HOST PLANT RESISTANCE, CULTURAL AND MECHANICAL CONTROL IN COCOA
World cocoa production
Cocoa is an important cash crop in West Africa

W. Africa produces 70% of the world cocoa
Major biotic and abiotic stresses to cocoa production

- Black pod disease
- Witches’ broom
- Frosty pod
- Swollen shoot virus disease
- Vascular streak disease
- Mistletoes
- Mirids and associated fungi
- Cocoa pod borer
- Planting materials
- Soil fertility
Emerging disease and pest problems in West Africa

- Pink disease
- White threads
- Stink bugs
- Stem borers
- Termites
- Pod feeders
Black pod disease problem of Cocoa

- Black pod caused by several species of *Phytophthora* is one of the most-important diseases affecting cacao.

- In Central and West Africa, *P. megakarya* is the species that causes most damage (up to 80% of pod losses).
Witches’ broom (left) caused by *Crinipellis perniciosa*  Photo: USDA, SPCL
Frosty Pod caused by *Moniliophthora roreri*

Photo: USDA, SPCL
Cocoa swollen shoot virus disease problem

- More than 230 million infected cocoa trees have been destroyed due to CSSVD (Dr Henry Obiatey, pers. comm.)
THE COCOA MIRID PROBLEM

Adult of *S. singularis*

Fungi

Fungi
Various *Fusarium* species from mirid feeding lesions
Mainly by insecticides against mirids

- Kerosene & soap emulsion (1908-1920s)
- Sulphur compounds (1920s to early 1940s)
- DDT (mid 1940s to early 1950s)
- Lindane* & other organochlorine insecticides (early 1950s to 1960s) [*Banned in 2001]
- Organophosphorus, carbamate* and pyrethroid insecticides (mid 1960s to 1970s) [propoxur banned in 2001]
- Nitroguanidines (late 1990s to date)
Need for alternatives to pesticide use for increased environmental and biodiversity protection
1. HOST PLANT RESISTANCE

- Plants have natural defence mechanisms
  
  Physical barriers
  
  Fungitoxic compounds
  
  Hypersensitive response
  
  Production of phytoalexins
Cocoapresents a wide biological diversity
HOST PLANT RESISTANCE TO INSECTS AND DISEASES

Selecting cocoa germplasm lines that have resistance or tolerance to insects or diseases makes it possible to avoid or lessen the use of pesticides.
Identification of pathogens
Methods of disease and pest resistance screening in cocoa germplasm

- A leaf inoculation
- Automated spray inoculation – witches’ broom
- Use of vegetatively propagated plants
- Agar droplet method
- Field observations
Activity: Laboratory micro-test experiments for mirid resistance
Activity: Laboratory cage experiments for mirid resistance
Activity: Sleeve cage experiments for mirid resistance in the field
What do we measure in host plant resistance studies?

### Disease resistance

- Success of pathogen entry
- Functional plant loss indices
  - Incubation & latent periods
  - Lesion lengths/area under the lesion expansion curve
- Rates of disease progression
- Percent biomass loss

### Insect resistance

- Feeding damage
- Antibiotic effects
- Records of survival times
- Fecundity
- Foliar area damage
- Quantifying chlorophyll loss by feeding
Examples of laboratory and field screening

- A polygenic control of black pod disease has been suggested (Enriquez and Soria 1996)

- A leaf inoculation method by Nyass (1997) and a significant positive correlation between leaf-test data and pod-rot rate in the field was observed.

- Results suggested a leaf test could be used as an early predictor of black pod resistance in the field.
Some published works


Some published works cont’d


- Teh, C-L, Pang, JT-Y, and Ho, C-T (2006) Variation of the response of clonal cocoa to attack by cocoa pod borer *Conopormorpha cramerella* (Lepidoptera: Gracillariidae) in Sabah. *Crop Protection* 25 (7) 712-717

2. Cultural, Quarantine & Environmental manipulation

- shade reduction and management
- Mixed farming systems
- Pruning and destruction of infected plants/plant parts
- Regular harvesting
- removal and burying of infected pods
- Restrictions on plant movement
- frequent weed control
- Barrier cropping
- Entomopathogens
IMPROVING HABITATS FOR BENEFICIAL INSECTS

- Avoiding pests by intercropping cocoa with food crops

- Increasing plant complexity to provide sites for beneficial insects is a recommendation for cocoa establishment
3. Use of plant based pesticides

- aqueous neem seed extract
- pyrethrum
4. Use of insect sex attractants
Certification of cocoa farms

Organic cocoa farmers are responding well to IPM strategies allowing them to market their produce as pesticide-safe or organic.
INNOVATIONS FOR DISEASE AND PEST CONTROL

Stakeholders learning and innovating together for improved benefits
Strengths in alternative disease and pest control in cocoa

- Strict quarantine restrictions on trans-continental movement of materials
- Continuous development and improvement of screening protocols
- Personnel and information exchange and collaboration between the north and the south
Key challenges in alternative disease and pest control in cocoa

- There is no standardised protocols and resistance assessment systems are subjective.
- There is always the compounding effect of climate change- drought and desertification etc.
- Cocoa is primarily monoculture and new stresses should be anticipated.
- There are loads of alternative hosts for pests.
Collaboration

- Need for continued collaboration

- Building the tools to sustainably control pests and diseases threatening cocoa production...

... building the required database through exchange of useful information!
Questions?