Institute of Agricultural Sciences in the Tropics (Hans-Ruthenberg-Institute)

Genotype by Environment Interactions Affecting Simulation of Rice Phenology

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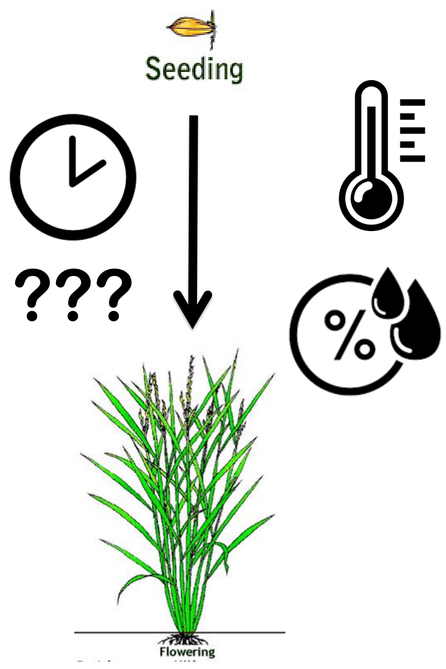
Introduction

- Decision-support tools can give location-specific advise to rice farmers on suitable varieties and optimum sowing window
- E.g. RiceAdvice, developed for West Africa → Wish to cover entire sub-Saharan Africa
- Rice model should cover wide range of environments
- Phenology forms backbone of rice models
- Increase robustness → incorporate G x E interactions into rice models



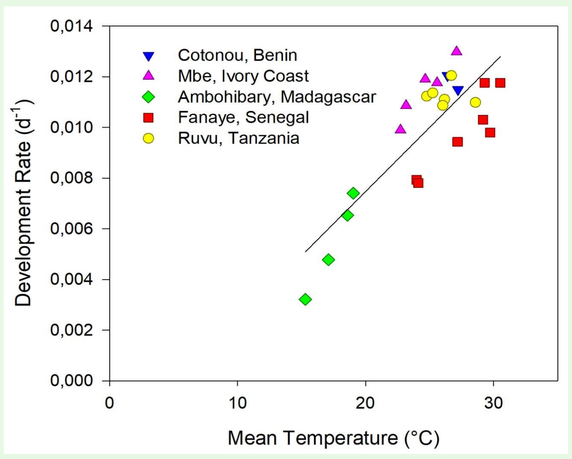
Conclusions

- Main env. factors influencing phenology:
  - Temperature
  - Relative humidity
- Asch – Groot Nibbelink model: Method to estimate genotype-specific cardinal temperatures and adjust this to RH
- More accurate simulation of crop duration
- Suggest to incorporate RH-adjustment factor for optimum temperature into rice models

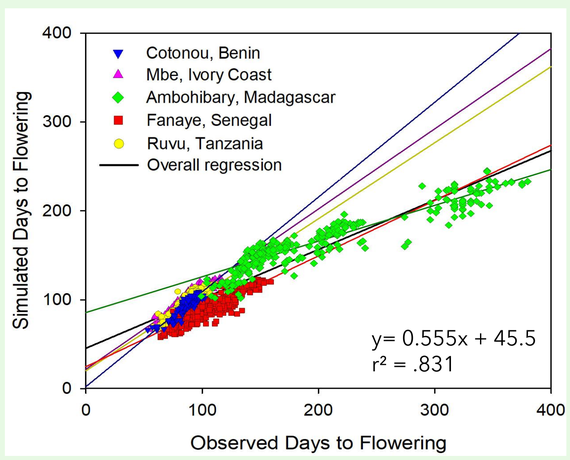
Results and Discussion

Summerfield

- Model: $DR = a * \bar{T} + b$
- Development rate stagnates as teamperature increases
- Underestimation of *f* in Madagascar and Senegal



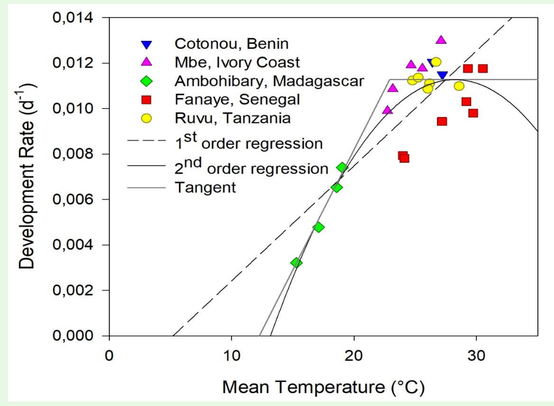
Cardinal temperature estimation for IR64 using Summerfield's model



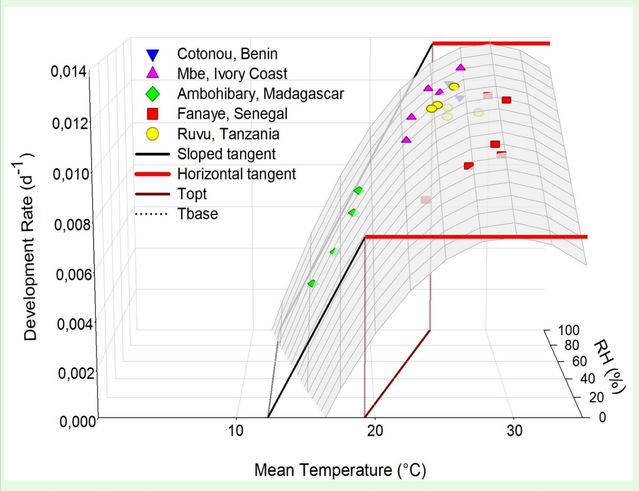
Observed vs simulated crop duration following Summerfield's model

Asch – Groot Nibbelink

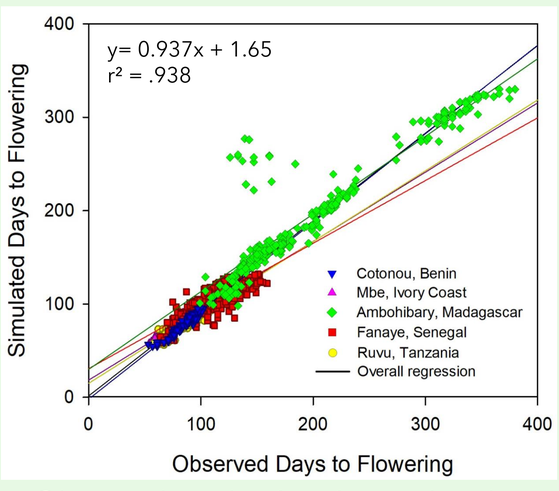
- 2nd order regression model: $DR = a * \bar{T} + b * \bar{T}^2 + c$
- Tangents to estimate cardinal temperatures



- Residuals regressed against environmental factors:
  - Daylength, RH, VPD, solar radiation
- All significant, RH highest correlation (r^2 =.384)
- RH included into model: $DR = a * \bar{T} + b * \bar{T}^2 + c * \overline{RH} + d$
- Optimum temperature increases with RH
- Captures both Senegal and Madagascar (few outliers)



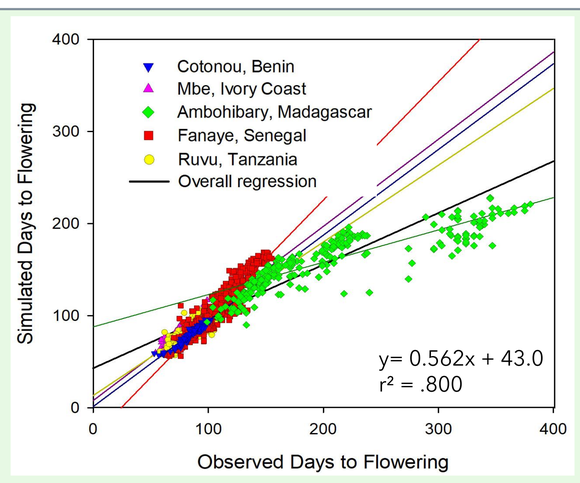
Cardinal temperature estimation for IR64 using AGN model incl. RH



Observed vs simulated crop duration following AGN model

Stuerz

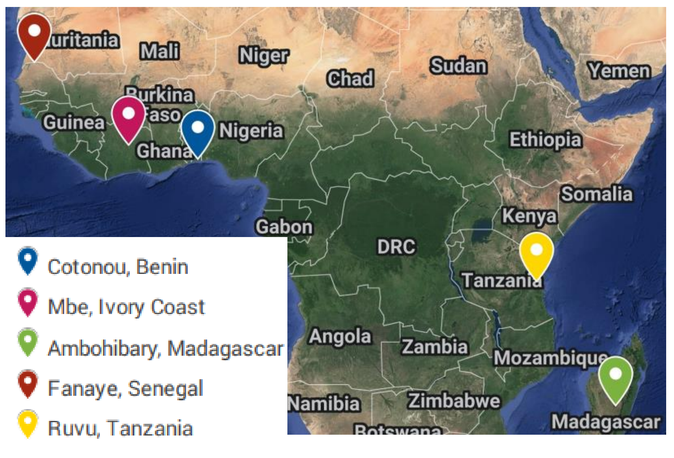
- Model: $DR = a * \bar{T} + b * \overline{RH} + c$
- Inclusion of RH slightly improves model
- Underestimation of *f* in Madagascar
- Overestimation of *f* in Senegal



Observed vs simulated crop duration following Stuerz' model

Materials and Methods

Rice garden experiments were conducted at five of AfricaRice's research locations with 25 sowing dates. Eighty varieties were grown in an irrigated lowland production system. Phenology and daily weather data were recorded. Days from sowing to flowering (*f*) were simulated across all these environments using cardinal temperatures derived from existing phenology models developed by Summerfield *et al.* (1992) and Stuerz *et al.* (2020). Residuals were regressed against environmental factors. Based on this, a new phenology model was developed.



Country	Site	Alt.	Sowing dates	Weather conditions
Benin	Cotonou	27	2	Warm, humid
Ivory Coast	Mbe	273	5	Warm, humid
Madagascar	Ambohibary	**1645**	5	**Cool,** humid
Senegal	Fanaye	10	7	**Hot, arid**
Tanzania	Ruvu	29	6	Warm, humid

Table 1: Description of experimental sites

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