COFFEE LEAF RUST: INDIA'S EXPERIENCE

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Coffee leaf rust – Indian perspective

- Coffee leaf rust (CLR) spread to India from Sri Lanka during 1870's and caused large scale damage to Arabica leading to panic among growers
- The United Planters Association of South India (UPASI) started research on CLR in 1892
- Mysore Coffee Experimental Station was set up in Balehonnur in 1925 for pursuing systematic research on coffee
- Coffee Board of India took over the Mysore Coffee Experimental Station in 1946 which strengthened the Research activities in all major disciplines

Pioneering work on CLR in India

- The findings of Wilson W.Mayne, the first Scientific Officer at Coffee Experiment Station, on existence of physiological races of rust pathogen is a classical work on CLR
- This paved the way for focused research on disease periodicity, resistance breeding, race diversity, host-pathogen interaction and disease management
- Spraying of Bordeaux mixture was introduced to tackle leaf rust disease way back in 1930's
- The basic work in India contributed towards establishment of the Coffee Rusts Research Centre at Oeiras, Portugal, in 1955

India's approach for managing CLR

The primary focus was on breeding varieties for leaf rust resistance

Importance was given for integrated disease management involving cultural methods and need based use of fungicides

Breeding for Leaf Rust Resistance

- Exploited spontaneous hybrids of Arabica and other diploid species to develop commercial strains
- Evolved 13 Arabica cultivars with resistance to CLR
- 'Chandragiri' - the latest variety manifests broad spectrum of field tolerance and shows wider adaptability
- Cultivation of rust resistant cultivars and ideal weather conditions speed up mutations in rust pathogen leading to presence of highest number of rust races (35) in India out the total 47 known races

Management strategies for leaf rust

- Well maintained two-tier mixed shade canopy
- Pruning & handling to minimize the initial inoculum
- Balanced nutrition for maintenance plant vigour
- Prophylactic spraying of 0.5% Bordeaux mixture before build up of disease once before onset of monsoon and again after cessation of monsoon
- Use of systemic fungicides sprays in combination with Bordeaux sprays especially for susceptible varieties

International collaborative programmes

- India actively participated in many international collaborative R&D programmes
- Joint research programmes with CIFC, Portugal since its establishment in 1955 enabled
  - characterization of rust race diversity
  - Screening for resistance spectra of genotypes
  - introduction of resistant plant material for exploitation in breeding
  - Introduction of rust indicator plants for isolation of rust races
- Collaborative research with IRD, France during the period from 1999 to 2004, resulted in identification of DNA markers linked to an important rust resistant gene, S_H3
- Provided opportunity for capacity building of the scientists and mutual sharing the technical know how

ICO-CFC SPONSORED MULTI COUNTRY PROJECT (CFC/ICO/40)

"Increasing the resilience of Coffee production to leaf rust and other diseases in India and four African countries"

Institutions Involved

- Central Coffee Research Institute (CCRI), Coffee Board, India
- Coffee Research Foundation, Kenya
- Institut des Sciences Agronomiques du Rwanda, Rwanda
- Coffee Research Institue, Uganda
- Coffee Research Station, Zimbabwe

Goal

"Contribute to sustainable coffee production and increase producer income and foreign exchange earnings by reducing the crop and quality losses caused by the diseases CLR and CBD, and resources spent on expensive chemicals, especially in regard to smallholder, coffee-based farming systems"

Objectives

- to build the capacity of partners
- to share improved varieties between participant African countries and India
- to conduct demand-led research for variety evaluation and that generates alternative methods for control of CLR and other diseases
- to deliver new knowledge including CLR resistant germplasm and environmentally friendly chemicals/ botanicals to coffee growers, particularly small holders.

Key components and approaches followed

- Identification of needs and resources: Collection of systematic data on rural community responses to CLR disease through community based surveys
    - Biological survey
    - Socio-economic survey
- Production & sourcing of resistant plant material to the coffee growers
- Conservation of genetic resources of coffee and identification of new sources of resistance
- Monitoring pathogen diversity and isolation of new races of rust pathogen
- Carryout field trials both on station and on farm for systematic evaluation of the new coffee varieties
- Delivery and transfer of technology to coffee growers especially small holder forms using various extension tools


Salient Accomplishments

Component 1. Community Based surveys

- The survey indicated no drastic changes in CLR incidence levels across Arabica growing areas, due to adoption of recommended management practices by coffee growers
- The constraints for CLR management are associated with environmental changes (e.g. lack of adequate or untimely rainfall) and workforce availability
- Growers' are knowledgeable about role of shade, fertility of soil, cultural operations and use of resistant coffee varieties in managing the CLR

How these surveys helped?

- Formulation of strategies for replanting of rust susceptible varieties with new tolerant strains in small coffee holdings
- Mechanization of farm operations for improving efficiency of labour

Component 2: Production & supply of resistant plant material

- Project provided impetus to production and supply of quality seed to the growers
- Established new seed blocks on 18 ha of land for the recently released rust tolerant variety '**Chandragiri'**
- Self sufficiency achieved to meet the seed demand of the coffee industry by 2012-13

Component 3: Conservation of genetic resources and identification of new sources of resistance

- Field gene banks were consolidated as a part of strengthening of germplasm conservation strategy
- Characterization of exotic gene pool of Arabica available in India and publication of a monograph on world coffee collections
- Monitoring germplasm collections for field tolerance to rust and documentation for breeding purpose

Component 4: Pathogen diversity and identification and isolation of new races of rust pathogen

- Three new rust races were isolated on resistant genotypes based on monitoring efforts for new rust races
- Validated DNA markers linked to rust resistance genes for marker assisted selection and breeding
- Resistance of Indian Arabica varieties against Coffee Berry Disease (CBD) has been established by screening conducted at CIFC, Portugal

Screening for CLR & CBD

Component 5: Field evaluation of new coffee varieties

- India shared two rust resistant varieties (Sln. 5A & Sln.6) with four African countries (Kenya, Rwanda, Uganda, Zimbabwe)
- Field performance of the Indian varieties was evaluated both on-station & on-farm in all the four African countries in comparison with local varieties
- The Indian varieties especially Sln.6 showed promising performance and broad spectrum of resistance to CLR, CBD and Bacterial blight (in Kenya) providing scope for further exploitation

On farm field trial in Zimbabwe

On farm field trial in Kenya

Component 6: Knowledge sharing and technology transfer

- Farmers Field School (FFS) approach facilitated community mobilization and on-farm evaluation of technologies in small holder farms
- Extension tools such as literature on improved cultivation practices in local languages and short duration video film on integrated approach for leaf rust management etc. were developed and distributed
- Extension network used for organizing the group gatherings, mass contact programmes, open field days to create awareness
- **`Cafe Movel'** a mobile phone based extension service developed and launched for dissemination of technical and market information and weather forecast to coffee growers

Farmer Field Schools

Take home messages from the project

- Growing tolerant cultivars is the best strategy to manage CLR
- Breeding for durable resistance should be a continuous process for developing new resistant varieties
- Climate change effects should be kept in focus while devising interventions especially the fungicide spray scheduling
- Innovative approaches for technology transfer are necessary for quick dissemination of information
- Joint efforts through multi-country programmes can help in accomplishing the goal in short time and should be encouraged

Current Focus

- Gene pyramiding approach using DNA marker assisted selection is pursued for achieving durable resistance
- Several promising lines of Arabica in the pipe line for commercial exploitation
- Search for new sources of resistance
- Use of advances in Bioinformatics and genomic information resources on coffee and rust pathogen for location of resistance genes
- Screening of eco-friendly Botanicals and Bio-agents as a component for integrated disease management

Thank you