Nordic Journal of Botany*, 34: 235-243.