Metaprogramme SMaCH

Sylvie Colleu, Xavier Reboud, . Cellule de Coordination Du Métaprogramme Smach

OUR APPROACH

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- To build a scientific community by federating multidisciplinary research in the field of crop health and more particularly by integrating the fields of biotechnology and socio-economics. To initiate events for this community: symposia, seminars, researcher schools, etc.
- To contribute to the emergence of full-fledged disciplinary fields with academic visibility. To participate in expertise in these fields.
- To develop a framework for privileged interactions with our European and international partners (ENDURE action), to link with the European project PURE, international short courses, and the Inra-Cirad coordinated activities on IPM.
- To encourage dialogue between researchers and actors in agricultural development.
- To participate in the training of young scientists through research: hosting of doctoral candidates and postdoctoral fellows from other countries.

NB: Financial means are only attributed to Inra units (including joint research units and contract-based research units). The participation of external teams is nevertheless encouraged provided that they fund their own participation.

OUR MANAGEMENT

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The metaprogramme SMaCH is coordinated by Xavier Reboud under the responsibility of Inra's scientific director for Agriculture, Hervé Guyomard.
SMaCH is supported by a steering committee. This group is composed of Inra scientific leaders and support staff. It coordinates scientific networking and consultation with Inra researchers. It defines the program guidelines and organises the Request for Proposals.

- Plant Health and the Environment: Xavier Reboud (Coordinator), Marco Barzmann, AgnèsCalonnec, Christian Lannou, Antoine Messéan, Cindy Morris, Serge Savary, Jean-Claude Streito, Anne-Sophie Walker
- Science for Action and Development: Marc Barbier, François Coléno,
- Plant Biology and Breeding: Carole Caranta,
- Environment and Agronomy: Jean-Noël Aubertot, Marie-Hélène Jeuffroy, Christian Mougin
- Social Sciences, Agriculture and Food, Rural Development and Environment: Alain Carpentier,
- Support staff: Sylvie Colleu (program manager), Arnaud Ridel.

The Scientific Advisory Board consists of internationally renowned scientific researchers, and a member representing the Inra scientific advisory board. It is chaired by Inra's Scientific Director for Agriculture. The purpose of the board is to provide advice on the roadmap of the programme and suggest redirection if needed, and to play a key role in the identification of strategic partnerships.

• **Hervé Guyomard**,	Agriculture scientific director, Inra, France, chairman	• **Tim Benton**,	BBSRC, UK
• **Christopher C. Mundt**,	Oregon State University, USA	• **Brenda Wingfield**,	University of Pretoria, South Africa
• **Holger Meinke**,	University of Tasmania, Australia	• **Catherine Kling**,	Iowa State University, USA
• **David Sands**,	Montana State University, USA	• **Rebecca Nelson**,	Cornell University, USA
• **Tom Tomich**,	University of California, USA	• **Rients Niks**,	Wageningen University, The Netherlands

(2014 list)

EIGHT INRA METAPROGRAMMES THAT ARE CURRENTLY OPERATIONAL

- **SMaCH**: Sustainable management of crop health *(Coordinator: Xavier Reboud)*
- **GISA**: Integrated management of animal health *(Coordinator: Thierry Pineau)*
- **ACCAF**: Adaptation of agriculture and forests to climate change *(Coordinator: Thierry Caquet)*
- **MEM**: Meta-omics of microbial ecosystems *(Coordinator: Emmanuelle Maguin)*
- **DIDIT**: Diet impacts and determinants: Interactions and Transitions *(Coordinator: Jean Dallongeville)*
- **SelGen**: Genomic selection *(Coordinator: Denis Milan)*
- **GloFoods**: Study of transitions for global food security *(Coordinator: Alban Thomas)*
- **EcoServ**: Practices and services of anthropized ecosystems *(Coordinator: Guy Richard)*

KEY FIGURES SMaCH

A budget about € **5** million per year, including operational costs and salaries

25 projects launched, involving about **230** Inra scientists (2011-2014)

7 INRA scientific division involved: Plant Health and the Environment; Science for Action and Development; Plant Biology and Breeding; Environment and Agronomy; Forest, Grassland and Freshwater Ecology; Applied Mathematics and Informatics; Social Sciences; Agriculture and Food; Rural Development and Environment.

CONTACTS

Xavier Reboud: Coordinator
Sylvie Colleu: Program manager
www.smach.inra.fr/en
smach@inra.fr

METAPROGRAMME SMaCH

Sustainable Management of Crop Health

INRA SCIENCE & IMPACT

Rédaction : Cellule SMaCH / **Coordination** : Sylvie Colleu / **Création** : UCPC - studio de création - mars 2014

Sustainable Management of Crop Health

Plant health management that reconciles yield and sustainability for a growing planet

Xavier Reboud
Coordinator

"In today's complex climatic, demographic and energy context, agricultural research must deal with major issues on various scales. Therefore, with the metaprogramme SMaCH, we have initiated a new method of piloting research with an integrated approach. In SMaCH we work on the integration of multiple objectives. Our principal aim is to improve the health of cultivated plants while reducing the dependence on pesticides. Of course, we need in the same time to assess the long term economic, environmental and social dimensions of prospective solutions. For these purposes, we encourage the development of plant health management and risk forecasting tools that are scientifically validated and operational in the field. Finally, we cooperate with crop health managers, in order to facilitate the transition of agricultural systems towards low pesticide input and high productivity. We believe this method will help us to make progress on the current challenges facing agricultural research."

RECONCILE YIELD AND SUSTAINABILITY

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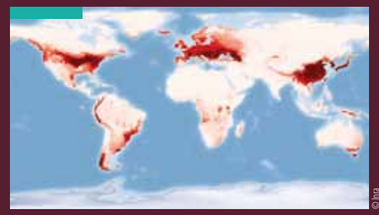
As the world population grows, controlling diseases and pests of cultivated plants can contribute to ensuring the quality and quantity of agricultural production. This entails the use of control methods other than pesticides and the development of environmentally-friendly strategies. The research challenge for the SMaCH Metaprogram is therefore to reconcile yield and sustainability.
To achieve this objective, it is necessary to develop new cropping systems and socio-economic organisations to support these innovations, and to focus on clarifying their benefits at the economic, social and environmental levels. This implies linking the numerous components, e.g. adapted plant varieties, the farming practices that support them, the spatial organisation of cropping systems and the development of a range of methods to diagnose and control the main pests. SMaCH places particular emphasis on the natural regulation processes that exist among the full spectrum of organisms that constitute the biodiversity of agroecosystems.

FAVOUR AN INTEGRATED APPROACH, HAVE A GLOBAL VISION



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Native from Asia, the Brown Marmorated Stink Bug could establish throughout the world.

SMaCH therefore favours research involving integrated approaches that bridge different disciplines including genetics, agronomy, ecology, and the social and economic sciences. To achieve this, Inra draws on the in-house skills that have been developed by its 13 Research Divisions and its previous experience in the coordination of national or European initiatives on this subject. The SMaCH Metaprogram aims to drive these research issues at an international level because they are of global importance.

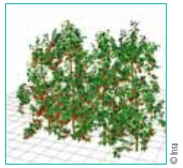
Members of the SMaCH community write books and publications to share scientific knowledge

OBJECTIVES AND RESEARCH

SMaCH is focused on five operational objectives

- To design and evaluate innovative cropping systems that may differ markedly from conventional systems, with a low use of pesticides and a high productivity
- To improve knowledge in agro-ecology, to exploit natural regulation mechanisms and to develop different facets of biocontrol
- To develop epidemiological surveillance and diagnostic tools
- To develop databases of validated findings that are shared within scientific and technical communities
- To initiate, stimulate, drive and support changes in farming practices partly based on grass-root innovations from farmers

The impact of plant growth management and crop architecture on pests and disease dynamics



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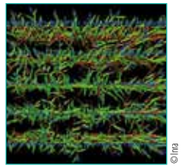

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The modification of plant growth can directly (in terms of resources) or indirectly (via micro-climate) modify fungal or insect development at the organ or plant scale. For wheat and grapevine, models show that the rate of leaf emergence and susceptibility, when modified by cultural practices, significantly reduces disease spread of fungi dispersed by wind or rain splash. For grapevine, the rate of disease spread is up to 4 times slower in plots with low vigour. For wheat in varietal mixture, disease is reduced by 45% after one season.
Microclimate models of perennial (apple tree) and annual (wheat and pea) plants, that take into account plant architecture, variation of temperature and wetness at the organ scale, give a more accurate prediction of risk of pathogen infection or larva survival. When simulating the climate change expected in 2100, spotted tentiform leaf miner mortality is 12% higher for pruned orchards than for unpruned ones.

A trial network of no-pesticide cropping systems

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In 8 locations in France, cropping systems using no pesticides and based on crops adapted to the region were designed and are being assessed in field trials. The aims are to maximise commercial production, to minimize the environmental impacts and to provide an acceptable profit for the farmer. The cropping systems were designed through workshops involving various actors including researchers and are based on alternative techniques from the literature or from farmers. A common set of measurements are assessed in all locations.

Spatial organization of cropping systems and semi-natural habitats as a means to manage crop health

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It is now clear that the spatial organisation of cropping systems and semi-natural habitats highly influence the size and genetic structure of pest populations. Management of this spatial organisation is a main means to favour natural regulation of pests. A study recently realised in north western France showed that the proportions of woodland and of grassland, in a radius of 1500 m from canola fields, significantly favours the presence of *Tersilochus heterocerus*, the main parasitoid of the pollen beetle, a major insect pest in canola. When the parasitism rate exceeds a certain threshold relative to the incidence of the pollen beetle, biological regulation is sufficient and allows the elimination of insecticide applications. In Normandy, insecticide application could be avoided in 62% of the cropping situations as a consequence of this spatial context.

Diagnostic advice on crop diseases via Smartphones: Di@gnoPlant®

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An Inra team has developed several plant protection applications to help the early and reliable identification of pests and diseases, and to enable an alignment of diagnosis with the most appropriate protection methods.
This project has two aims: to build a continuum of diagnostic/advice tools already accessible over the internet on the e-Phytia® Inra website and to make it available in the field using the new opportunities provided by Smartphones and tablets.
For tobacco plants, CORESTA (Cooperation Centre for Scientific Research Relative to Tobacco) has provided an English translation. Thanks to its worldwide networks and links with numerous organisations and universities, CORESTA will regularly supplement and improve the database. This free application already assists tobacco farmers all over the world.

A 10-year trial of IPM systems for weed control

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In 2000, the Epoisses research unit in Dijon initiated a long term experiment on weed control. The experimental set-up was composed of a traditional reference system and four trial systems: an IPM no-till system, an IPM system without mechanical weeding, a typical IPM system and a system without herbicide application. Every year the experimental set-up is visited by farmers and field technicians who observe the degree of weed control that is achieved in these different systems without herbicide.