ABSTRACT BOOK

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Scientific colloquium of the UEAA,

Paris, 12 October 2016

"Science in agriculture: historical perspectives and prospective insights"

Chairman : Professor Michel Thibier

and

Oral Presentations

at the 9 th General Assembly of

The Union of European Academies For Science Applied to Agriculture, Food And Nature

Paris, 11 October 2016

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"Science in agriculture: historical perspectives and prospective insights"
Chairman : Professor Michel Thibier

Part 2
IXth General Assembly of the Union of European Academies for Science Applied to Agriculture, Food and Nature (UEAA)
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Oral Presentations

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PROGRAM

Date	Session	Speaker and country	Title
Tuesday 11 October 2016 During the General Assembly session of the UEAA	**Tuesday afternoon** 14h30 – 17h30	D Gardner (UK)	Update on the 4D4F (Data driven dairy decisions for farmers)
		M Pais (PO)	Soil borne diseases
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Wednesday 12 October 2016 **Colloque Européen des Académies d'Agriculture on** **"Science in agriculture: historical perspectives and prospective insights"**	**8h15** **8h45**	**Accueil des participants** **Introduction,** par	
	Session 1 9h00 – 11h00 Chairman P Vialle	N Vivier (FR)	European Agricultural Societies, 1750-1900: experimenting and disseminating scientific progress
		P Brassley (UK)	The impact of agricultural science 1850 – 2016: from a gentleman's amusement to the saviour of the world?
		G Maracchi (IT)	Climate change and agriculture
		M Duponcel (EU)	Challenges of sustainable agriculture and food security – the contribution of EU research and innovation
	Coffee break: 11h00 – 11h30		
	Session 2 11h30 – 13h00 Chairman V Podrazski	D Couvet (FR)	Territorial management of natural resources: challenges for the Anthropocene
		R Matyssek & J-C Munch (DR)	Providing knowledge toward an improved biota supported soil management, an actual challenge
		B Rivza (LT)	Outcome and benefits of scientific research on development in Latvia
	Lunch: 13h00 – 14h30		
	Session 3 14h30 – 16h30 Chairman G Maracchi	A Ricroch & L-M Houdebine (FR)	Biotechnology in agriculture: solutions for our alimentation
		G Sin (RO)	The impact of science on Romanian agriculture in the last 20 years
		J-P Renard (FR)	Genomics and resilience
		L Sennerby Forsse (SE)	Future agriculture: in the minds of the next generation
	Conclusion: 16h30 – 16h45		

Part 1

Scientific colloquium of the UEAA, Paris, 12 October 2016

"Science in agriculture: historical perspectives and prospective insights".

« Science et agriculture : éléments historiques et perspectives d'avenir »

Chairman : Professor Michel Thibier

EUROPEAN AGRICULTURAL SOCIETIES, 1750-1900: EXPERIMENTING AND DISSEMINATING SCIENTIFIC PROGRESS

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By the middle of the eighteenth century, favorable conditions gave rise to the introduction of a scientific approach to agriculture. There were new economic theories (Physiocrats, Kameralists, Illustrados…); governments, aware of the need to increase production, set scientists to work (for example, in 1760 Duhamel du Monceau and Tillet were sent to the Angoumois to study the preservation of grains). In France, Bignon, secretary of the Académie des Sciences, asked scientists to study botanical taxonomy, animal breeds, diseases, pests, and forestry. Agronomy became a section of the Académie des Sciences.

As well as fundamental research, agricultural societies were created, in order to improve agricultural practice. This applied research was complemented by experimental stations. In European countries similar encouragements resulted in the flourishing of various agricultural institutions. Knowledge networks were highly active all over Europe, leading to the dissemination of publications, and debates about scientific findings and agricultural practices. The European knowledge network was supplemented by secondary national networks. Who was involved in this quest for agricultural progress? Those most renowned for their scientific work on agriculture became members of agricultural societies, and often they were also members of an Academy of Sciences. They were joined by senior clerics, administrative officers and large landowners who aimed at experimenting with new practices and testing their adaptation to local conditions of soil and climate. The revolutionary and Napoleonic wars temporarily broke the networks. From 1798 onwards, the French administration encouraged the revival of agricultural societies and the European networks were soon restored.

What changed between 1830 and 1870? The debates in agricultural societies turned from questions of land structures (use rights and distribution) to precise technical issues. The rise of chemistry produced many studies of plant nutrients and fertilizers; agricultural tools, and the selection of breeds and species were also investigated. Whether this progress arose from academies or from the agricultural societies, it became clear that only experts were now trusted.

One important shift was the desire to involve more farmers, in order to spread new practices such as rotations, by the creation of comices (local agricultural associations) in most of the European countries. Often created as a result of government incentives, they became very popular among the rural population in the 1850s.

It can be argued that during the period 1750-1850, science did not completely change agricultural practice; nonetheless important modifications were progressively introduced at every level, from large landowners to small farmers.

THE IMPACT OF AGRICULTURAL SCIENCE 1850-2016: FROM A GENTLEMAN'S AMUSEMENT TO THE SAVIOUR OF THE WORLD?

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The title of this paper is designed to be debatable and disputable. Was agricultural science merely an amusement for gentlemen in the middle of the nineteenth century, with the implication that its results were unimportant and that it had little impact? Is the world currently facing problems that only agricultural science can solve, so that its impact is potentially enormous? And if the answer to either question is 'yes', or even 'yes, to some extent, up to a point', what happened to change agricultural science from one state to the other?

One of the first problems we face in thinking about these questions lies in what Parolini (2015) calls 'the ambiguous definition of agricultural science itself'. At one extreme, it is no more than the knowledge and methodology of the pure sciences applied to agriculture. At the other it might be defined as experimental husbandry, in which agricultural operations are carried out, as far as possible, under controlled conditions, with the results being statistically analysed. The consequence of this ambiguity is a conflict over the purpose of agricultural science: is it for explanations of how agriculture works, or prescriptions, to tell farmers how they can make it work better? Another consequence is the difficulty of defining successful agricultural science, as Harwood (2005) highlights. Should it be measured by its effects on output or productivity, which will also be affected by many other factors, or by the extent to which agricultural scientists produced useful explanations of agricultural questions, irrespective of whether they affected the actions of farmers?

In fact, by 1850 the gentlemen were being replaced by the professionals in agricultural science. Thaer, de Saussure, and Mathieu de Dombasle, for example, were dead, whether we call them gentlemen or professionals, and landowning gentlemen such as Wilhelm Crusius, instrumental in the establishment of the Möckern experimental station near Leipzig in 1850, or John Bennet Lawes, who began experiments on his Rothamsted estate in 1843, might be seen as employers of scientists as much as scientists in their own right. By the 1890s there were 67 experimental stations in Germany, and 53 in France, although in Britain Rothamsted remained almost alone. There, and arguably also in Spain, the real expansion came in the middle of the twentieth century.

The extent to which agricultural scientists, as opposed to those who would identify themselves as pure scientists, or engineers working in associated industries, have been responsible for the major changes we have seen in agricultural technology, is something that we can debate. What is indisputable is that major changes have occurred, in crop and animal breeding, fertilisers, pesticides, animal health, mechanisation, and so on. They have not all been costless, as witness problems of water pollution and antibiotic resistance, inter alia. But when we consider global challenges such as climate change, or the problem of feeding 9 billion people by the middle of the twenty-first century, it is difficult to see how they could be met without some contribution from agricultural science.

CLIMATE CHANGE AND AGRICULTURE

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Climate change in the last twenty years put in evidence a strong variation in the general circulation of atmosphere. The increase of heat content of the ocean means much more energy than in the past and an increase of water vapor content of the atmosphere. The consequence of these processes due to the greenhouse effect was the increase in extreme event related to the energy and water vapor content of the atmosphere. Intensity of rainfall in the temperate area is increased of 900% in the last twenty-five years in relation to the data of the reference period 1960-1990. The extreme event that occur are mainly the rainfall intensity and consequent floods, the heat waves, the drought and the strong winds. Another important issue is related to the shift in the seasons with impact in spring on the vegetative calendar of crops, in autumn to the date of some cultural activity as the grapes harvest and always in spring on the anomalous development of insect generations and pest attack.

Agriculture interact with the problems of climate Change from three different point of view: the first as damaged by the intense events, the second as a partially responsible of the emission of CO_2, methane and nitrogen oxides, the third one, may be the most important, as the only activity that can give a positive contribution together with forestry to the reduction of greenhouse gases. The last one, considering a type of agriculture with less technical inputs, is related to the basic process of crop growth, the photosynthesis that is at balance 0, with the production of green energy and with a good management of soils.

This is a good reason for considering agriculture and forestry in a new perspective that is not only food production but even a way to manage earth in a viable way for the sustainability of the planet for the future generations.

If these assumptions are true we need: a good revenue for the farmers, innovation on the technical assessment and acknowledgement of the public service to the farmers.

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COPING WITH THE CHALLENGES OF SUSTAINABLE AGRICULTURE AND FOOD SECURITY – THE CONTRIBUTION OF EU RESEARCH AND INNOVATION

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The presentation is organised in three main parts. It first looks at the landscape of agricultural research in the EU and Member States with the objective to check whether it is fit to cope with the big challenges agriculture and food systems face. Budget resources, research intensity, synergies between EU and Member State research, research and innovation policy and other issues are discussed.

The presentation then turns to the main elements of the strategic approach to EU agricultural research and innovation which has been developed in the course of 2015-2016 and is meant to be implemented by the EU Framework Programme for Research and Innovation with a contribution from the CAP. The strategy is based on five priority areas: 1) resource management (notably soil, water, biodiversity); 2) healthier plants and animals; 3) integrated ecological approaches from farm to landscape level; 4) New openings for rural growth; 5) Enhancing the human and social capital in rural areas. The strategy identifies also five cross-cutting issues: systems approach to research; societal engagement; information and communication technologies (ICT) as an enabler; enabling research and infrastructures; socio-economic research and support for EU policies.

The last part of the presentation focuses on the European Innovation Partnership "Agricultural productivity and sustainability (EIP-AGRI) which aims to boost innovation in agriculture and rural areas and is implemented through both Horizon 2020 and the CAP. The EIP-AGRI mobilises an interactive innovation approach which is set in motion by a variety of measures or instruments under the CAP (at local and regional level) and Horizon 2020 (at transnational level). The so-called Operational Groups are the cornerstone of the EIP-AGRI under the CAP and support the development of innovations by groups of relevant actors. Horizon 2020 contributes to the EIP-AGRI with the implementation of the multi-actor approach in collaborative projects, aiming to involve all the actors in a process of co-creation of knowledge across all the phases of project formulation and activities. In addition knowledge exchange is facilitated by boosting requirements for outreach activities and providing support to transnational networks such as thematic networks.

TERRITORIAL MANAGEMENT OF NATURAL RESOURCES IN THE ANTHROPOCENE

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The term 'Anthropocene' has been proposed to qualify a new epoch, characterized by major environmental changes, in climate, biodiversity, soil and water, landscapes…. As a result, addressing social concerns, the United Nations defined 17 Sustainable Development (SD) goals. Agriculture is quite involved in these 17 SD goals. A major challenge for its stake-holders is that faster changes far beyond than those expected might be necessary.

Territorial policies should help stake-holders to increase their adaptive abilities, to navigate among the 17 SD goals, their synergies and also their contradictions. Extending the notion of 'positive energy territories', where the goal is energy self-sufficiency, notions of 'positive biodiversity, 'positive water', or a more inclusive notions like 'positive agriculture' territories could be proposed. Scenarios involving technologies, market-based instruments, state-led initiatives, or citizen movements, ought to be compared to achieve success in these policies, their ability to mobilize stake-holders.

The relevant spatial scale for these territorial policies remains a major question. Defined from a human view-point, relevant scales can be local, regional, national, European, and even larger. Any scale having advantages and weaknesses; lower scales being closer to citizens, but also having lower social and environmental diversity, being more exposed to external shocks. Relevant scales depend also on the efficiency of the institutions at the concerned scale, their abilities to manage political conflicts and responsibilities towards citizen within and among territories.

These territorial policies require also scientific and technical tools. Notions of socio-metabolism, indicators of social and environmental vulnerabilities, life-cycle analyses for products, integrated at the level of modes of consumption or territories. Indicators beyond GDP, noticeably human richness indicators should help to compare outcomes of different policies, scenarios. More generally, closer, denser, and more symmetric relationships between environmental sciences, society and technologies should help stake-holder to adapt.

PROVIDING KNOWLEDGE TOWARDS IMPROVED BIOTA-SUPPORTED SOIL MANAGEMENT – A TIMELY CHALLENGE

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The progress in soil use for warranting plant productivity has always been supported by augmenting knowledge. Particular efforts are fostered currently towards sustainable soil use, for which understanding of biotic components in plant-soil-ecosytems is crucial, requiring focus on the habitats of soil microbiota. Progress is based on molecular insights as well as on novel analytical approaches for exploring soils as physical habitats of microbial communities and fine roots by non-invasive techniques, overarching scales from soil microcompartments across plant canopies towards landscapes.

Beside the need for sustainable soil use, i.e. without degradatation, and by ensuring soil quality and conservation, we have to face new contraints by climate change and resource limitations, while being challenged by the feedings needs of the increasing human overpopulation. Soils being non-renewable and limited demand for paramount attention in warranting feeding needs and buffering global resource cycling. Hence, appropriate sustainable management requires consolidation of knowledge.

Soils consist of functional networks of biotic associations acting together with the physical environment. Energy input is given mainly by the vegetation, as some part of assimilates is not used by microbes for own energy gain, but to synthesize humic molecules, the glue of the soil structure and a main chemical buffer, essential for soil. This continous process of formation and stabilization of soil structure with 50 vol % of pores assuring aeration, gas exchange, water retenion, space for life, a prerequisite for soil stabilisation, depends on continued inputs of organic matter. Heterogeneity in biotic communities together with biodiversity are keys to ensuring biotic functions unter variable ecological conditions, determined by seasonal and management influences.

Organisms in soils support functions such as nitrogen fixation by bacteria, mobilization of nutrients by degradation of organic compounds and solubilization of minerals. They are in constant exchange with plant roots, promoting rhizobacteria as well as mycorrhizal fungi which altogether support plant growth by mobilization of nutrients and defence against pathogens and abiotic stress. All such aspects of biotic interactions are under investigation, enabling for activating biotic processes that help to reduce chemical inputs into soils. However, as habitat conditions shape biotic activities, integration of research on soil biotia and on physical conditions is mandatory.

Future constraints are given by extrem hydrological conditions in soils, waterlogging after heavy rain events as well as longer dryness. Adressed will be on free-air humidification experiments with side-effects of waterlogging on woody-plant systems. Climate warming will influence plant growth enhancing nutritional needs and soil respisration, while consuming organic matter. An additional constraint on forests and agricultural sites is the anthropogenic ozone increase in the lower troposphere. The consequently reduced photosynthesis and limited plant growth not only reduce yield, but also drive radiative forcing of the atmosphere and reduce the input of organic residues in soils, important for supporting biotic activities and warranting soil stability.

OUTCOMES AND BENEFITS OF SCIENTIFIC RESEARCH ON DEVELOPMENT IN LATVIAN AGRICULTURE

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The Latvian Academy of Agricultural and Forestry Sciences (LAAFS) was established on 4 June 1992. The LAAFS is a non-profit scientific organisation in which scientists, based on voluntary principles, are unified representing the following branches – agriculture, rural economy, veterinary science, food science, engineering sciences, food and wood processing. In total, the LLAFS unites 137 full members, all of them hold PhD degrees. The members have a considerable number of research papers published in international databases, inter alia, SCOPUS and Thomson Reuters and considerable experience in the implementation of scientific projects at both national and international levels.
The LAAFS is an active member of the Union of European Academies for Science Applied to Agriculture, Food and Nature (Union) and EURAGRI.

Representatives of the LAAFS closely cooperate with the Latvian Academy of Sciences Division of Agriculture and Forestry Sciences, and since 2006 a protocol of intention has been signed among the LAAFS, the Latvian Academy of Sciences and the Latvian Ministry of Agriculture of the Republic of Latvia.

The Latvian Academy of Agricultural and Forestry Sciences and the Ministry of Agriculture of the Republic of Latvia are involved in performing the following tasks:

1. Elaboration of suggestions for policy planners on the possible improvements in science and higher education;
2. Organisation of joint conferences, exhibitions and other activities for popularising scientific achievements;
3. Contribution to the preparation of new scientists by organising seminars on problems of doctoral-level study programmes and challenges, as well as by giving a possibility to doctoral level students to deliver reports in the meetings of the LAS and the LAAFS on their research results in the fields represented by the LAAFS;
4. Organisation of the competition of new scientists in the field of agricultural science;
5. Participation in activities held by the Scientific-consultative body of the Ministry of Agriculture;
6. Promotion of international cooperation;
7. Maintenance and development of the research database www.llu.lv.

Outcomes and benefits of our scientific research on development in Latvian agriculture are as follows:

1) International and national projects;
2) Books;
3) PhD theses in:
biology, economic sciences, agricultural sciences, forestry sciences and food sciences.

(*)**Baiba Rivza,** Professor, President of the Latvian Academy of Agricultural and Forestry Sciences.

BIOTECHNOLOGY IN AGRICULTURE: SOLUTIONS FOR OUR ALIMENTATION

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Biotechnology is the use of biological processes, organisms, cells or cellular components to be useful to any human purpose. Biotechnology is part of the toolbox to better respond and quickly to issues of healthy food, accessible to all in the context of climate change, and reconquest of biodiversity.
Crops, bred animals and microorganisms used for fermentation should be improved to be able to meet the world's growing demand for food in a permanently changing context. From the simple observation since the Neolithic period to the present genetic engineering including random mutagenesis since 1926 and the decoding of genome sequences in the 1990's, biotechnology is in a continuum of progress. During the last century, the genetic improvement using biotechnology contributed markedly to nourish populations and animals in rapid growth. The environmental impact of this agriculture method must be better controlled. The examples in agriculture are numerous and the perspective for the XXIst century appears promising. The devices for biosurveillance and the tools for anticipation are more and more precise and adapted, particularly thanks to the exploitation of Big Data for agriculture and climate.
In plant breeding, biotechnology allows a better knowledge of genomes, and associated to other tools or methods, a better exploitation of the genetic resources diversity (in gene banks). Biotechnology may give access to new genetic resources non-existent in the species (thanks to transgenesis) and to the acceleration of the genetic progress (by enhancing the efficiency of selection which is more and more based on genotype, but also by accelerating the process of selection). This progress allows food sovereignty, a reduction food and feed prices by lowering production costs, the creation of economic wealth, and a reduction of greenhouse gas emissions. Qualitative improvements as well as resistances to pests and diseases make it possible the limitation of pesticide use.
As far as animal productions are concerned, biotechnology is also extensively used. The first and likely one of the oldest techniques is artificial insemination which allowed an enhanced diffusion of the genetic progress (namely in the milk domain), thanks to the insemination of tens of thousands of cows by improver progenitors. In addition, it made it possible a better control of the selection schemes, the sanitary constraints, and the economic development. Later, the transfer of embryos from individual females allowed dozens of pregnancy per female favoring the transmission of more specifically female traits. Presently, genomic selection makes it possible to study criteria so far not accessible (resistance, adaptation, conformation…). This approach is compatible with the use of a great number of families thus reducing consanguinity risks.
The first transformations, namely of fermentations of the raw products to generate food, result more and more from biotechnology process: milk coagulation to obtain cheese is due to the addition of chymosin, a recombinant protein which is a substitute to an enzyme found in calf stomach. Yeast is extensively used to obtain wine, beer, and a number of microorganisms are a source of enzymes to prepare aliments.
The challenges of agriculture for the XXIth century are huge and the new available techniques are required to face this situation. Beyond GMOs which have been banished in a number of countries for political controversies, new techniques of genome edition such as CRISPR-Cas9 in 2012 open vast perspectives for human health and agriculture. Without implicating transgenesis, they allow the inactivation of unwanted genes or the replacement of an allele by another allele. Recent applications are already been proposed to generate plants as wheat resistant to pathogens or to accelerate the growth of some fishes (salmon and carp) or farm animals as pigs, as well as cow dehorning. These techniques are cheap and easy to use making possible the return of public laboratories, start-up and SMEs in innovative projects. To reach this goal, it is indispensable to adapt the guidelines and the evaluation of the products in Europe in order to avoid that these new techniques be restricted to large cultures, to some animals, and to a few big companies.

LES BIOTECHNOLOGIES EN AGRICULTURE : DES SOLUTIONS POUR NOTRE ALIMENTATION

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Les Biotechnologies utilisent des processus biologiques, organismes cellules ou composants cellulaires. Elles font partie de la boîte à outils pour mieux répondre et rapidement aux enjeux d'une alimentation saine, accessible à tous dans le contexte du changement climatique et de reconquête de la biodiversité. Les plantes cultivées, les animaux d'élevage et les microorganismes utilisés en fermentation doivent pouvoir être améliorés pour que leurs performances répondent à ces enjeux dans un environnement en constant changement. De la simple observation, pratiquée depuis le néolithique au génie génétique via la mutagenèse aléatoire depuis 1926 et le décryptage des génomes dans les années 1990, les biotechnologies s'inscrivent dans un continuum de progrès. Depuis un siècle, l'amélioration génétique grâce aux biotechnologies a fortement contribué à nourrir des populations humaines en très forte croissance mais aussi animales, au service d'une agriculture de production dont les impacts environnementaux doivent être mieux maîtrisés. Les exemples en agriculture sont nombreux. Les dispositifs de biovigilance et d'outils d'anticipation qui les accompagnent sont de plus en plus précis et adaptés, notamment grâce à l'exploitation de Big Data agricoles et climatiques.

En sélection végétale, les biotechnologies permettent de mieux connaître les génomes et associées à d'autres outils ou de méthodes de mieux exploiter la diversité des ressources génétiques (dans les banques de gènes). Elles permettent aussi d'avoir accès à de nouvelles ressources génétiques n'existant pas dans l'espèce (grâce à la transgénèse), d'augmenter la vitesse du progrès génétique (en augmentant la rapidité et l'efficacité de la sélection, qui devient de plus en plus basée sur le génotype. Ces progrès ont permis la souveraineté alimentaire, la réduction du coût de l'alimentation par la baisse des prix, la création de richesse économique et la diminution des émissions de gaz à effet de serre. Des améliorations qualitatives ainsi que des résistances limitent l'utilisation des produits phytosanitaires.

En ce qui concerne les productions animales, les biotechnologies sont aussi largement mises en œuvre. La première et sans doute une des plus anciennes est l'insémination artificielle qui a permis une diffusion accrue du progrès génétique (notamment dans le domaine laitier) grâce à l'utilisation de géniteurs améliorateurs capables d'inséminer des dizaines de milliers de vaches. Outre cet apport, elle permet une meilleure maîtrise des schémas de sélection, des contraintes sanitaires et du développement économique. Plus tardive, l'utilisation des transferts embryonnaires a permis d'utiliser la voie femelle pour transmettre le progrès génétique en permettant à une même femelle plusieurs dizaine de gestation au cours de sa carrière et en touchant des caractères plus directement maternels. La sélection génomique permet aujourd'hui de travailler sur des critères jusqu'alors inaccessibles (résistance, adaptation, conformation..) et sur de nombreuses familles réduisant ainsi les risques de consanguinité.

La première transformation, notamment les fermentations, bénéficie très largement aussi des biotechnologies : tous les fromages sont faits avec de la chymosine, une protéine recombinante substitut de la présure. Des levures améliorées sont utilisées pour la fabrication du vin comme de la bière et l'obtention d'enzymes utilisés pour la préparation des aliments.

Les défis du XXIème siècle pour l'agriculture sont immenses et les nouvelles techniques disponibles sont indispensables pour y faire face. Au-delà des OGM qui ont été bloqués dans certains pays par des controverses politiques, les nouvelles techniques d'édition de gènes comme CRISPR-Cas9 en 2012 ouvrent de grandes perspectives en agriculture. Sans recours à la transgénèse, elles permettent d'inactiver des gènes indésirables, d'obtenir des mutations dirigées ou de remplacer un allèle par un autre. Des applications sont déjà proposées pour rendre des plantes résistantes à des maladies comme chez le blé ou augmenter la croissance de poissons comme le saumon et la carpe ou d'animaux de ferme comme le porc, ainsi que l'écornage des vaches. Très économiques, faciles à mettre en œuvre et précises, elles rendent possible le retour des laboratoires publics, de start-up et de petites et moyennes entreprises dans des projets innovants. Pour que ces perspectives se réalisent, il est indispensable d'adapter la règlementation et l'évaluation des produits en Europe afin d'éviter que ces nouvelles techniques soient réservées à quelques très grandes cultures ou certains animaux et à quelques très grandes entreprises.

RESEARCH RESULTS AND THEIR IMPACT ON THE ROMANIAN AGRICULTURE

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The Romanian agricultural research is carried on in institutes (18) and stations (40) belonging to the Academy of Agricultural and Forestry Sciences and are located in different pedoclimatic areas.

The research work refers to field crops, horticulture (fruit growing, viticulture, vegetables growing), animal husbandry (including pisciculture), as well as the conservation of soils fertility, agrarian economics, mechanization, land reclamation, etc.

In the field of vegetal production, the research activity is focused on: the creation of better adapted cultivars to different crop conditions, with high productivity and resistance to drought and bad weather, diseases and pests attacks; the elucidation of some aspects on the genetic determinisms of some agronomic traits capitalized in the breeding works; knowledge of the physiological mechanisms involved into plants resistance/tolerance at thermic and hydric stress; the development of non-polluted / alternative crop technologies (crop rotation, soil tillage, sowing, fertilization, weeds, diseases and pests control, irrigation), based on physiology research and plant biotechnology, chemistry and soil biology; the development of integrated methods for weeds, diseases and pests control; the production of seeds and seedlings from the newly created cultivars, their multiplication, introduction and extension into the production activity; the improvement of food quality of vegetal products;

In the field of animal husbandry (bovines, sheep and goats), the main research activity is aiming to: the improving of genetic breeding methods and creation of more productive specialized lines for milk and meat production; the achieving of genetic prophylaxis by cytogenetic investigation in bovines; the increasing of the conversion degree of forage into animal products; the extension of reproduction and embryos transfer biotechnologies as well as to provide reproduction animals with high biologic value to farmers.

In the field of pisciculture, the research activity is focused on: acclimatization of some species from other geographic areas, original technologies of artificial reproduction, intensive breeding technologies and complex exploitation of aquatic bioresources.

In the field of food safety, the research has pointed out the factors that affect food quality (fungi and mycotoxins contamination, nitrates, acrylamide, dioxins and furani presence in the products and heavy metals in the packages), as well as for obtaining some aglutenic, hypoglucidic and hypocaloric foods or fortified with iron or dehydrated fruits.

Important research has been developed in the field of soil fertility by "soil - atmosphere - plant" relationship, remediation *techniques* for *soil contaminated with* petroleum *hydrocarbons* and *heavy metals*, soil quality monitoring programs for a sustainable management etc.

Important research is also dedicated to other issues regarding agrarian economics, mechanization, climatic changes etc.

The impact of research results on the Romanian agriculture consists in extending of newly created cultivars and livestock breeding into farmers practice, offering new knowledge concerning the crop technologies and animal husbandry, the efficient use of fertilizers, pesticides and irrigation water, yield preservation, animal feeding.

A permanent concern is given to the technology transfer by various activities such as: demonstrative plots, trainings and information meetings with farmers, publications, radio broadcasts and television etc.

GENOMICS, ROBUSTNESS AND RESILIENCE IN ANIMAL BREEDING: BREEDERS AT THE CENTRE OF THE GAME

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Genomics allows the selection of animals using the information generated from high density maps of molecular markers identified all over the genome. It offers a reliable mean to improve functional traits and allows the identification of candidate animal for selection before the recording of their own performances. Resilience refers to the ability of living organisms to adapt to stresses induced by changes in their environment. It deserves increasing attention because of global climate change.

Resilience can be characterized in animal breeding from the profiling of individual animal zootechnical performances. Such data can now be implemented with records of physiological parameters collected from friendly designed non invasive devices (captors). The size and accuracy of the resulting databases is crucial for computational research to define the ability of each animal to keep in equilibrium its physiological functions (homeostasis) despite changes in the farming management imposed by the strong constraints related to a changing environment. Conversely, these databases can be exploited by breeders for a higher reactivity in breeding management. This means that the participation of breeder is crucial to the development of a predictive zootechnical science where each animal within a herd becomes a key reference.

Predictors of resilience can be identified as a complement to genomic selection from epigenetic databases established by the repeated sampling of few cells of blood or tissues from a given animal. Epigenetics refers to the molecular mechanisms that mediate genome–environment interactions and are involved in the control of gene activities variations not based on differences in nucleotide sequences but on marks or imprints apposed on DNA and chromatin. In human medicine epigenetic information is now being used in conjunction with individual genetic counseling to prevent the occurrence of prevalent metabolic-dependent diseases such as diabetes or cardiovascular disorders. A similar approach, determining the individual epigenome of animals within a herd in could be used in conjunction with genetic selection for a better care to each individual resulting in an optimization of the genetic potential expression in a changing environment.

Ruminants such as cattle with both a long generation interval (2 to 6 years depending on the breeding management) and gestation period (nine months) are at the front of this new scientific challenge. This because the epigenetic marks apposed during the period of embryonic development that can be affected in response to maternal environment can induce lifespan effects on the expression of genes contributing to adult phenotypes. Moreover, they can also be transmitted to the next one or two generations from either one of the two parents, as a soft inherited intergenerational process contributing to phenotypical variability.

Beyond combining genetic and epigenetic databases, capturing at an individual animal level any type of information assembled into as many databases considered as pertinent to breeding, while computing applications are becoming more and more accessible to agriculture (big data), will extend the capabilities of breeders in better phenotypical measurements, modelization and execution. Connected breeders are able to fuel those databases with their daily observations. Providing they keep collectively an intellectual property on the information generated from computed analysis, they will remain at the center of the game.

GENOMIQUE, ROBUSTESSE ET RESILIENCE EN ELEVAGE : LES ELEVEURS AU CENTRE DU JEU

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La génomique permet de sélectionner les animaux à partir des informations obtenues à l'aide de cartes à haute densité de marqueurs moléculaires identifiés sur l'ensemble du génome. Elle offre la possibilité d'améliorer de façon fiable les caractères fonctionnels et d'identifier les animaux à sélectionner avant même l'enregistrement de leurs propres performances. La résilience désigne l'aptitude d'un organisme vivant à s'adapter aux stress induits par des changements de l'environnement. Cette aptitude fait l'objet d'une attention marquée en élevage notamment à cause du changement climatique en cours.

La résilience peut être caractérisée pour chaque animal à partir de l'enregistrement de ses performances zootechniques. Ces données peuvent être enrichies par des mesures de paramètres physiologiques recueillies à l'aide de dispositifs (capteurs) non invasifs. La taille et la précision des bases de données ainsi générées est essentielle pour définir par recherche informatisée, l'aptitude de chaque animal à maintenir en équilibre ses fonctions physiologiques (homéostasie), malgré les modifications dans la conduite d'élevage qu'imposent les fortes contraintes d'un environnement changeant. Dans le même temps, ces bases de données peuvent être exploitées par les éleveurs pour une plus grande réactivité dans la conduite de leurs troupeaux. La participation des éleveurs au développement d'une science zootechnique prédictive où chaque animal devient une référence clé, est donc essentielle.

Des critères prédictifs de la résilience peuvent être identifiés en utilisant des bases de données épigénétiques établies à partir de prélèvements réguliers de quelques cellules de tissus et de sang sur le même animal. En effet, l'épigénétique s'intéresse aux mécanismes moléculaires des interactions entre le génome et son environnement impliquées dans le contrôle de variations d'activités géniques qui ne dépendent pas de variations de séquences nucléotidiques mais de marques apposées sur l'ADN et la chromatine. En médecine humaine, l'information épigénétique est maintenant utilisée en association avec un conseil génétique individualisé pour prévenir l'apparition de maladies métaboliques importantes (diabète, maladies cardiovasculaires...). Une démarche similaire caractérisant l'épigénome des animaux d'un élevage pourrait être utilisée en relation avec la sélection génétique pour un suivi individualisé permettant d'optimiser l'expression du potentiel génétique d'un troupeau dans un environnent changeant.

Les ruminants comme les bovins dont l'intervalle de génération (2 à 6 années selon le type de conduite d'élevage) et la durée de gestation (9 mois) sont élevés, sont directement concernés par ce nouveau défi scientifique. Ceci parce que les marques épigénétiques apposées pendant la période du développement embryonnaire jusqu'à la formation des premiers tissus du placenta peuvent modifier l'expression de réseaux géniques déterminants le phénotype à l'âge adulte. Elles peuvent en outre être transmises à la première, voire la seconde génération, par l'un ou l'autre des parents, un processus d'hérédité molle intergénérationnelle qui participe à la variation des phénotypes.

Au-delà d'une utilisation combinée de bases de données génétiques et épigénétiques et alors que les applications numériques sont de plus en plus répandues en agriculture, l'enregistrement, dans des bases de données multiples, de tous types de données individuelles considérées comme pertinentes en élevage (big data) étendra de façon importante la contribution des éleveurs à l'utilisation de mesures phénotypiques, à leur modélisation et à leur traitement. Les éleveurs connectés peuvent fournir les bases de données à partir de leurs observations quotidiennes. S'ils conservent collectivement une propriété intellectuelle des informations générées par les analyses informatiques, ils resteront au centre du jeu.

FUTURE AGRICULTURE: IN THE MINDS OF THE NEXT GENERATION

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In October 23–25, 2015, twelve young students and practitioners, full of expectations, gathered at the Royal Swedish Academy of Agriculture and Forestry in Stockholm. They were to participate in a case-event called "UNIK Challenge".

A case-event is a pedagogic model for solving problems. The event takes place during a short period of time, hours or days. The idea is that the contestants work in groups made up by members whose knowledge and skills complement each other. The groups are allowed to use the internet and to talk to experts. The case-event is judged by a jury and a winner is selected.

The case-event of this year focused on widening the perspective and finding the path to a sustainable use of natural resources. The participants came up with four different case-solutions based on new thinking and a firm belief in the future. The viewpoint was the situation in the year 2050.

Group 1 tells the story about Matteo and Elsa who are engaged in a successful farming affected by climate change. A forest company developing new ways to use the woody raw material is also described.

Group 2 looks back at a growing world population during the last 50 years and gives an insight in how food production is secured for the future. It contains everything from electric tractors, and perennial rape seed to closed-loops and multi functionality. Collaboration with your neighbors also assures a more stable economy.

Group 3 talks about the milk producer Göte who, in the year 2050, runs a profitable company with the help of immigrants and new ideas. The critical factor here is sustainability that cuts across the whole society.

Group 4 presents nine basal conditions for sustainable use of natural resources and describes how we in the future with the help of a circular revolution have gone from resource utilization to resource management.
The winner of the event was Group 4.

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Part 2

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Paris, 11 October 2016

Past President : Professor Vilem Podraszky

President : Professor Michel Thibier

UPDATE ON 4D4F – DATA DRIVEN DAIRY DECISIONS FOR FARMERS

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The Data Driven Dairy Decisions for Farmers (4D4F) is a Horizon 2020 project with 16 partners from 9 European Countries. A number of the partners are UEAA members and the UEAA's network was instrumental in bringing the partnership together. The project will create a thematic network that will focus on the role which dairy animal and environmental sensors can play in collecting real time information to help make more informed decisions in dairy farming.

The network will develop a Community of Practice (COP) in which farmers, farm advisors, technology suppliers, knowledge exchange professionals and researchers will work together to debate, collect and communicate best practice drawn from innovative farmers, industry and the research community to facilitate the co-creation and implementation of best practice.

The results will be communicated to farmers via:

- Best Practice Guides
- Infographics
- Videos
- Standard Operating Procedures
- Farm Events
- Workshops
- Virtual Warehouse of Technologies

4D4F will work closely with EIP Agri (European Innovation Partnership Agriculture), and at member state level will work with appropriate existing and potential EIP operational groups. It will also publish an annual research prioritisation report.

These outcomes will facilitate farmers and farm advisors implement innovative sensor and data analysis technology, and promote its best practice. This will also lead to local peer to peer support to promote the adoption of data driven dairy decision making, resulting in a more productive and sustainable dairy industry.

http://cordid.europa.eu/project/rcn/200852_en.html
http://www.4d4f.eu

THE THREATENED EUROPEAN CHESTNUT – WHAT FUTURE?

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World forestry, in particular European chestnut forestry, face increasing challenges more and more associated to global changes. These changes causing natural catastrophes and forest fires significantly influence water availability and the increase / emerging of plant pests and diseases. As a consequence, forest species, in particular chestnut have to adapt or dye.

The present and future generations have to generate the knowledge required to understand the mechanisms underlying resistance / tolerance to biotic and abiotic stresses as a way to minimize the European chestnut forest decline, guarantee the ecosystem equilibrium, the sustainability of chestnut forestry with the associated sociological aspects.

In this presentation we will focus on the scientific advances resulting from the genomics, transcriptomics and metabolomics research on resistance /tolerance to *P. cinnamomii* and *C. parasítica* as well as well as on the understanding of the myccorrhizal association, in order to cope with problems resulting from biotic agents infections namely fungi and restore the European chestnut forest in a friendly manner. We will also discuss briefly a possible strategic approach to minimize emerging chestnut pests and diseases.

Key words :
European Chestnut, *Castanea sativa*, Global changes , resistance / tolerance, Biotic agents, Genomics, Transcriptomics, Mycorrhizal fungi.

CLIMATIC CHANGE – DANGER OR CHALLENGE FOR THE FORESTRY SECTOR

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Changing climate is considered to be a global threat by a large part of the scientific and political communities. As a result, many countries and the EU as a whole are imposing numerous regulations and limits based on projected climatic conditions. Many of these restrictions are related to forestry and forest management and are promoted by different governmental institutions as well as non-governmental organizations. Some of the proposals could have a substantial impact on forest management and other socio-economic aspects of forestry–society relations. As the forestry sector has the weakest political support among landscape-based activities, it is a frequent target of non-governmental and political lobbying.

Records indicate that there have been comparable or even larger climatic changes throughout history, even in recent decades, yet these periods of climatic change have had low if any *direct* social impact and have attracted little scientific interest. The causes of these changes are not completely clear, despite coinciding with CO_2 concentration in the atmosphere. The trends of both phenomena - an increase in global temperatures and in CO_2 - are presented as directly connected. Reacting to the prevailing interpretation of these trends, some segments of society aim to lower fossil fuel consumption as the main step to counter these trends. Ecological activists support this response by working to return the forest resource to a "natural" state. They seek to impose restrictions on forest use and to increase intervention in forest management. The demand for natural tree species composition and suppression of forestry activities have become almost a religion.

These activists, some scientists, and other do not fully appreciate that the "natural" state in Europe is a failing concept in many cases. This concept does not take into account the human impact over millennia, which has led to profound changes in forest structure since the Neolithic age - especially at lower elevations and on sites historically suitable for agricultural activities. Nor does it take into account long-term climatic change that may exceed projections in the next century. We have to keep in mind that today we are at the end of the "Little Ice Age" (ca. 1300 – 1900), which begs the question: Are observed climatic changes the result of the profound human impact, or is the Earth returning to the conditions of the "Medieval Climatic Optimum" (ca. 900 – 1300)?

Compounding these uncertainties is the threat to "traditional" Middle European forestry. Even-aged coniferous monocultures as well as pure stands of some broad-leaved species are vulnerable to many influences, both climatic (e.g., Norway spruce) and biotic (e.g., ash, alder, oaks). The goal would be more structured forest stands with a greater mixture of tree species, stocking levels, and age. "Traditional" forestry has known for centuries the appropriate methods to achieve more diverse stands. The problem lies in the "economic" point of view of many forest owners. Among the people taking a short-term view are those in effect in charge of state forests, which are currently being managed more by politicians than by foresters. A considerable challenge lies in trying to reverse the trends in thought and action that threaten forests' long-term capacity to provide ecosystem services. The forestry sector has a crucial opportunity to explain to society its capability to shift the forest status to the necessary composition and structure — if a reasonable societal need is agreed upon with an understanding of the appropriate time scale for implementation. Forestry itself is able to satisfy these demands, without the pressure or intervention of other interest groups. To achieve this target, the joint activity of academics, researchers, forest owners, and administration is imperative. In this collaborative aspect lies the greatest opportunity for our sector to meet society's needs while maintaining the tradition of long-lasting care for forests in Europe.

The sharing of experiences in forestry in other parts of the world is the next desirable step.

SCIENTIFIC AND INFORMATION SUPPORT OF USING SOIL RESOURCES IN XXI CENTURY

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The Ukraine has unique soil resources composed of black soil more than 60 % (21.3 million hectares) compared with 9 % in Europe and 1.8 % in the world in general. The soil of Ukraine is extremely varied and consists of more than 800 types of soil. Soil is the primary mean of agricultural production, regulates the quality of surface and groundwater, air composition, serves as a living environment for many organisms on land surface, and provides a favorable environment for people. Detailed and accurate information about the qualitative composition of soil is the basis of rational management of land resources based on differentiation system of crop rotation, fertilizers, processing, reclamation and other farming activities.

The main sources of information on the status of soil resources in Ukraine are materials of large-scale soil survey, soil monitoring, and agrochemical certification of agricultural lands which held under the scientific guidance of the National Academy of Agrarian Sciences of Ukraine (NAAS). Over the 85-year history of NAAS has accumulated a huge amount of data on soil properties of different regions of Ukraine - from the forest zone of Polissya and the Carpathians to dry steppes of the Azov Sea and the Black Sea. The database "Properties of Soils in Ukraine" is adapted for use of international SOTER methodology and contains information on more than 2000 soil profiles in the territory of the country and the application package for automated creation of digital maps for all soil parameters (more than 100). In fact, several dozens of thematic soil maps have been published in the National Atlas of Ukraine and the Soil Atlas of Europe. Stationary field experiments are the main source of scientific information and a special type of scientific (prognostic) soil monitoring, conducting by research Institutions of NAAS in different soil and climatic zones of Ukraine. At this time 89 stationary field experiments are carried out in Ukraine.

Since the beginning of market reformation in Ukraine under scientific support of NAAS nearly 30 million hectares of agricultural land donated in the population's property. However, in the process of land reform appeared problems that led to incoordination of land management in Ukraine. As a result, rates of degradation processes are increased: erosion, acidification, salinization, nutrient depletion, etc. According to the assessment scientists of NAAS, the area of degraded and marginal soils in Ukraine reaches 8-10 million hectares, and the annual loss from main types of soil degradation is about 1.5 billion €.

In such circumstances, NAAS, as the leading scientific organization in the agricultural sector, has taken the lead in improving the information, legislative and methodological support of soil conservation. Information about the increasing soil degradation was published in the National Report on the State of Soil and Its Fertility in Ukraine. A number of legislative initiatives was prepared, including the draft of the Law of Ukraine "On the Conservation of Soils and Protection of their Fertility," National Action Plan to combat degradation and desertification, approved by the Cabinet of Ministers of Ukraine on 30 March 2016, the draft of the National Program of Rational Use and Protection of Soil Resources of Ukraine, the National Report on Land Reform completion.

Further prospects of NAAS are closely linked to international cooperation. In response to the initiative of the Global Soil Partnership (FAO, 2012) on the establishment of the International Network of Soil Information Institutions, with the support of Ministry of Agrarian Policy of Ukraine and Ministry of Environmental Protection of Ukraine, the main profile Institute of NAAS was identified as an Interdepartmental National soil-information center of Ukraine.

The next step should be the support of mutually information exchange with leading European research centers, preparation of joint projects, scaled soil surveys, modeling and forecasting of soil resources. With highly skilled scientific staff and extensive experimental network, NAAS is open for fruitful collaboration in this direction.

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