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**International research and development
services for durable genetic control of the
coffee leaf rust disease in Arabica coffee**

Background

1. This document has been submitted by the Coffee Rust Research Centre (CIFC) and contains a proposal for assisting the coffee growing countries to tackle the coffee leaf rust (CLR) problem by characterizing the regional variability of the pathogen and supporting national breeding programmes in developing resistant cultivars, which offer opportunities for environmentally and economically sustainable coffee production.
2. The proposal has been circulated to the Virtual Screening Subcommittee (VSS) for assessment and will be considered by the Projects Committee in September 2013. A copy of the full project proposal is available in English upon request.

Action

The Projects Committee is requested to consider this proposal as well as the recommendations of the VSS and, if appropriate, to recommend its approval by the Council.

PROJECT SUMMARY

1. **Project title:** International research and development services for durable genetic control of the coffee leaf rust disease in Arabica coffee
2. **Duration:** Five years
3. **Location:** Coffee Rust Research Centre (CIFC) at Oeiras, Portugal. Collaboration with several research centres in coffee producing countries in Latin America, Asia and Africa is foreseen.
4. **Nature of Project:** Project activities will be based on: Applied research in plant-pathogen interactions of CLR; identification and maintenance of races/isolates of the pathogen and of critical coffee germplasm; pre-breeding for resistance; training of research personnel from coffee producing countries
5. **Brief description:** CLR (*Hemileia vastatrix*) is the most important disease in Arabica coffee worldwide, causing annually considerable economic damage (estimated at US\$1.5 – 2 billion). Timely application of fungicides can provide adequate control, but is usually considered qualitatively counter-productive if not applied properly and often beyond the financial means of smallholders.
6. **Estimated total cost:** €1,898,000
7. **Financing sought from donor:** €868,500 (grant)
8. **Contribution Portuguese Government:** €1,029,500
9. **Project Executing Agency (PEA):** IICT-CIFC, Oeiras, Portugal
10. **Supervisory Body:** International Coffee Organization (ICO), London, UK

I. Background

The fundamental way to achieve higher prices is to bring about a better balance between supply and demand. Encouraging a sustainable coffee economy in producing countries and promoting coffee consumption are therefore two main objectives of the current International Coffee Agreement 2007 between coffee exporting and importing Member countries. A recommended policy is to shift away from high-volume production of average quality to smaller volumes of high quality coffees. Nevertheless, producing countries compete for market share and are understandably reluctant to impose restrictions on national output.

Arabica coffees are more expensive to produce because of the destructive fungal diseases generally not occurring in Robusta coffee. Coffee leaf rust (CLR), caused by *Hemileia vastatrix*, is the most important disease in Arabica coffee. Confined to Africa and Asia for more than a Century since the first epidemics on cultivated Arabica coffee in Sri Lanka, India and Indonesia, CLR finally reached Brazil in 1970, Central America in 1976, Colombia in 1983, and is now present worldwide in all coffee producing countries, except Hawaii and Australia. Its economic damage to world Arabica coffee production has been estimated at US\$1.5 – 2 billion per year due to crop losses (20-50%) and the need to apply chemical control measures (10-20% of production costs). Genetic control through the development of cultivars with resistance to the CLR disease has proved to be possible, but so far has been insufficiently exploited as an effective method of reducing production costs in Arabica coffee.

II. Institutions involved

Since 1955 the CIFC has been assisting the coffee growing countries in tackling the CLR problem by characterizing the regional variability of the pathogen (from its labs in Oeiras, Portugal) and supporting national breeding programmes to create resistant cultivars.

The CIFC is ideally positioned to test and maintain a world collection of old and current CLR isolates/races without running risks of inadvertently spreading new virulent races from one to other coffee growing regions because it is located outside the global coffee belt. The collections of physiologic races of the CLR fungus and differential coffee germplasm at the CIFC are unique in the world.

This is why coffee producing countries fully recognize the CIFC authority on the CLR subject and its services provided. The CIFC's capacity to fulfill Research and Development services in regard to the CLR disease has offered the possibility to contribute considerably to the training of pathologists and breeders from many coffee growing countries. All these services have been made available almost free of charge so far.

The main beneficiaries of the project will be national and regional coffee research institutes and through them the coffee producers, as cultivars with durable resistance to CLR will enable them to produce coffee in an economically and ecologically sustainable manner.

Results produced by the project will be made available to all research centres in coffee producing countries without claims of property rights by the CIFC.

III. Project rationale

The development of cultivars combining yield and quality with host resistance to the destructive CLR disease is considered the most effective way of avoiding considerable crop losses and reducing production costs in Arabica coffee. It offers the opportunity of economically sustainable coffee production to the smallholder coffee growers in particular, since they usually lack the financial means for chemical control measures and so end up with very little 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 fungicides.

IV. Project components to be implemented

Component 1: Monitoring the evolution of virulence of the CLR pathogen in all coffee producing countries and identification of new physiologic races.

Component 2: Maintaining and updating the world collection of CLR races and coffee differentials; general access to CLR differentials for research centres in coffee producing countries.

Component 3: Supporting research into the pathogen variability and the physiological and molecular basis of host resistance to CLR at national and international research centres and universities (e.g. in the EU and US).

Component 4: Screening of coffee germplasm for new and more durable sources of host resistance to CLR; pre-breeding to develop progenitors for national breeding programmes.

Component 5: Training of coffee pathologists and breeders.

V. Expected project results

An efficiently operating the CIFC, thanks to renovated facilities and adequate finances for recurrent expenditure, will provide the essential support services to the national coffee research centres participating in the Research and Development network to combat the constant threat of CLR for sustainable production of Arabica coffee. Verifiable component results are:

- Further improvement of facilities of the CIFC, the glasshouses in particular.
- Regular monitoring and reporting of developments in virulence or aggressiveness of the CLR pathogen worldwide.
- Adequate updating and maintenance of physiologic races of CLR.
- Adequate maintenance and (vegetative) propagation of CLR differentials; supply of such differentials on request by national coffee research centres.
- Cooperation with research institutes (outside coffee growing regions) in studies of the pathogen variability and physiological and molecular basis of host-pathogen interactions in coffee with the objective of developing molecular solutions for durable resistance to CLR. This research will be based on the CLR pathogen and host plant materials of the CIFC collections. This collaboration will also include active exchange of scientific information.
- The detection and development by pre-breeding of new progenitors for durable resistance to the CLR disease.
- A large number of coffee scientists, who have received training at the CIFC with full satisfaction of the national coffee research centres.

VI. Budget

Of the total budget of €1,898,000 about 54% will be met by the IICT-CIFC and the EU or other donor will be requested to fund the remaining 46%. The training component (9% of total grant) will entirely benefit research personnel from coffee producing countries.

LOGICAL FRAMEWORK
CIFC-ICO Project, International Research and Development service for durable genetic control of the CLR disease in Arabica coffee

NARRATIVE SUMMARY	VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Broader project goal			
Strengthened services of the CIFC to national coffee research centres (NCRCs); breeding for durable resistance to CLR, which is a precondition to sustainable production of Arabica coffee, for smallholders in particular.	Progress in development of new cultivars combining durable resistance with yield and quality. Efficiency of networking of the CIFC with NCRCs and IRCs.	Reviewing breeding programmes of major NCRCs in Latin America, Asia and Africa. Appreciation of services from the CIFC declared by management of participating research centres.	Real impact of CLR resistant cultivars on reducing field costs and crop losses and in that way on better sustainability of coffee production. Acceptance of new resistant cultivars by the coffee growers and trade.
Project objectives			
<ol style="list-style-type: none"> 1. Monitoring changes in virulence of the CLR pathogen on Arabica coffee worldwide. 2. Maintaining and updating the world collection of CLR races and differentials, at the CIFC. 3. Supporting innovative work on pathogen-host interactions for CLR at international research centres (IRCs). 4. Screening breeding lines for CLR resistance; pre-breeding of new progenitors as service to NCRCs. 5. Training of coffee pathologists/breeders. 	<ul style="list-style-type: none"> • Number of field surveys carried out in several coffee producing countries. • Technological capacity of the CIFC to maintain isolates of the pathogens and develop/propagate coffee differentials. • Cooperation between the CIFC and such NCRCs and IRCs. • Degree of satisfaction for the services rendered by the CIFC expressed by the NCRCs. • Quality of the courses; number of trained coffee scientists. 	<ul style="list-style-type: none"> • Reports by the CIFC and NCRCs; evaluation missions. • CIFC progress reports; review missions. • Reports and publications; review missions to such research centres. • Reports by the CIFC and NCRCs. • Confirmation by management of NCRCs. 	<ul style="list-style-type: none"> • Continued optimal networking between the CIFC and NCRCs. • Adequate financial resources for the CIFC. • Cooperating international research centres have adequate resources to continue such research on coffee. • Adequate financial resources for the CIFC. • The demand for training from NCRCs remains high.
Outputs			
<ol style="list-style-type: none"> 1. Improving facilities at the CIFC, the glasshouses in particular. 2. Regular monitoring and reporting of developments of CLR pathogenicity. 3. Up-to-date collections of CLR races and of CLR differentials. 4. Regular supply of CLR differentials and new progenitors to NCRCs on request. 5. CIFC collections (plants and isolates) will be used in joint collaboration with IRCs. 6. Well-trained coffee scientists. 	<ul style="list-style-type: none"> • Quality of improvements leading to better plant growth and reduced energy costs. • Number of field surveys carried out and reports written. • Completeness and accessibility of coffee differentials. • Speed and accurateness of supplies. • Degree of cooperation. • Satisfaction expressed by NCRCs. 	<ul style="list-style-type: none"> • CIFC progress reports; inspection by review missions. • Evaluation by review missions. • Confirmation by NCRCs. • Reports by the CIFC and IRCs. • Reports by the CIFC and NCRCs. 	<ul style="list-style-type: none"> • Basically sound structure of the glasshouses and facilities. • Unrestricted access to Arabica coffee regions worldwide. • Competence of the CIFC research staff. • Demand from NCRCs. • The great potential of genomics to durable disease resistances in coffee. • Demand from NCRCs.
Inputs			
<ol style="list-style-type: none"> 1. Portuguese Government's co-financing of the CIFC. 2. Declaration of support by NCRCs. 3. IRCs declared interest in research projects on CLR. 4. ICO's support of project to donor. 5. Donor co-financing of the project. 	<ul style="list-style-type: none"> • Contribution of €1,029,500 for 5 years. • Signed documents of intent. • Formal submission of project application. • Grant of €868,500 for 5 years. 	<p>Applying to all inputs: *Project progress and financial reports. *Mid-term and final evaluation reports.</p>	<p>Stability of implementing institutes to ensure optimum realization of project objectives.</p>