

PhD 1 Over view

Understanding how host-parasite interactions for economically important parasitic weed species of rain-fed rice in sub-Saharan Africa are differentially affected by environmental conditions.

Stella Kabiri



Aim

- Obtaining insights in how local environmental conditions determine the presence of parasitic weeds and the interactions with their hosts
- To envisage future infestations and effects and generate pointers for sustainable and effective control strategies



Objective 1

- **To identify environmental requirements for germination and establishment of facultative and obligate parasitic weeds in rice.**



Research Question 1

- Even though *R. fistulosa* seeds do not require exposure to germination stimulants from the host to germinate, how does exposure to these stimulants influence their germination?
 - Experiment 1: Wageningen, 2012
 - Collection of root exudates from 3 rice varieties, GR24 to stimulate germination of *R. fistulosa*, *S. asiatica* and *S. hermonthica*
 - Experiment 2: will be a repeat in Wageningen, 2013



Research Question 2

- Which environmental factors influence the establishment of parasitic weeds in rain-fed rice?
 - 2 moisture experiments were done in Dar and Morogoro
 - Success of *R. fistulosa* and *S. asiatica* when exposed to dry, moderate and saturated soil conditions
 - Field work; assessment of characteristics of parasite habitats in Kyela
 - Soil texture, NPK, pH, extractable soil cations, C.E.C, EC
 - Weed species diversity and association of weeds species to parasitic plants.

Paper Outputs from Objective 1

- i. Ecological niche differences between *Rhamphicarpa fistulosa* and *Striga asiatica* in rain-fed rice

Objective 2

- **To ascertain mechanisms of attachment of facultative and obligate parasitic weeds in rice.**



Research Questions objective 2

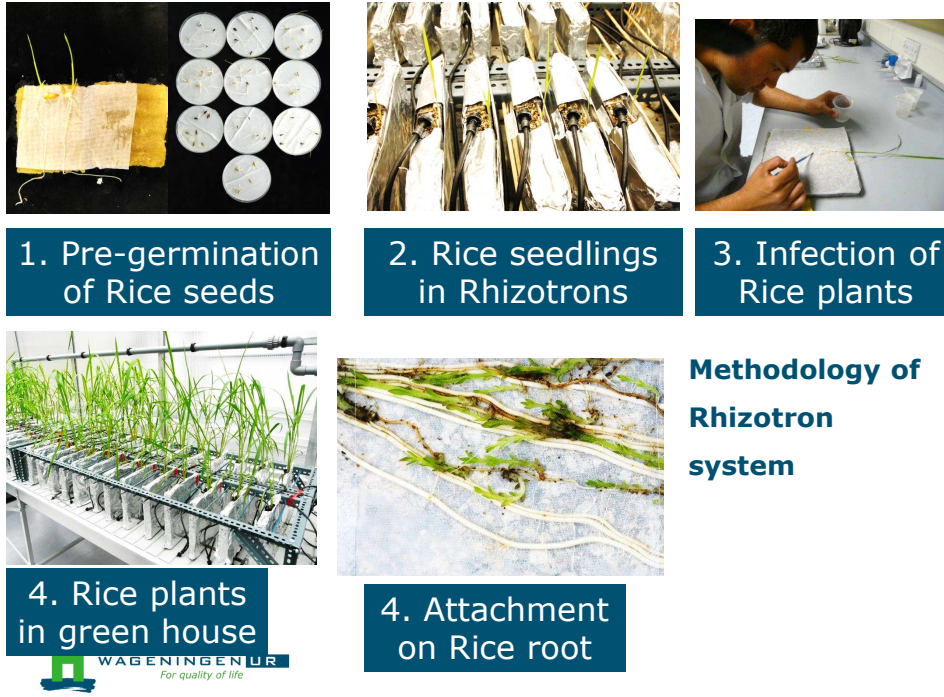
- At what age range of the parasite and what age range of the host is *R. fistulosa* able to attach and develop a successful parasitic relation?
- Does the position on the host root determine attachment success of *the parasite*?

***Striga* attachment on host root**



***Rhamphicarpa* attachment on host root**





1. Pre-germination of Rice seeds

2. Rice seedlings in Rhizotrons

3. Infection of Rice plants

4. Rice plants in green house

4. Attachment on Rice root

Methodology of Rhizotron system

WAGENINGEN UR
For quality of life

Paper Outputs from Objective 2

- ii. Mechanisms of attachment on host root that enhance efficiency of *Rhizophicarpa fistulosa* in parasitism of rice

Objective 3

- **To determine the consequences of host parasite interactions on host physiology and yielding ability.**



Research Question from Objective 3

- What are the consequences of host parasite interactions on host physiology and yielding ability?
- 3 density experiments for *Rhamphicarpa*
 - Wageningen 2011, Dar es Salam 2012, Morogoro 2012-2013
- 2 density experiments for *S. asiatica*
 - Dar es Salam 2012, Morogoro 2012-2013
- How and to what extent do parasitic weeds affect the photosynthetic activity and hence yielding ability of rice?
- 2 photosynthesis experiments at Wageningen 2012 on *Rhamphicarpa*; *To be repeated*
 - More measurements of photosynthesis will be done with *Striga asiatica*.



Paper Outputs from Objective 3

- iii. Consequences of *Rhamphicarpa fistulosa* and *Striga asiatica* infestation density on the interaction with its rice host
- iv. Influence of *Rhamphicarpa fistulosa* and *Striga asiatica* infection on photosynthesis of rice host



Objective 4:

- **To determine host induced effects on the reproductive potential of *Rhamphicarpa fistulosa***



Research Question Objective 4

- How does the presence and or absence of the host affect growth and development of the parasite?
 - Determined from 2 moisture experiments done in Dar and Morogoro
 - Success of *R. fistulosa* host absent plants compared to host present *Rhamphicarpa* plants at different moisture levels
- How does the presence and or absence of a host affect reproductive output of *Rhamphicarpa* including seed viability of the parasite?
 - Experiment scheduled for Wageningen 2013
 - Host-induced variation in seed viability, growth and reproductive output of *Rhamphicarpa fistulosa*.



Research Question 3 of Objective 4

- How will obligate and facultative parasitic weed population dynamics be affected by control strategies that make use of prolonged periods of host plant absence?
- Simulation Modelling from available experiment data in combination with field data from PhD 2
 - Basic model of parasite seed bank dynamics
 - Determination of the shape of the parasite number response curve in pot experiments and at field scale
 - Parasite number response curve at various stages in the parasite life cycles
 - Pot experiment to be designed on self thinning and mortality of *Rhamphicarpa fistulosa*



Paper Outputs from Objective 4

- v. Host-induced variation in growth, reproductive output, seed viability of *Rhamphicarpa fistulosa*.
- vi. Strategy for long-term management of *Rhamphicarpa fistulosa* with a weed populations dynamics model.

Experiments Time Line

Experiment Time line	2013								2014			
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1 Germination stimulants												
2 Photosynthesis of <i>S. asiatica</i>												
3 Host induced variation												
4 Self thinning and mortality												
5 Attachment experiments												