



Editorial

Determining the origin of a product and being able to authenticate it, trace it and control its quality by means of non-destructive, rapid, economical analyses that do not involve using solvents... this is what CIRAD researchers set out to achieve by developing analysis methods based on near-infrared spectroscopy.

The examples of projects detailed in this newsletter illustrate the range of applications of this method: forest species breeding operations, coffee roasting, fruit flavour quality, environmental impact of wildlife, chemical properties of wood, etc, etc.

To enable it to improve the technique still further and explore all the possible applications in the laboratory and in industry, along with scientific partners and users, CIRAD is a member of Helio-SPIR, a network for sharing experiences, equipment and know-how, backed up by the Agropolis scientific community. The next meeting of the Helio-SPIR international network is to be held at CIRAD at the end of August 2008, on the topic of what NIRS can contribute to agricultural research and development.

We invite you to join us at the meeting if you are interested in the possibilities offered by this already tried-and-tested technology with an ever-growing range of applications.

Véronique VISSAC-CHARLES

CIRAD Technology Transfer
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Coordinator

Helio-SPIR meetings in August 2008

The Helio-SPIR club, founded in 2003, is a skills centre of international scope, in the field of near-infrared spectroscopy (NIRS). Its aim is to promote the NIRS technique, and it is largely supported by the AGROPOLIS scientific community in Languedoc-Roussillon. CIRAD will be organizing the next Helio-SPIR meetings, in August 2008, on what NIRS can contribute to agricultural research and development.

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Intelligent beehives

The APISYSTEMS firm was set up in collaboration with a CIRAD research team working on sound signal processing. It designs "intelligent" beehives fitted with sound sensors, which can detect swarms, intrusions by predators, diseased bees, etc, from a distance. Beekeepers can thus take the necessary steps in real time. APISYSTEMS has just been approved by the business incubator Languedoc-Roussillon Incubation.

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A new sorghum variety in Nicaragua

Blanco Tortillero, an improved sorghum variety with white grains intended for small-scale growers in dry areas, has just been added to the official catalogue of varieties in Nicaragua. It is the first sorghum variety produced by a participatory breeding programme in central America run by CIRAD, the *Centro Internacional de Agricultura Tropical*, the NGO CIPRES, the COSENUP agricultural cooperative, and local farmers' groups. Blanco Tortillero is early, hardy and high-yielding, fits in well with existing cropping systems, and produces top quality grain for making tortillas.

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Barrel wood quality

CIRAD and Ondalys, a chemometrics firm nurtured by the CEMAGREF (Agricultural and Environmental Engineering Research) enterprise centre, in association with CEMAGREF and the *Institut national de la recherche agronomique*, are working on the phenol composition of the oak used to make wine barrels and chips, and on its effect on wine sensory quality. The current study suggests that it may be possible to use near-infrared optical sensors to identify quality woods at the sawmill, and also to control byproduct heat levels before conversion into chips.

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Diagnosing banana diseases

CIRAD recently organized a training course in Guadeloupe, on diagnosing sigatoka disease and viral diseases of banana, for staff from crop protection services on the English-speaking islands of the Caribbean, in Surinam and in Cuba. The workshop was geared towards putting diagnostic techniques into practice, to enable participants to implement those techniques at their respective organizations. The idea of establishing a mutual diagnostic service covering several Caribbean islands was also evoked.

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Science

► CHARACTERIZING THE CHEMICAL PROPERTIES OF WOODS

The fact that wood comprises lignin and cellulose, two major constituents whose respective proportions determine whether a wood is suitable for charcoal or paper production, accounts for its undeniable economic importance.

CIRAD is working to pinpoint the genetic and environmental factors that determine wood chemical characteristics, particularly lignin and cellulose content, so as to select the best trees in eucalyptus breeding populations. While wood chemical analyses are time-consuming and costly, applying near-infrared spectroscopy (NIRS) to woods makes it possible to assess the chemical characteristics of a large number of samples in a short time, and enables genetic analyses of study populations.

assess the chemical characteristics of a large number of samples in a short time

These studies are being conducted on eucalyptus in partnership with the wood industry in Brazil, for steel-making applications, and in Indonesia and Congo, for paper-making. ■

► Are you interested in the wood industry?

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► COCONUT BIOCHEMICAL QUALITY

Measuring the sugar and fat content of coconuts is useful for studying fruit ripening phenomena. However, when assessing the biochemical and nutritional quality of coconuts, it is important to take account of the variations linked to the variety, season, soil, etc, which rapidly calls for a large number of samples.

CIRAD and the Vanuatu Agricultural Research and Training Centre studied the quality of the fruits of a given coconut variety over a three-year period. Analysing the 385 coconut kernel samples using conventional methods would have required 109 litres of chemical solvents and taken 40 weeks. Combining an automatic fat extractor with near-infrared spectroscopy meant that the analysis required just 9 litres of solvents and took only 10 weeks. Using NIRS reduces the overall cost of analyses and the amount of solvents, which pollute the environment. ■

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► Are you interested in this analysis method?

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► WILDLIFE AND EXTENSIVE ANIMAL FARM MONITORING

To study the feeding habits, movements and impact on the flora of wildlife and extensive animal farms, it is necessary to be able to characterize the spatial and temporal changes in food resource availability. Those resources may be assessed directly, through plant analyses, or indirectly, by analysing animal excrement. In both cases, NIRS makes it possible to conduct the large numbers of analyses required for such studies, at very little cost.

CIRAD's capacity to supply reference chemical analyses enables it to develop spectral databases that can be adapted to numerous situations, to study the environment and biodiversity. For instance, it has participated in monitoring Rusa deer populations in New Caledonia, managing impala farms in Zimbabwe, studying buffalo herd mobility in Burkina Faso... and even studying the diet of mouflons in France! ■

spectral databases that can be adapted to numerous situations, to study the environment

► Are you interested in our projects?

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Arabica coffee roasting in Burundi. Near-infrared spectrums of green coffee.

Market

► DETERMINING WATER CONTENT IN ROASTED COFFEE

For coffee makers, roasting is a key stage in the production process: it has to be controlled and reproducible, in order to satisfy consumer demand and current regulations. The organoleptic and physicochemical characteristics of coffee, particularly its water content, which has to be less than 5%, are controlled to ensure rapid, accurate adjustment of the industrial machinery used.

To characterize green and roasted coffee quality in a non-destructive way, CIRAD uses NIRS, and for over ten years now, it has been compiling spectral databases. In 2006, at the request of the Kraft Foods firm (Hérault, France), CIRAD developed a method for controlling coffee lots after roasting, using a near-infrared spectrometer tested under industrial conditions. The study, which received an award from the Ministry of Agriculture, served to determine the investment required in terms of equipment. ■

characterize green and roasted coffee quality in a non-destructive way

► Are you interested in coffee roasting?

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► MANGO QUALITY CERTIFICATION

The quality of the tropical fruits sold on the European market is very variable. Distributors are often faced with fruit lots at varying stages of ripeness, which complicates logistical operations, and the fruits are often tasteless.

To ensure more uniform quality in tropical fruit production chains, CIRAD is working to predict



Technology

► RAVENSARA AROMATICA ESSENTIAL OIL

Ravensara aromatica is a forest species endemic to Madagascar, which is grown by small-scale producers for the essential oil that can be extracted from its leaves and used in cosmetics. However, the species includes several chemical types, and some trees produce a toxic oil. *Ravensara aromatica* essential oil producers often see their products rejected by national collectors, resulting in a significant drop in their income when they have already extracted the oil.

identify undesirable trees while limiting the number of chemical analyses

To control oil quality before extraction, CIRAD and FOFIFA, the Madagascan agricultural research centre, are working to identify undesirable trees, while limiting the number of chemical analyses. They are looking into using NIRS to detect chemical types on dry leaves, based on data from a sample of trees also analysed in the conventional way. The results of the study should enable it to help producers choose suitable trees on their land. ■

► Are you interested in this essential oil?

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► CONSTRUCTION TIMBER RECYCLING

Wood preservatives extend wood durability by protecting it against insects, rot and the weather... However, before recycling treated construction timber (to make charcoal, for burning, etc), it is vital to identify the products used, as they may harm the environment. This requires time-consuming, costly chemical analyses.

CIRAD and the Sylvadour laboratory for applied research on wood and wood byproducts (Mont de Marsan, France), supported by the Landes Departmental Council, have shown that NIRS can detect the molecules used and treatment levels in

detect the molecules used and treatment levels in maritime pine

maritime pine. This shows that NIRS could prove useful for recycling firms in future. Nevertheless, the technique will have to be tested on the main timber species used for construction purposes. ■

► Do you want to recycle timber?

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► DATE LOT QUALITY

Aromatic compounds are useful fruit quality markers. To analyse those compounds, electronic noses, sets of metal oxide-based sensors that simulate the human nose, are another tool in addition to the NIRS technique. The data obtained rapidly produce a veritable olfactory identity card for the fruits analysed.

CIRAD is looking into the possibility of using this method, which can handle large volumes of samples, to characterize varieties and origins, using a system combining sensors and mass spectroscopy. To promote the dates produced in an oasis, CIRAD and the Moroccan agricultural research centre were recently able to differentiate between the particularly subtle aromas of nine date varieties of differing commercial value. The technique can be used to detect fraud, adulteration, contamination, etc. Small, portable types of electronic noses are available, comprising only specific sensors for the application in question. ■

characterize varieties and origins, using a system combining sensors and mass spectroscopy

► Are you interested in aroma detection?

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fruit flavour quality. For certain fruits, such as mangoes, which continue to ripen after picking, quality can be predicted based on their composition (sugar, acidity, dry matter, etc) at the time of harvesting, so as to select

introduce a mango quality certification system for consumers

fruit lots that will be flavoursome. NIRS can be used to measure those characteristics in green fruits, without destroying them. CIRAD is working with a mango wholesaler from the Rungis market near Paris to introduce a mango quality certification system for consumers keen on exotic fruits. ■

► Are you interested in predicting fruit quality?

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► A WOOD MECHANICAL CLASSIFICATION MACHINE

European legislation obliges sawmills to classify timber intended for construction purposes based on its mechanical characteristics (EN standard 14081-1). Visual classification is labour-intensive, and systematically underestimates wood mechanical performance. Mechanical classification machines exist on the market, but they were developed for large sawmills, and are a significant investment.

CIRAD has worked with the Lozère Chamber of Commerce and the Arfo Bois interprofessional association to develop an automatic classification machine using CIRAD's "BING" vibration measurement system. Certification tests were conducted on spruce and Douglas fir, in conjunction with the wood technology centre FCBA. The machine rapidly provides information on the mechanical resistance properties of wood samples. It is suitable for use by small and medium-sized sawmills. ■

the machine is suitable for use by small and medium-sized sawmills

► Do you want to classify construction timber lots?

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Bourbon pointu

Coffee growers in Réunion recently set up the "Bourbon pointu" cooperative. They have been working with CIRAD since 2002, to develop a premium coffee supply chain in Réunion.

Interview with Mr Josian Corré, administrator of the Bourbon pointu cooperative



© Bourbon pointu

○ What does the Bourbon pointu cooperative do?

Coffee growers have resumed growing Bourbon pointu, a coffee that is typical of Réunion, fruity, with no bitterness and very little caffeine. We currently produce around 2 tonnes of green coffee a year. The cooperative collects ripe cherries from farmers, takes charge of postharvest processing, and markets a coffee whose quality characteristics are specific to its region of origin. We sell 60% of what we produce on the local market, and the remaining 40% is exported to Asia, Europe and the United States, although we are unable to meet demand. Our plantings are currently being extended.

○ How did you come to work with CIRAD?

With the death of geranium growing on the island, the Réunion regional council asked CIRAD to help it re-launch high added value coffee growing. Frédéric Descroix, a CIRAD researcher, launched an experimental programme in 2002, backed up by the island's network of coffee growers, who helped to develop appropriate crop practices and processing techniques. It was the excellence of the initial results that prompted us to continue our efforts and to set up a cooperative.

Bourbon pointu at a glance

Nationality: French
Status: agricultural cooperative enterprise
Founded: 2007
No. of members: 30
Turnover in 2006: 50 000 euros
Field: premium coffee

○ How did you select this elite material?

Coffee was grown on Réunion in the 18th century and is still found in "jardins créoles". We therefore worked on coffee trees with the typical Bourbon pointu morphology. We selected cherries that contained less than 0.7% caffeine. Progenies of these mother trees were planted within the network to assess their performance in terms of quantity and quality. We selected promising lines and drew up a map of favourable growing areas.

○ Do you also control coffee bean quality?

We monitor quality all the way along the processing chain—cherry quality, bean carbohydrate, fat and caffeine content, etc—, using near-infrared spectroscopy (NIRS) and sensorial tests by a tasting panel, for each lot supplied to the factory. These controls are vital if the coffee is to be classed among the premium commercial grades, and in order to offer premium coffee buyers "grands crus", like for wine.

○ What are the most significant results of your collaboration with CIRAD?

The high point was seeing the Specialty Coffee Association of Japan list our coffee among the best in the world (worldwide premier cru in 2006), despite the fact that it was still at the experimental stage. We have also set up a tasting panel in Réunion that is now recognized by large-scale distributors in Europe.

○ Do you have any plans for new projects with CIRAD?

This is only the start. The supply chain is just starting out, and we need organizational and technical support in order to upsize from 2 to 6 tonnes of grand cru coffee. We intend to develop a sensor to measure coffee cherry ripeness, study the role of green coffee biochemical constituents in aroma formation, and develop a protected designation of origin.

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Cameroon

In Cameroon, CIRAD's research operations centre on ecological intensification. Its cooperation projects concern smallholder production dynamics and new demand on consumer markets as regards product quality and diversification: cocoa, cotton, oil palm, banana, plantain, fruit, aquaculture and market garden products. CIRAD is also involved in the development policy debate, and provides the private sector with support services.



► CIRAD in Cameroon

has a Regional Director and 20 staff members assigned to the *Institut des recherches agricoles pour le développement* (IRAD), the *Pôle régional de recherche appliquée au développement des savanes d'Afrique centrale* (PRASAC), the *Centre africain de recherche sur bananiers et plantains* (CARBAP) and the Center for International Forestry Research (CIFOR).

CIRAD builds its research methods in partnership with research users:

- in the North of the country, it is working closely with the *Pôle régional de recherche appliquée au développement des savanes d'Afrique centrale* (PRASAC), notably through a project to support regional research for the development of the savannas of central Africa (ARDESAC);
- in the South of the country, CIRAD is building a research platform in partnership, "Grand Sud Cameroun", in conjunction with IRAD and the Universities of Dschang and Yaoundé I, on integrated management of family farms in humid agroforest ecosystems. The platform includes a project aimed at building agricultural research partnerships in Cameroon (REPARAC).

Each year, CIRAD receives some thirty trainees from both Cameroon and France. It also participates in group training sessions on research-action in partnership, land resources, statistical data processing, etc.

► Main operating fields

- Support for export-oriented agroindustrial production chains: cocoa, cotton, oil palm, banana
- Local development and food security: management advice for family farms, research-action in partnership
- Sustainable management of natural resources: forests of the Congo Basin, agroforestry in cocoa-growing zones, fertility in cotton-growing zones, etc
- Food supplies to towns: market garden product supplies, product marketing, waste management

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