General overview of genetic research & experimentation on Coconut varieties tolerant/resistant to LY

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Introduction

- LY: a plague for farmers in affected areas
- A concern for countries that are not yet affected
- Use of resistant varieties
- Successes and mishaps
- Need to summarize past experience

This presentation

- Review the most important resistance breeding experiments
- Underline difficulties
- Statistical interpretation of screening trial results
- Distribution of resistance factors among coconut varieties
- Suggestions

Resistance breeding experiments

- Jamaica
  - 6 resistance trials from 1961 to 0970
  - Generally replicated blocks
  - 55 treatments including 24 hybrids
  - ≈ 30 cultivars
  - ≈ 5,700 palms
  - Been 1981, Ashburner and Been 1995
  - MAYPAN extensively planted as a result of this series of experiments

Resistance breeding experiments

- Tanzania
  - 5 resistance trials starting in 1981
  - Planted in phases according to seed availability
  - 33 treatments including 15 hybrids
  - 21 cultivars)
  - ≈ 10,000 palms
  - Schuilling *et al.* 1995

Resistance breeding experiments

- Ghana
  - 9 trials planted (7 affected), planted in 1981-82 and 1995
  - Generally replicated blocks
  - 38 treatments including 17 hybrids
  - 10 cultivars
  - ≈ 5,000 palms
  - Sangaré *et al. 1992*, Mariau *et al.* 1996, Dery *et al.* 2008
  - See updated results in next presentation

Resistance breeding experiments

- Other countries
  - Mexico: 4 trials, 5 treatments (Zizumbo et al. 1999 and 2006)
  - Genetic variation of resistance monitored in Mozambique, Cuba, Nigeria, Florida

Difficulties encountered

- As a tree crop, coconut is bulky and has a long life cycle
- The symptoms are well characterized but need to be observed carefully
- The disease tends to develop in an erratic way
- Adequacy of the planting designs

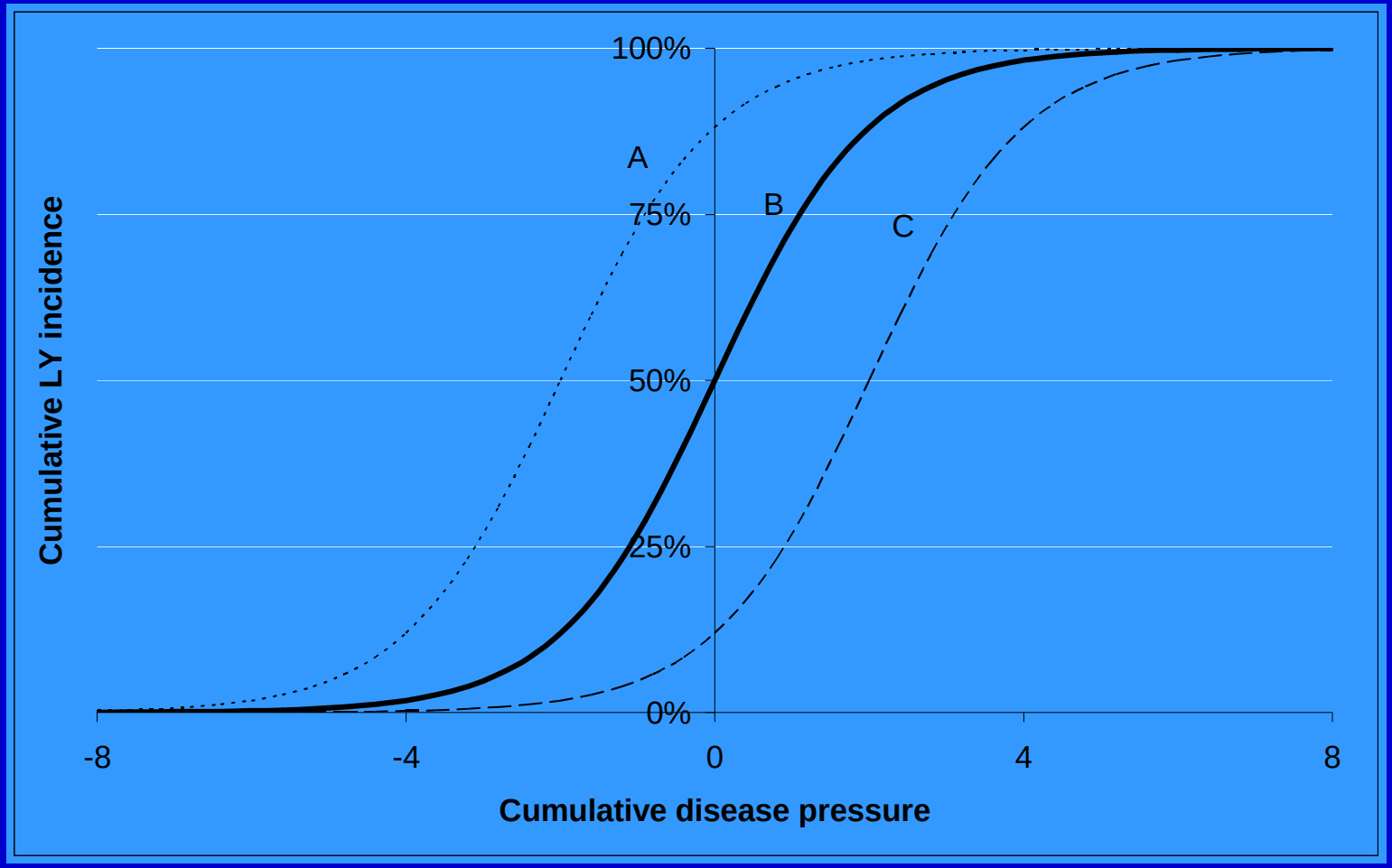
Interpreting resistance trial results

- Complete resistance not observed
- Resistance as a threshold trait

➔Generalized Linear Model (McCullagh and Nelder 1989)

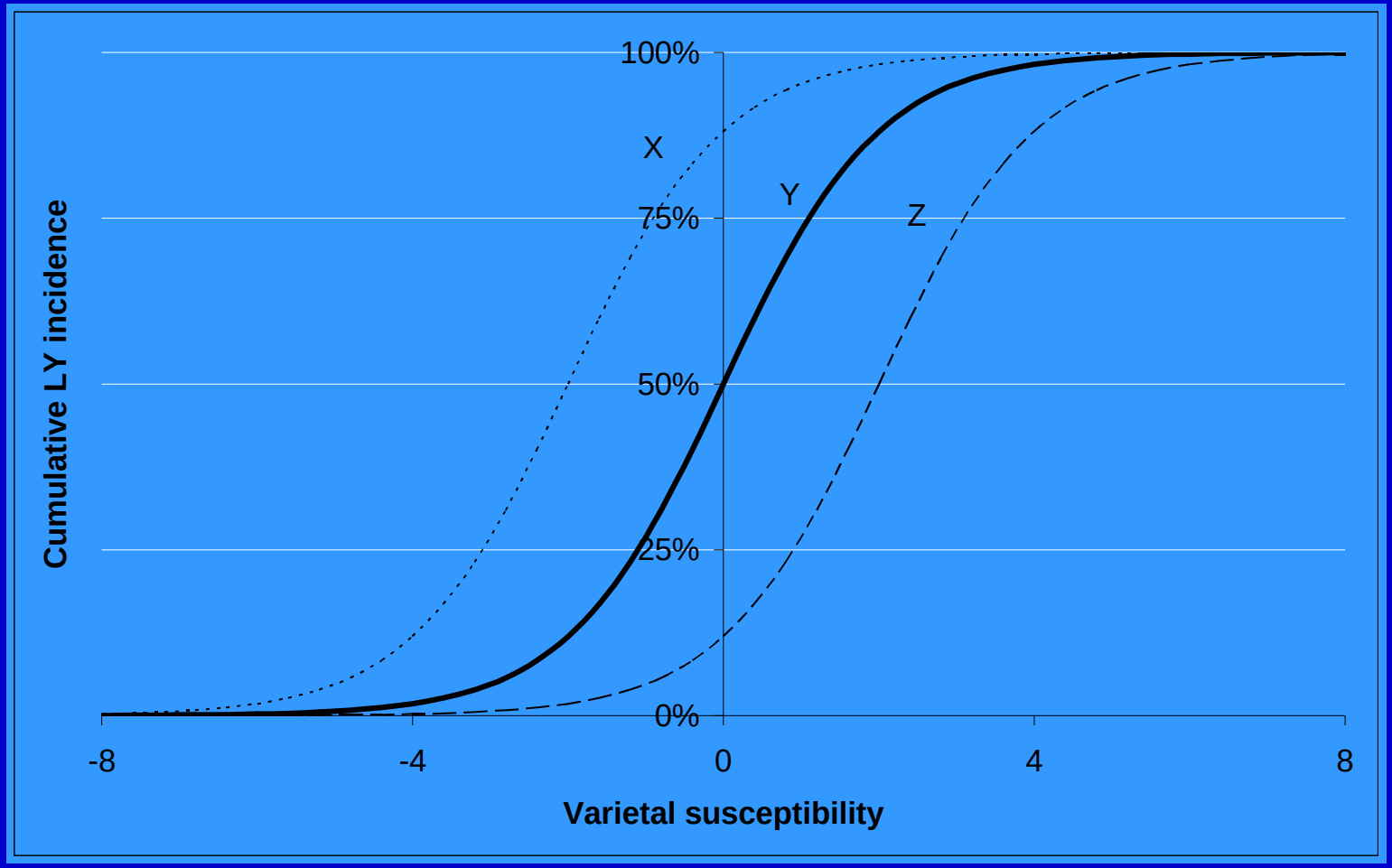
Interpreting resistance trial results

Modelling response to LY in a variety

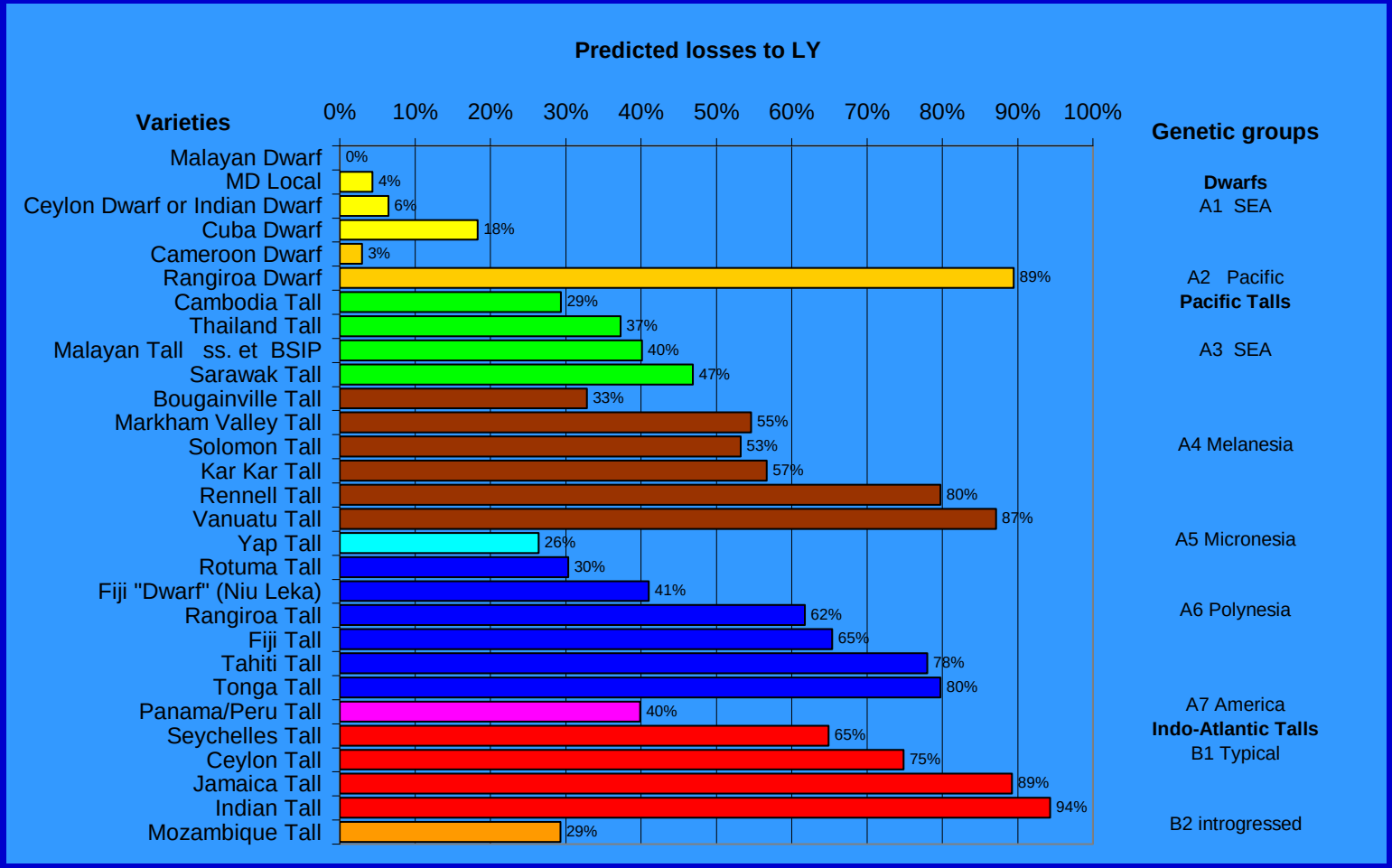


Interpreting resistance trial results

Modelling incidence at a site



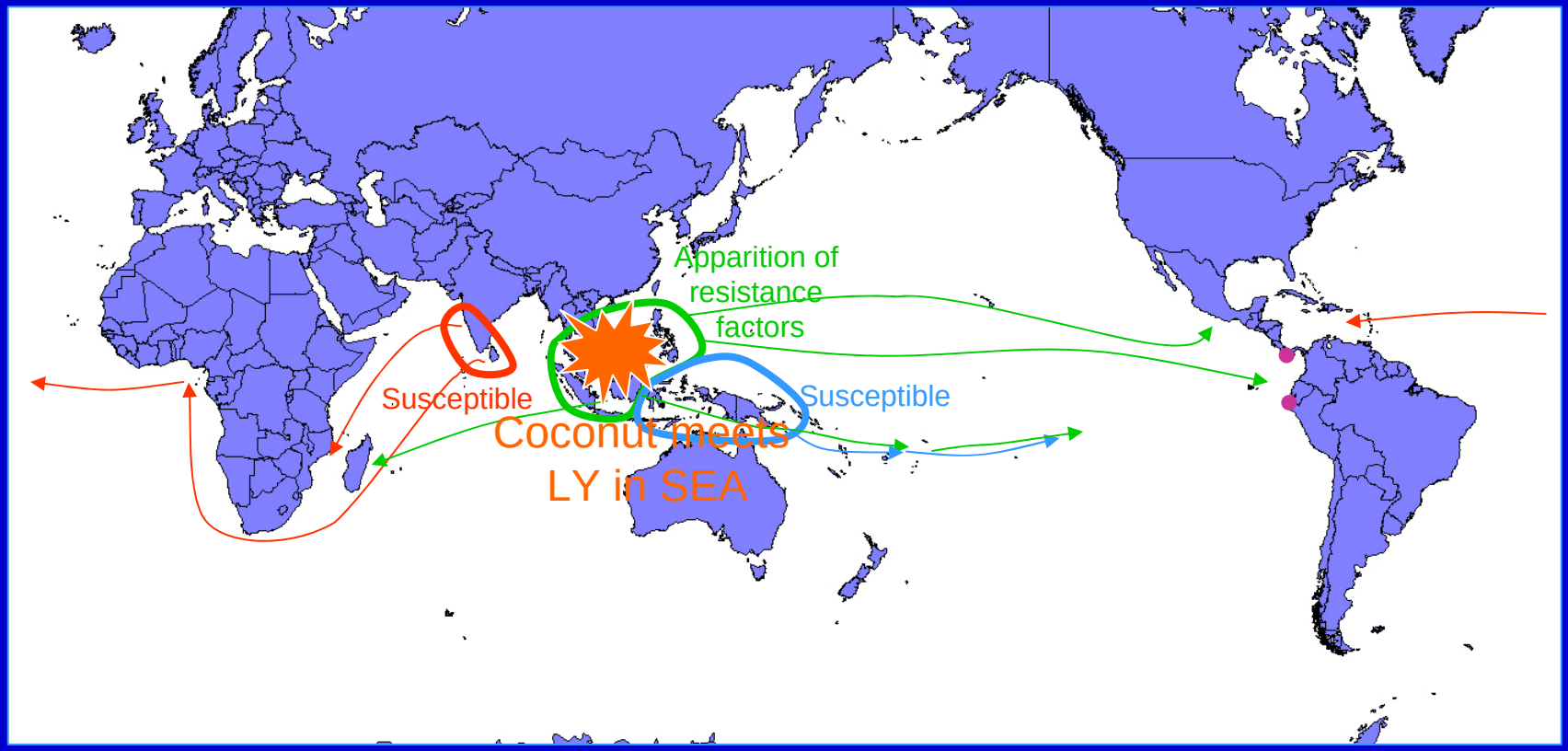
Predicted losses of the varieties tested in Jamaica



Common features to most countries

- “Typical” Indo-Atlantic varieties always highly susceptible
- “Introgressed” Indo-Atlantic (East Africa) behave better
- Varieties from Southeast Asia present strong to intermediate resistance level
- Varieties from the Pacific Ocean range from highly susceptible to moderately resistant

Tentative reconstitution of the dissemination of resistance factors in coconut



Difference between countries

- GxE interactions
  - Low GxE interaction within country
  - Notable GxE interaction among countries
    - Varieties are ordered differently
  - Varieties considered as highly resistant may become highly susceptible
- Possible interpretations
  - Interactions between resistance genes in coconut and virulence genes in the pathogen
  - Varying behaviour of the vector(s) in response to environment (including available coconut varieties)
- **In both cases, increasing genetic diversity in resistant varieties is likely to improve resistance sustainability**

Conclusion

- No complete resistance
  - Need to treat genetic resistance as part of an integrated control strategy
- Locating resistance QTLs: a challenge for the future
  - “conventional” QTL mapping if mapping population available
  - Association mapping if population structure unknown
- Southeast Asia as a source of resistance factors
- Toward more sustainable resistance
  - Testing more varieties from Southeast Asia
- Diversification of resistant coconut types
  - Using varieties from East Africa and the Indian Ocean