SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Ecology and Biodiversity

has the honor to invite you to the public defense of the PhD thesis of

Kodikara Arachchilage Sunanda Kodikara

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Physiology of the death of mangrove propagules, seedlings and saplings with particular emphasis on photosynthesis, transpiration, water transport and free radical accumulation

Promotor:

Prof. dr. Nico Koedam

The defense will take place on

Wednesday September 5 2018 at 16:00h

in Auditorium D.2.01 at the campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

Members of the jury:

Prof. dr. Ludwig Triest (chairman)
Prof. dr. Harry Olde Venterink (secretary)
Prof. dr. Farid Dahdouh-Guebas (co-promotor)
Prof. dr. L.P Jayatissa
(co-promotor, Univ. of Ruhuna, Sri Lanka)
Prof. dr. Bram Vanschoenwinkel
Prof. dr. Geert Angenon
Prof. dr. Renate Wesselingh (UCL)
Prof. dr. Mark Huxham (Napier Univ., Scotland)

Curriculum vitae

Sunanda Kodikara graduated as a plant biologist in 2009, University of Ruhuna, Sri Lanka and graduated as Master of Science in Ecological Marine Management in 2011 at the VUB. He started his PhD on stress physiology of young mangrove plants in 2012. The research was funded by the Green-Dyke project (VLIR UOS) in relation to coastal protection and mangrove restoration. Sunanda, as the first author, published 2 papers pertaining to his PhD in peer-reviewed journals, and so far, authored 9 full-papers. In addition, he holds two local patents for innovative products (microscope in-built camera and soil hydrometer) which were used in his PhD study. Sunanda supervised 28 BSc students and 2 M.Phil students. Currently he serves as a lecturer in Ruhuna, and teaches plant stress physiology, plant biochemistry and ecophysiology.

Abstract of the PhD research

Mangrove replanting is a priority for the Sri Lankan government in its quest to safeguard coasts against natural calamities like ocean surges. The concern grew in the wake of the 2004 tsunami. However, most restoration attempts showed high failure rates in Sri Lanka.

Planting at the incorrect inundation level often entails inappropriate environmental conditions for mangroves. They are adapted to grow in the intertidal zone *i.e. area between low and high tide marks*, and tolerate dynamics in soil and hydrology resulting from periodic inundation. However, since Sri Lanka has a microtidal regime, the ranges of suitable conditions are very narrow (but spatially wide). Mangrove seedlings at ecologically inappropriate sites undergo hypersalinity, substrate drought or prolonged submergence and hypoxia, resulting in early seedling mortality. This study targeted the physiological basis of early mortality of planted mangrove seedlings. On basis of a survey, mangrove replanting was shown to be unsuccessful in Sri Lanka, as more than 85% of the planting projects along its entire coastline failed to restore mangroves, bearing a high financial and social cost.

Experiments were carried out with the most frequently planted species *Rhizophora mucronata* in the field and in a plant-house setting. Starch stored in *Rhizophora* seedlings grown under stressed conditions was depleted at a higher rate than in non-stress condition. Strong inhibition of growth of mangrove seedlings could be observed, while plant maintenance being prioritized over plant growth as an acclimatory strategy. This leads plants to run out of energy, resulting in unhealthy seedlings, necrosis, leaf wilting, abscission and eventually early seedling mortality. In addition, an imbalance between antioxidant capacity and free radical scavenging, caused oxidative damage to seedlings at the cellular level, resulting in cell death and severe leaf necrosis. Interconnected processes collectively cause imbalance of carbohydrate metabolism in *R. mucronata* seedlings. Although *Rhizophora* plants showed plasticity in morphology, anatomy and physiology, they were unable to acclimate properly, even with robust acclimation strategies, upon higher intensity of stress and prolonged exposure.

Thus, seedling dysfunction and mortality can be prevented by planting mangroves in intertidal zones with suitable hydrology, which requires informed management of restoration, lacking as of now.