Summary of Doctoral Thesis

Enrollment year: 2018y 4m
UGAS Specialty: Regional Environment Creation
Name: Citra Gilang Qur'ani

Title	Toward a better understanding on survival behavior of Black locust against environmental stress and physical disturbance

Introduction and purpose

Unpredictable of environmental changes, such as canopy gaps, flooding, and artificial cutting have caused various types of stresses and organ damages to plants. In response to those, plants require to build survival strategy, including allocating resources to the needed organs that are beneficial against stress, such as leaf for photosynthesis and root for storage, to maintain the carbon balance. Plants rely on root storage content to survive against stress and disturbance, which cause storage depletion due to various metabolic activities, including respiration that contributes to survival and recovery of the whole-plant level. Non-structural carbohydrates (NSCs), which contains soluble sugars and starch constrains, is one of the most crucial components across plant species as survival support factor against stress and damage.

Black locust (*Robinia pseudoacacia* L.) is nitrogen-fixation, fast-growing, legume, and pioneer species with high ability of survival in physical and environmental disturbances, but found invasive in many areas that need to be controlled. The species is found dangerous because it is found not only in open but also in shade areas. Moreover, high ability of resprouting after natural or artificial damage has caused more serious problem. Black locust is reported to have large amount of starch content in the roots, that supports the survival rate against environmental stress and physical disturbance. It is less explored how Black locust use the carbohydrates in organ and whole-plant level, especially when experiencing different sizes of NSCs content and limiting resources. The aims of this study are **to investigate the flexibility changes of organ functional dynamics in response to limiting resources (light stress) and to understand the survival strategy to overcome the organ loss (artificial cutting)**.

Materials and methods

The Black locust seedlings and trees were tested in the condition of low light stress (research 1) and organ loss (research 2 and 3) to represent the limited resources condition, respectively. The one-year-old seedlings of Black locust and two other pioneer, legume, and invasive trees species *Falcataria moluccana* (Miq.) and *Acacia mangium* (Willd.) were grown in pots during research 1 to be observed the morphological and physiological changes after experiencing two light regimes of 100% - (open) and 15% of light availability (shade). In research 2, the two-years-old seedlings of Black locust and other two resprouter species *Juglans ailantifolia* and *Quercus crispula* have been grown in pots before the cutting at basal area were applied to be observed the resprout production and organ carbon dynamics. At different site (research 3), total of 150 trees of 5 or 6-year-old Black locust were cut at the height of diameter-breast-height (tall-stump, TS) and basal area (short-stump, SS) to be observed the resprout production and organ carbon dynamics during two years period.

Results

In research 1, only *R.pseudoacacia* grown longer (13.67%) and bigger (26.61%) shoots in open- than shade sites. Dry mass, respiration rates, and NSCs in *R.pseudoacacia* were allocated more to the roots but were more allocated to the leaves in *F.moluccana* and *A.mangium.* It is understood that *R.pseudoacacia* strengthen the function of root storage better than other two legume species when facing low light condition, while others strengthen photosynthesis. In research 2, temporal changes of NSCs were experienced by all species during resprouting with *R.pseudoacacia* performed the highest leaf respiration rate during resprouting with high root starch concentration. It is believed that *R.pseudoacacia* strengthen the function of photosynthesis during resprouting without significant change on NSCs. In the last chapter, only within two months after the cutting, TS trees produced new leaf and stem bigger than SS trees. NSCs concentration in stump and root were decreased during summer 1 but recovered in summer 2 in both treatments. Leaf respiration rate at SS is higher than TS, indicating higher needs of photosynthesis to resupply the used resources. It is understood that Black locust experienced temporal changes of storage during resprouting with rapid recovery from new photosynthates from new organs.

From all sections, it is understood that the key traits to survive for Black locust is through balancing the carbon inputs and outputs by prioritize the roles of each organ to support the whole plant performances, such as leaf for photosynthesis and root for storage that work simultaneously depending on the stress level.

Conclusion and recommendation

It is also understood that using a single method (e.g. only shading or only clear cutting) to create the carbon starvation condition for Black locust is less effective. The combination of multiple methods is highly recommended for future research approach, such as shading condition combined with frequent cutting.

The format above is just an example. It can be changed according to a doctoral thesis composition style.

e.g. chapter-by-chapter summary in short sentences

Summary paragraphs (introduction, main body and conclusion) in short sentences