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Department of Plant Production and Agroecology in the Tropics and Subtropics
Section: Crop Waterstress Management

Environmental Effects on Yield of Upland Rice Grown Along an Altitude Gradient in Madagascar

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Introduction

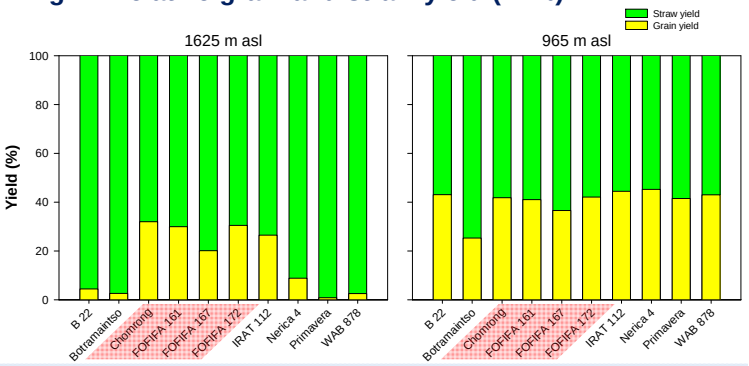
Upland rice can supplement lowland rice as the pressure is increasing on irrigated land. In Madagascar, rice is cultivated on 1.3 M ha of which 29% are upland rice, growing along altitude gradients. High altitude rice cultivation is constrained by a short vegetation period due to low temperatures and, thus, by the time the crop needs to complete its life cycle. As climate change is assumed to increase mean temperature, rice cropping in higher altitudes may become more favourable as long as precipitation is not a limiting factor. In this context, field testing of rainfed upland rice genotypes and the establishment of a database on genotypic phenology and yield response to diverse environments is of high interest to cope with climate change.

Conclusions

- Variation in cold tolerance can be used to adapt genotype to cold environments.
- Mean air temperature affects biomass partioning, e.g. harvest index is higher in low altitude.
- Cold tolerant rice genotypes have above average yield stability.
- Morpho-physiological traits contributing to cold tolerance need to be identified for further breeding.

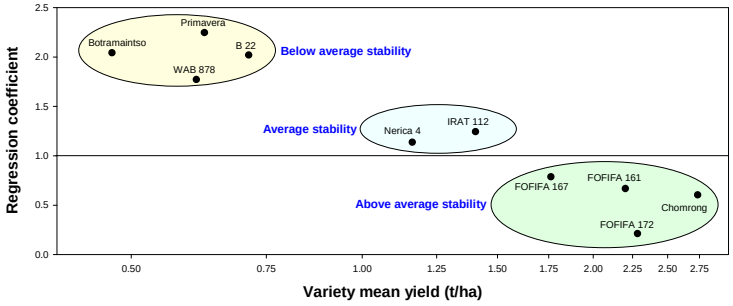
Results and Discussion

Fig 1. Relative grain and straw yield (in %)



- ❑ Cold tolerant varieties (marked red) perform well at high altitude
  - ➢ Genetic adaptation to cold environments can be exploited
- ❑ Grain yield, on average, was higher at lower altitude
  - ➢ Higher mean air temperture during cropping period
- ❑ Harvest index decreased at high altitude
  - ➢ Low temperature effects on sterility

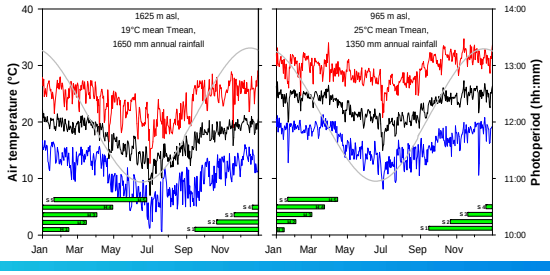
Fig 2. Variety adaptation to different environments (Finlay-Wilkinson approach)



- ❑ Rice genotypes such as B22, Botramaintso, Primavera and WAB 878 produce low grain yield in unfavourable environments
  - ➢ Adapted to favorable environments only
- ❑ Cold tolerant rice genotypes such as Chomrong, FOFIFA 161, FOFIFA 167 and FOFIFA 172 produce high grain yield in both favourable and unfavourable environments
  - ➢ These varieties allow to adapt rice system to unfavorable environments without yield penalty in productive environments

Materials and Methods

- ➢ 10 varieties of upland rice were planted at 5 monthly staggered sowing dates in two locations for two years.
- ➢ Plot size was 1 X 1 m with 20 X 20 cm spacing between plants.
- ➢ Daily values for minimum and maximum temperature were recorded.
- ➢ Different phenological stages were monitored during crop cycle.
- ➢ Biomass, yield, and yield components were determined at maturity.



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