



INTERNATIONAL COFFEE ORGANIZATION
ORGANIZACIÓN INTERNACIONAL DEL CAFÉ
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ORGANISATION INTERNATIONALE DU CAFÉ

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London, England

**International Coffee Genome Network –
report and concept note**

Background

The attached concept note entitled ‘Sequencing the Coffee Genome’ and a report on the Coffee Genome Sequencing Initiative have been received from the International Coffee Genome Network (ICGN).

The representatives of the ICGN will make a presentation to the PSCB at its meeting on 16 March 2009.

Action

The PSCB is requested to note this document.



International Coffee Genome Network

SEQUENCING THE COFFEE GENOME

ICGN Concept Note

March 16, 2009

The ICGN (<http://www.coffeegenome.org/>) is a worldwide network of scientists from universities, research institutes and industry within the coffee producing and consuming countries. It includes more than 50 individual and Institutional members networking scientific groups around the world in Africa, America, Europe, & Asia. Our collaborative network is focused on building the foundation for advancing agricultural research for sustainable coffee production worldwide by developing genomic tools and resources to further our understanding of the coffee genome at the molecular, biochemical, and physiological levels. ICGN membership is opened to any individual, laboratory, or institution that can contribute to this effort in genomics resource development, sequencing and genome assembly, annotation, biological scientific expertise, or funding.

Despite its economic and social importance for numerous countries around the world, coffee has received very little attention with respect to molecular genetics and genomics research. ICGN has developed a coordinated and cost efficient strategy to sequence the coffee genome using new generation sequencing technologies. ICGN is interested on securing international funding for this important effort on behalf of the coffee scientific community worldwide. Support from ICO and the private sector is needed to ensure a broad international participation and a broad funding base.

Sequencing the coffee genome will help decipher the genetic and molecular bases of important biological traits in coffee that are relevant to growers, processors, and consumers. This knowledge is fundamental to allow efficient use and preservation of coffee genetic resources for the development of improved cultivars in terms of enhanced quality, yield, and resistance with reduced economic and environmental costs. Although considerable diversity exists in diploid *Coffea* species, its use in conventional coffee breeding programs has been very limited. *Coffea arabica* is characterized by a very low genetic diversity, which is attributable to its allotetraploid origin, reproductive biology, and evolution. The narrow genetic base of cultivated *C. arabica* has created a bottleneck for coffee breeding and limits cultivar improvement. Similarly, the considerable genetic diversity observed in *C. canephora* is still largely unexploited in the cultivated varieties. In the future, the ability to capture and manipulate genetic diversity and effectively utilize germplasm in traditional coffee breeding programs will be vital for sustainable coffee production.

Significant advances in our understanding of the coffee genome and its biology must be achieved in the next decades to increase quality, yield and protect the crop from major losses caused by insect pests, diseases and abiotic stress related to climatic changes. Unravelling the coffee genome will contribute significantly to the characterization and utilization of germplasm needed for future coffee improvement. Development of genomic tools for coffee can help breeders identify, characterize, and utilize diversity.



REPORT ON THE COFFEE GENOME SEQUENCING INITIATIVE .

Coffee provide earnings for about 120 million people in the producing countries and the economy of many developing countries depends on the trade of this commodity. In the consuming countries, coffee acquires added value through industrial processing and commercialization and it generates earning and occupation for a large number of people. Investment on research on coffee does not correspond to its commercial relevance, in facts only a few tens laboratories or institutions carry out research on coffee, less than a dozen in the consuming countries. The reason for such a low support to research are several, ranging from the scarcity of economical and human resources in some of the producing countries, to the disinterest of most of the research funding agencies in the consumer countries. It is obvious that low level of research is detrimental to development of new products, agronomic characteristics amelioration and quality improvements.

Genomics of coffee: why sequencing the coffee genomes.

Research interests of the producer countries and of the consumer countries do not necessarily coincide: the producer are more interested in high yield, in the resistance of the plant to pests and diseases, while the consumers are more interested in the cup quality and in the characterization of the different green coffees. Genomics can unify the different interests through one single approach: both the agronomic characteristics and the quality aspects can be disclosed by studying the complete genetic composition of the coffee plant.

Agronomy advantages. In the last few years a consistent number of genes coffering resistance to the various pest have been identified. It is obvious that plant naturally resistant to nematodes or to drought require less labour and investments. Resistant plants can avoid the risk of the complete loss of a plantation (see the relatively recent case of Congo). Resistant genes can be transferred to relevant plants by conventional breeding and selective techniques. Similar considerations applies to productivity traits as well as to other important agronomic characteristics as flowering synchronization.

Quality advantages. The genetic composition of the plant is the fundamental base for a good quality coffee. There is no way to have a good coffee out of beans produced by a plant with "bad" genes. The coffee can be easily spoiled at any stage along the productive chain, up to the brewing machine, but technological cosmetics cannot always cure the defects a low quality coffee. Moreover the genetic characterization of the different coffee varieties will allow for a better identification of the right environment for a specific genetic composition.

Consumer protection. Modern DNA fingerprinting techniques allow for the biological certification of specialty coffees and terruars. Moreover the indisputable certification on DNA should help the traders as well as the producer in obtaining a better premium for the high quality coffee sector.

The scientific approach.

A number of molecular tools of coffee are now available and we are in the position of sequencing the entire genome and construct a catalogue of all the genes of the coffee plant. Seven laboratories, Brazil, France, Canada, two in Italy and two



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In the USA, invested some of their resources to start the sequencing of Robusta. The sequencing of Arabica will be started when the Robusta sequences will be available because technical reasons do not allow for a direct approach to Arabica. Once we have the catalogue of the coffee gene, we will proceed to the proteomics and to the metabolomics to identify those important molecules which confer to good coffees their unique aromas.

Costs and resources.

Taking in account that research does not have an end, significant results, including the complete sequence of Arabica and Robusta as well as the downstream informatic analyses, can be obtained with the investment of less than US \$ 2 millions. Public resources can provide part of the sum but the participation of the Private Companies is essential, especially to provide the necessary input on the strategies as well as for the development of links between research and coffee trade. Relevant investment on the genomics of coffee has been done by Nestlè and by Illycaffè. Governmental financing agencies supported coffee genomics in Brazil, Colombia and India and applications are now under consideration in Italy, France and USA. It is obvious that the establishment of a "Coffee Companies Consortium" would substantially promote the genomics of coffee and it would be the first beneficiary together with the producers.

Contacts.

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