



Organización Internacional del Café
Organização Internacional do Café
Organisation Internationale du Café

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**International research and development
services for the durable genetic control of
two destructive diseases affecting Arabica
coffee**

Project proposal

Background

1. This document has been submitted by the CIFIC (Coffee Rust Research Centre) which is a specialized department of the IICT (Tropical Research Institute), Oeiras, Portugal with the support of the Association for Science and Information on Coffee (ASIC) and Embrapa. It contains a summary of a project proposal involving research into plant-pathogen interactions of two quarantine diseases (coffee leaf rust (CLR) and coffee berry disease (CBD)); identification and maintenance of races/isolates of the pathogens and of critical coffee germplasm; pre-breeding for resistance; and training of research personnel from coffee producing countries.

2. The proposal has been circulated to the Virtual Screening Committee (VSC) for assessment and will be considered by the Executive Board in September 2007. A copy of the full project proposal is available in English upon request.

Action

The Executive Board is requested to consider this proposal together with the recommendations of the VSC and, if appropriate, to recommend approval by the Council.

PROJECT SUMMARY

- Project title:** International research and development services for the durable genetic control of two destructive diseases affecting Arabica coffee
- Duration:** 5 years
- Location:** Coffee Rust Research Centre (CIFC) at Oeiras, Portugal; and various research centres in coffee producing countries in Latin America, Asia and Africa
- Nature of project:** Research into plant-pathogen interactions of two quarantine diseases (coffee leaf rust (CLR) and coffee berry disease (CBD)); identification and maintenance of races/isolates of the pathogens and of critical coffee germplasm; pre-breeding for resistance; and training of research personnel from coffee producing countries
- Brief description:** The overall objective of the project is to strengthen the capacity of the CIFC to function efficiently within the international research and development (R&D) network of coffee research centres, which has durable resistances to CLR and CBD in Arabica coffee as its main targets. Specific project objectives include:
- Monitoring the evolution of virulence of the CLR pathogen in all coffee producing countries and identification of new physiologic races; monitoring the evolution of aggressive strains of the CBD pathogen in Arabica coffee-producing countries in Africa.
 - Maintaining and updating the world collection of CLR races and coffee differentials; maintaining a collection of CBD isolates with regular restoration of pathogenicity and also germplasm representing the full range of CBD resistance; general access to CLR differentials for research centres in coffee producing countries; access to CLR races and CBD isolates for collaborating research institutes and universities (e.g. in the EU and US).
 - Supporting research into the physiological and molecular basis of host resistance to CLR and CBD at international research centres

- Screening of coffee germplasm for new and more durable sources of host resistance to CLR and CBD; pre-breeding to develop progenitors for national breeding programmes.
- Training of coffee pathologists and breeders (short-term, MSc and PhD courses).

Estimated total cost €1,970,000

Financing sought from the Fund: €1,145,000 (excluding contingencies, ICO supervision and CFC management costs)

Mode of financing from the Fund: Grant

Counterpart contribution: €825,000

Project Executing Agency (PEA): The CIFC - IICT, Oeiras, Portugal

Supervisory body: International Coffee Organization (ICO)

Estimated starting date: tbd

PROJECT BACKGROUND

1. CLR (*Hemileia vastatrix*) is worldwide the most important disease affecting Arabica coffee, causing considerable economic damage, estimated at more than US\$1 billion annually. The timely application of fungicides can provide adequate control, but this is usually beyond the financial means of small farmers who are the main coffee producers in most countries. Coffee genetic improvement programmes in a number of producing countries have resulted in CLR-resistant cultivars, which offer opportunities for environmentally and economically sustainable coffee production. However, the adaptive capacity of the CLR pathogen has been causing a gradual loss of host resistance of very promising coffee cultivars in some countries in recent years. Since 1955, the CIFC in Portugal has assisted coffee growing countries in solving the CLR problem, by characterizing the variability of the pathogen and supporting national breeding programmes in developing resistant cultivars. The CIFC is ideally positioned to test and maintain all physiologic races of CLR without running the risk of inadvertently spreading new virulent races to coffee growing regions. The collections of physiologic races of the CLR fungus and differential coffee germplasm at the CIFC are unique in the world. Furthermore, the CIFC has contributed considerably to the training of pathologists and breeders from many coffee growing countries. All these services have been made available almost free of charge.

2. CBD (*Colletotrichum kahawae*) is still restricted to Arabica coffee in Africa, although climatic conditions in certain high-altitude coffee areas of Latin America and Asia appear to be very favourable to the fungus. CBD epidemics can quickly destroy 50-80% of the developing crop of susceptible Arabica cultivars during prolonged wet and cool weather conditions. Preventive control by frequent fungicide sprays may account for 30-40% of total production costs and new cultivars with high levels of apparently durable host resistance, although successfully developed (e.g. in Kenya), have not yet sufficiently replaced the old susceptible cultivars. Annual economic damage to Arabica coffee production in Africa, due to crop loss by CBD and cost of chemical control, is estimated at US\$300-500 million. The CIFC has been studying variations in pathogenicity of CBD isolates from different countries in Africa since 1989 and maintains also Arabica accessions with various levels of host resistance to CBD. As a consequence, the CIFC is now providing unique services to coffee research centres in Latin America and Asia, by screening their breeding lines against a quarantine disease, which enables them to develop resistant cultivars in anticipation of any future outbreak of CBD in Arabica coffee in their own countries. This is analogous to the early CLR resistance breeding programme carried out by Colombian and Brazilian coffee research institutes in collaboration with the CIFC several years before the first CLR outbreak in those countries. In recent years, the CIFC has also been very active in training African coffee breeders and pathologists in all aspects of this disease.

3. The coffee producing countries fully recognize the dependence on this international R&D service, with the CIFC in a pivotal position, to remove serious constraints on coffee production caused by the CLR and CBD diseases. Additional funding will be indispensable to reinforce the capacity of the CIFC to effectively support and complement national R&D programmes leading to robust genetic solutions.

Project rationale and expected results

Project rationale

4. The development of cultivars combining yield and quality with host resistance to the destructive diseases CLR and CBD is considered the most effective way of reducing production costs in Arabica coffee. The project offers the opportunity for economically sustainable coffee production to smallholder coffee growers in particular, since they usually lack the financial means for chemical control measures and so end up with very little of their crop to sell in years of severe disease epidemics. It also improves the ecological sustainability of coffee production in the estate sector as a consequence of considerably reduced use of agro-chemicals.

5. The adaptive capacity of the CLR pathogen has caused a gradual loss of host resistance of very promising coffee cultivars in some countries in recent years. The CIFC in Portugal has assisted coffee growing countries in solving the CLR problem, by characterizing the variability of the pathogen and supporting national breeding programmes in developing new cultivars with durable resistance to CLR. The CIFC has also built up expertise on CBD to provide similar services of screening breeding lines for resistance, particularly for countries wanting to start developing their own CBD resistant cultivars in anticipation of possible future outbreaks of that disease.

6. Coffee producing countries fully recognize their dependence on this international R&D network, with the CIFC in a pivotal position, to remove serious constraints on Arabica coffee production caused by the CLR and CBD diseases. Additional funding will be indispensable in reinforcing the capacity of the CIFC to effectively support and complement national R&D programmes leading to robust genetic solutions. The long-term nature of these activities justifies an application for funding of five years, the longest period of time allowed for Common Fund for Commodities (CFC) sponsored development projects.

Expected project results

7. An efficiently operating CIFC, thanks to updated facilities and adequate finances, will provide all necessary support services to the national coffee research centres participating in the R&D network to combat the constant threat of CLR and CBD to sustainable production of Arabica coffee. Verifiable component results will include:

- Renovation of facilities of the CIFIC, the glasshouses in particular.
- Regular monitoring and reporting of developments in virulence or aggressiveness of the CLR and CBD pathogens
- Adequate updating and maintenance of physiologic races of CLR and aggressive isolates of CBD.
- Adequate maintenance and (vegetative) propagation of CLR differentials; free supply of such differentials on request to national coffee research centres.
- Cooperation with research institutes (outside coffee growing regions) in studies of the physiological and molecular basis of host-pathogen interactions in coffee, with the objective of developing molecular solutions for durable resistance to CLR in particular. The main contribution of CIFIC to such research will be the free supply of CLR/CBD pathogen and host plant materials, but also active exchange of scientific information.
- The detection and development by pre-breeding of new progenitors for durable resistance to both diseases.
- A large number (at least 15) coffee scientists, who will have received training at the CIFIC at the full satisfaction of the national coffee research centres.

Benefits and beneficiaries

8. National coffee research centres in all producing countries with a serious problem of CLR in Arabica coffee will continue to receive, practically free of charge, scientific support from the CIFIC, which is indispensable to their efforts to develop new cultivars with more durable resistance to CLR: verification of physiologic races present in the field, access to new differentials and progenitors with improved resistance.

9. In the case of CBD, coffee research centres of producing countries in Latin America and also Asia will benefit from the CIFIC's more recently acquired expertise to screen breeding lines for resistance, enabling them to be ready with CBD (and CLR) resistant cultivars in anticipation of unpredictable outbreaks of this very destructive disease in their countries.

10. The unique capacity of the CIFIC to train coffee scientists in all plant pathological and genetic aspects of CLR and CBD is of great importance to many coffee research centres in producing countries in order to maintain continuity in their long-term breeding projects.

11. International research centres with innovative (genomic; molecular) studies of host-pathogen relationships of coffee diseases depend greatly on the CIFIC's reliability in providing base material and expertise regarding CLR and CBD.

12. The eventual and most relevant beneficiaries of this project will be the coffee growers, the millions of smallholder farmers in particular, as cultivars with durable resistance

to CLR and/or CBD will make them less dependent on the vagaries of the international coffee market and will thus enable them to produce coffee in an economically and ecologically sustainable manner.

Intellectual property rights

13. All results produced by the project will be made freely available by the CIFC to all research centres in coffee producing countries without any intellectual property claims, just as has always happened before.

14. However, in the case of the CIFC carrying out screening tests for CLR and/or CBD resistance of advanced breeding lines belonging to a national coffee research centre, all results and plant material will remain the exclusive property of that particular research centre, as stipulated in a bilateral contract. Such CIFC activities are beyond the scope of this project.

Budget

- Of the total budget of €1,970,000 about 42% will be met by the IICT-CIFC and the CFC will be requested to fund the remaining 58%. The training component (25% of the total CFC grant) will entirely benefit research personnel from coffee producing countries.
- The CLR project components will take up about 75% of the total budget against 25% for CBD.