Integrated Management of the Invasive Cocoa Pathogen *Moniliophthora roreri*

Ulrike Krauss

Forestry Department  
Ministry of Agriculture, Lands, Forestry and Fisheries  
Union  
Saint Lucia
Moniliophthora roreri causes Frosty Pod Rot (FPR) of Cocoa (*Theobroma cacao*)

- Spanish: moniliasis
- Highly invasive pathogen
- Losses up to 100%
- Crop abandonment
- Loss of livelihoods
- Change of land use with loss of biodiversity
Invasive Spread of *M. roreri* throughout Mesoamerica

Source: Phillips *et al.*, 2005
Management Cascade for Invasive Alien Species (IAS)

- **Prevention**
  - Most cost-effective approach

- **Early detection and rapid response**
  - Based on analyses of pathways and risks

- **Impact mitigation**
  - Integrated approach
  - Benefit : cost analyses

Both require:
- ✓ strategic planning
- ✓ public awareness
- ✓ training
- ✓ effective enforcement mechanisms
Prevention

- **Scope:**
  - Insular Caribbean, Eastern Venezuela, Guyanas and Bolivia:
    - Extreme alertness
    - Regional cooperation
  - Africa and Asia:
    - Strategic measures for intercontinental germplasm transfer, transport and trade

- **Public awareness and education**
  - FPR destroys livelihoods
  - Apparently healthy pods may harbour the pathogen

- **More efficient enforcement of existing regulations**
  - Ports of entry by air, sea and land
Early Detection and Rapid Response

- Train quarantine and survey personnel in early detection
  - Latent infection last up to two months
  - Least visible on outside of pod

Focus on early stages

5 diseased pods
5 healthy pods

Looks like witches’ broom

6-8 week window of opportunity

Diagnostic confirmation
Early Detection and Rapid Response

- Emergency plan
  - Develop with anticipation
  - Focus on high risk pathways: the infamous “4 Ts”

Source: Meissner et al., 2009
Early Detection and Rapid Response

- Implementation and enforcement mechanisms
  - Prompt host elimination
  - Farmer compensation scheme
  - Replanting capacity

- Early detection and rapid response have never been used successfully against FPR!
Impact Mitigation: Integrated (IPM) Approach

- Invariably centres around cultural control
  - Fundamental to IPM approach: no short-cuts
  - Already available (short term)
  - Epidemiology urges weekly phytosanitation,

- Benefit: cost analysis may highlight need to modify
  - Frequency and combination of interventions
  - Modelling as decision-making tool

- Complemented by:
  - Chemical control
  - Biopesticides
  - Disease resilient agroforestry systems
  - Classical biocontrol, e.g. with endophytes
  - Genetic and induced resistance
Impact Mitigation: IPM - Chemical Control

- Already available (short term)
- Copper fungicides consistently most cost-effective
  - Select low hazard class (Cu hydroxide; NOT Cu sulphate)
  - Cu still permitted in organic cocoa if $\leq 8 \text{ kg ha}^{-1} \text{ yr}^{-1}$
- Flutolanil (oxathiin: systemic, specific against basidiomycetes)
  - Beneficial in early season
  - Best applied with a sticker
  - No measurable residue
- Targeted application
  - Determines %age waste and thus cost-effectiveness
  - Requires manageable tree height

=> CULTURAL MEASURES !
Impact Mitigation: IPM
Biological and chemical control
Impact Mitigation: IPM
Biological control – inundative and classical

➢ Short term:
  • Inundative use of local antagonist mixtures in Peru

➢ Medium term:
  • Classical biocontrol approach in Central America
  • Using coevolved endophytes
Impact Mitigation: IPM
Resistance – genetic and induced

- Long term perspective
- Horizontal (multi-gene) resistance is less complete but more durable
- ICS-95 showed consistent resistance against seven isolates from four genetic groups of the pathogen
- QTL-assisted breeding under investigation
- Immunization with endophytes building on phosphonate experience?

Source: Schnell et al., 2007
Monoculture: Continuous cross-infection
Splash-dispersal up to 8m

Impact Mitigation: IPM
Disease-resilient agroforestry systems (AFS)

- AFS design to diversify risks and to regulate
  - Temperature / Shade
  - Aeration
  - Inoculum interception

Non-hosts intercept inoculum, but increased humidity
Conclusion

- Prevention is the first choice

- Early detection and rapid response have never been used successfully against FPR
  => Approach needs to be more rigorous

- Impact mitigation must centre around sound cultural management

- Priority action points:
  => Proactiveness of intervention cascade
  => Training and public awareness
  => Effective enforcement cascade, including funding
  => Regional and international cooperation
Thank you!

Participation funded by T-STAR programme