



cra-w

Walloon agricultural research centre



ACTIVITY REPORT
2013 / 2014 / 2015



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Foreword

Publication of the CRA-W 2013-2015 Activity Report represents a significant milestone for this institution. While this report is of course an opportunity for us to present the main activities during the period under review, it is also and above all our first assessment of the implementation of ecologically intensive agriculture, which has become the backbone of CRA-W's research programme.

As part of CRA-W's overall scientific objectives, ecologically intensive agriculture aims to produce more and better with lower input, by using natural mechanisms and increasing the use of ecosystem services in the production function. The environment thus becomes a lever for innovation, rather than a constraint. Integrated into CRA-W's research programme since 2013 and also part of the Walloon Agricultural Code, ecologically intensive agriculture requires in-depth understanding of the interactions between all the components of agricultural ecosystems at all levels of production in order to be used effectively. The aim is indeed to give the ecological component of agriculture a greater role. This has led to the adoption of three main lines of research and development:

1. Integrated, dynamic management of production factors
2. Managing risks and adapting to changes
3. Managing and developing production

This research programme was initiated and led by Jean-Pierre Destain, Acting Director General of CRA-W until 30 September 2014. All the staff would like to take this opportunity to thank him for the remarkable and profound work he did in developing the essential role played by scientific agricultural research in multifunctional agriculture, which is integrated with the countryside and helps to maintain farm competitiveness, conserve the environment and enhance the image of agriculture.

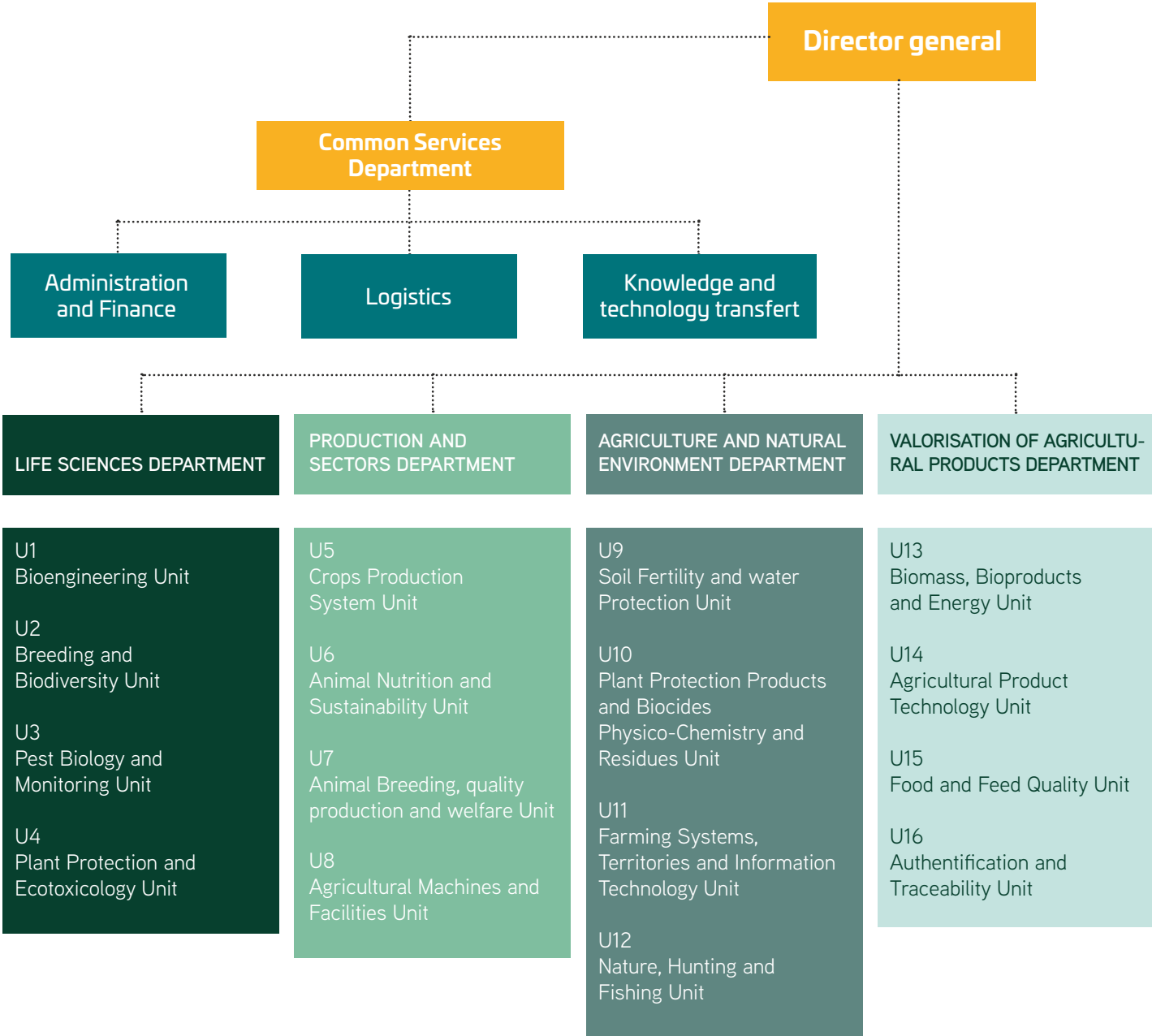
This report does not claim to be an exhaustive review of the Walloon Agricultural Research Centre's activities. It highlights some notable achievements which illustrate the Centre's strong points and also shows the importance for a scientific institution of maintaining a balance between producing knowledge and generating know-how that will meet producers' requirements and society's expectations in both the short and the long term. CRA-W's activities and results are described in full on our website (www.cra.wallonie.be), which readers are invited to visit.

Finally, I want to emphasize the dynamism and openness of CRA-W's research and support teams, at regional, national and international level, in difficult budgetary and staffing circumstances. I would like to thank them most sincerely.

Yves Schenkel
Deputy Director General



Organisation chart of CRA-W



TRANSVERSAL RESEARCH UNIT IN ORGANIC AGRICULTURE

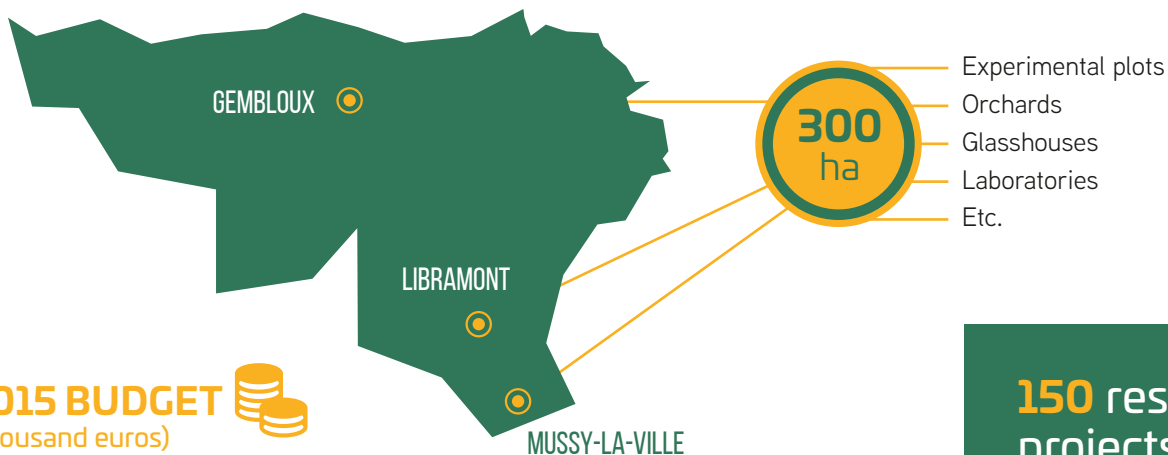
CRA-W IN A FEW FIGURES

FOR REFERENCE YEAR 2014

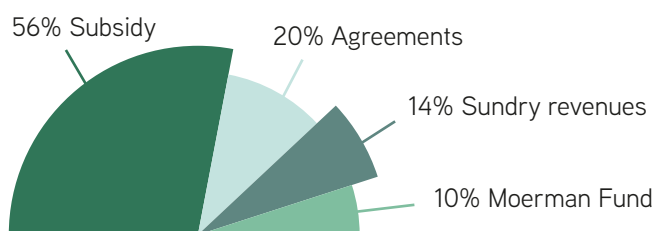
432 Staff including **120** Scientists



3 SITES



2015 BUDGET
(thousand euros)



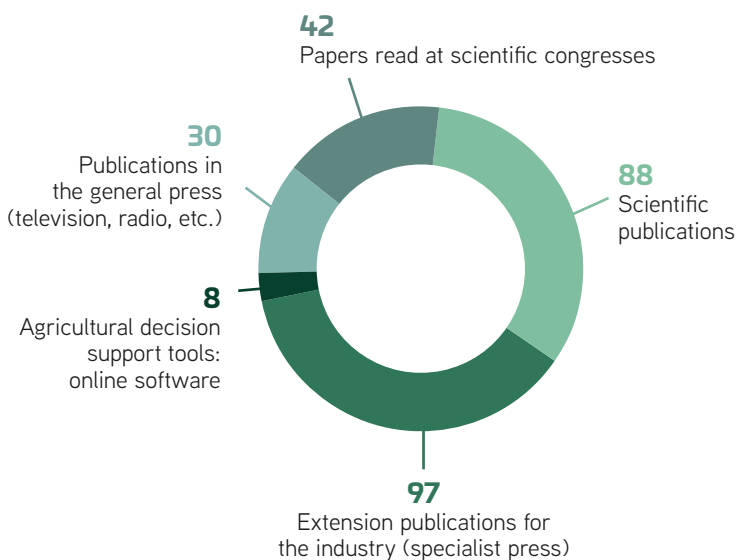
150 research projects

- Regional
- National
- European



CRA-W PUBLICATIONS 2014

Details of all the publications can be found on the CRA-W website.



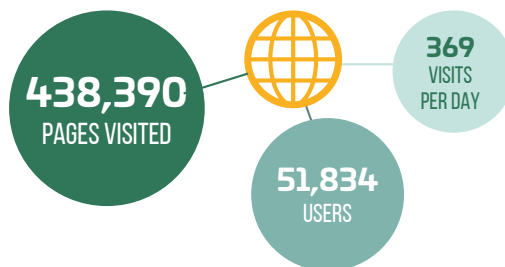
Distribution of CRA-W's quarterly newsletter,
CRA-W INFO = 4 ISSUES/YEAR

Each issue:

- **PAPER VERSION: 1,000 PRINT RUN** (subscribers, conferences, fairs, etc.)
- **ELECTRONIC VERSION**, on our website (French and English), with a list of **1,500 SUBSCRIBERS** (French version) and **3,500 SUBSCRIBERS** (English version).

WEBSITE STATISTICS

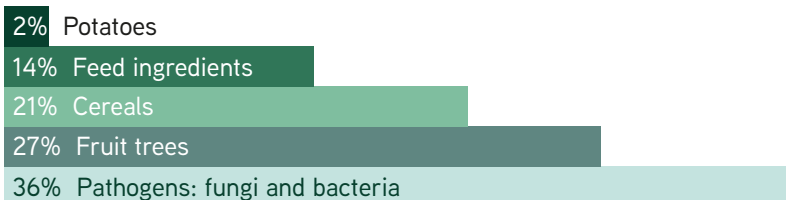
www.cra.wallonie.be



COLLECTIONS

CRA-W maintains and develops

14,478 living elements in the collections



EVENTS, APPEARANCES AND OTHER EXTERNAL COMMUNICATIONS

CRA-W HAS ORGANISED OR CO-ORGANISED

42 symposiums/ seminars/congresses/ conferences bringing together **10,709** people from the worlds of science or agriculture.

23 tours of trial sites, laboratories, orchards and demonstrations bringing together **4,914** professionals from the agricultural or horticultural sectors.

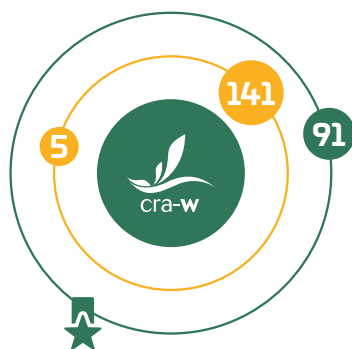
CRA-W HAS COOPERATED WITH ITS PARTNERS IN

52 symposiums/ seminars/congresses/ conferences bringing together **65,344** people from the worlds of science or agriculture.

CRA-W HAS ATTENDED

Fairs and exhibitions, national or international, general public and trade: **20** attendances

CRA-W AND ITS INFLUENCE



141 consultancy or representative **ASSIGNMENTS** at national and international level with **91** organisations

5 doctoral **THESES** in 2014

CRA-W's **services** are **officially recognised**, as evidenced by **ACCREDITATIONS/CERTIFICATIONS** to international standards.

73,178

analyses/studies/inspections carried out by CRA-W's accredited laboratories.

70,957 analyses and studies



2,221 inspections

15 **ISO 17025 LABORATORIES** for laboratory tests + **1** additional lab compared with the previous period

2 **GOOD LABORATORY PRACTICE (GLP) LABORATORIES**

1 **ISO 17020 SERVICE** for sprayer inspection

1 **CPVO-RECOGNISED EXAMINATION OFFICE** for cereal testing: DUS (Distinctness-Uniformity-Stability) tests



Common Services - a vital part of CRA-W

The Common Services Department's mission is to support the research departments, harmonise the Centre's administrative and financial management, provide logistical services to underpin its development, and exploit research results more effectively. The Department has a team of fifty people and comprises three sections:

- Administration and Finance
- Logistics
- Knowledge and Technology Transfer

Like the rest of CRA-W, the Common Services Department suffers from chronic understaffing, which hampers it in performing its supporting role. Nevertheless, over the 2013-2015 period the Department duly provided the Centre's essential services.

Within **Administration and Finance** the Personnel Department (human resources and financial management) carried on its staff career management activities (hiring, recruitment, promotion, retirement) as well as staff payroll administration. The contract worker hiring processes have been improved and the Capello programme (retirement scheme) was successfully managed. The Accounts unit closed the accounts for the 2007, 2008 and 2009 financial years, enabling CRA-W to make up some of its backlog. These accounts have been checked and audited by the Audit Office. The Accounts unit then turned its attention to the accounts for 2010, while continuing its day-to-day accounts management work.

Logistics, through its Facilities unit, manages the buildings owned by CRA-W since January 2015, the associated technical equipment, and the environment and waste. Maintaining the Centre's properties and upgrading them to current standards is a huge task and one which is progressing and regularly growing. An environmental policy has been established and is put into practice as part of a quality initiative.

Finally, in cooperation with the Health & Safety unit, a daily action plan has been drawn up for monitoring logistics and welfare at work activities. Within Logistics, the IT unit is in charge of administering and managing CRA-W's facilities and computer systems as well as overseeing data processing security and incident traceability.

The Communications unit designs and maintains the Centre's external and internal communication tools. The quarterly publication CRA-W info provides brief information and concrete results of research and services. It is aimed at a wide readership of industry players, agricultural support and advisory bodies, businesses, scientists and administrators. New content is added daily to the website <http://www.cra.wallonie.be>, the intranet and the Centre's Facebook page, which are constantly adapted to users' needs. CRA-W maintains its public profile in all the sectors relevant to its expertise through the papers presented by its scientists and technicians and by organising conferences, tours, seminars, etc.





Within **Knowledge and Technology Transfer** the Quality Improvement Office has made significant progress in self-assessment of activities and the quality management system (and, more recently, the environmental management system), notably:

- Introduction of a general management review which since 2015 has included an assessment of environmental performance (ISO 14001);
- Establishment of a new QHSE policy comprising Quality, Health, Safety and Environmental Management aspects;
- Accreditation of four new internal auditors, thus enabling a pool of 15 internal auditors to be maintained for the whole of CRA-W;
- Setting up, in cooperation with the Communications Unit, of an online customer satisfaction survey for our test laboratory customers.

Also, with a view to continuously improving the operation of CRA-W as a whole, the setting up of a participatory scheme for personnel, launched by the Quality Improvement Office at the end of 2012 with the ICARE project (integration of and self-assessment framework for research) is currently taking the form of action plans drawn up on the basis of improvement challenges identified by the Synapse[®] method within the IT, Logistics, Personnel and Purchasing platforms, each bringing together about fifteen people drawn from the scientific units and from Common Services (support) and led by the Quality Improvement Office.

RESEARCH TOPICS



**INTEGRATED,
DYNAMIC
MANAGEMENT
OF PRODUCTION
FACTORS**



Aim 1.

Safeguarding, analysing and utilising plant and animal germplasm in order to identify and improve varieties and breeds to meet industry expectations

The genetic diversity of plant and animal species is a valuable biological resource for adapting agriculture to social and environmental constraints such as product diversification, environmental intensification and adaptation to global changes. In this context the aim is to optimise the conservation methods applied to quality plants and animals and to better understand the physiological and molecular mechanisms that determine genetic improvement processes. Assessing the adaptability of new plant varieties and animal breeds to Wallonia's production conditions also forms a major part of the Centre's activities aimed at meeting industry expectations. The analyses draw on genetic resources, on the one hand, and various disciplines belonging chiefly to bioengineering, crop husbandry strategies and plant breeding, on the other. Notable examples are spelt and potatoes as field crops, apple trees, cherry trees, strawberries and Christmas trees as horticultural species and other woody plants as biomass sources.

SÉRÉNITÉ: THE NEW SPELT VARIETY OF HIGH BREADMAKING QUALITY

In the context of the spelt improvement programme the germplasm is regularly assessed to identify valuable characteristics, in particular disease resistance and breadmaking quality. The successful combination of two CRA-W varieties with a local strain led to the Sérénité variety being registered in the Belgian catalogue in 2015. A spelt variety of high breadmaking quality is now available to the industry. This variety has the highest Zeleny index and the highest Chopin W value on the Belgian market.

Sérénité also offers good disease resistance and a good, stable yield, these being key agricultural criteria for farmers. Seed production began in autumn 2015. Sérénité will be available from all Belgian cereal seed producers and will be marketed in France by Lemaire-Deffontaines.

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PHENOTYPING VARIETY RESISTANCE TO THE ORANGE WHEAT BLOSSOM MIDGE

Despite its low profile, the orange wheat blossom midge is the commonest wheat pest in this part of Europe. The larvae feed on the growing grain, to the detriment of the yield and crop quality. Using resistant varieties is an effective means of controlling this pest.

The work undertaken by CRA-W since 2005 has resulted in a good understanding of the midge's biology. Thanks to the progress made, the emergence of young adults ready to lay can now be spread throughout the wheat heading period, in controlled conditions. This makes it possible to test resistance in glasshouses where, irrespective of earliness, the varieties are subject to homogeneous pressure from the pest. The tests have been perfected since 2012 and are now open to breeders. They are recognised by the variety registration authorities in several countries as a special experiment.

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GENETIC DIVERSITY OF WALLONIA'S POULTRY BREEDS

95% of domestic fowl breeds in Belgium are endangered. With local breeds owing their survival, and sometimes even their revival, to the passion of committed fanciers, the result may be damaging consanguinity, leading to a need to assess the existing diversity.

Genetic analysis was performed on 175 local fowl in Wallonia that were as unrelated as possible. This showed an almost perfect juxtaposition between the 10 breeds selected for the purpose and 10 separate groups. 93% of the poultry were linked to their breeds. While Walloon breeds were found to be more diversified than other local breeds in Europe, their consanguinity is at the same high level. The explanation lies in the low number of such poultry and their distribution over a limited number of farms.

With a view to preserving local breeds while at the same time minimising inbreeding, an initiative has been formalised with the Poule de Herve Breeders Club aimed at setting up a conservation network according to a rotational design (D GARNE project).

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Aim 2.

Studying the processes involved in natural cycles and identifying agricultural practices and systems compatible with developing ecologically intensive agriculture



NO-TILL AND DIRECT DRILLING: PRECISION SERVING THE ENVIRONMENT

No-till farming is frequently mentioned as a way of maintaining or indeed improving soil fertility. However, it does not suit some crops, such as beet and maize, which require high-energy de-compacting of the arable layer. One new alternative is the strip-till method, in which the soil is tilled at medium depth along the seed row only. Using this technique in sugar beet cultivation results in poor seed bed preparation, adversely affecting the emergence rate and stunting the seedlings, with repercussions on yields. Various ways of overcoming this problem were tried, such as tillage in late autumn rather than at sowing time, deposition of the fertiliser at the bottom of the furrow, combining strip-till with additional surface tillage, or pressing the seed row.

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ORANGE WHEAT BLOSSOM MIDGE EMERGENCE FORECASTING MODEL

Despite its low profile, the orange wheat blossom midge, whose larvae feed on the growing grain, can cause significant yield and quality losses in wheat crops. The extent of the damage depends on the intensity of the flights and how closely they coincide with the wheat's susceptible stages.

The work undertaken by CRA-W since 2005 has resulted in the publication of a model for forecasting the adult emergence period. The ability to forecast pest emergence is crucial in determining the agricultural risk and is an important asset in integrated pest management. The model can also be used to predict the emergence of *Macroglenes penetrans*, the orange wheat blossom midge's main parasitoid. The latter plays a decisive role in integrated management by developing inside the host and killing it at the final stage of development.

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INDUSTRIAL HEMP, A NEW SECTOR FOR WALLONIA

Hemp has regained respectability in Wallonia through applications that combine innovations with agricultural and environmental benefits. Industrial hemp growing in Wallonia has in fact increased from 6 ha in 2007 to 405 ha in 2015, with more than 80 producers, and a target of 1,000 ha by 2020. This development has been made possible by local support (surveys, meetings, research, monitoring, etc.) by the Walloon hemp association, asbl Chanvre wallon, and CRA-W and also thanks to the dynamism of the processors operating in Wallonia: ChanvrEco, PurChanvre, IsoHemp and the BELchanvre agricultural cooperative, established in 2012. CRA-W's activities have resulted in the development of a crop guide, new harvesting systems, a network of players, a new website (www.chanvrewallon.be) and methods for analysing product quality.

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Aim 3.

Physico-chemical characterisation and agricultural management of plant protection products and biocides to limit the risks to the environment and the food chain

GETTING THE AIR TO TALK AS A WAY OF UNDERSTANDING WHEAT DISEASES

Like pollen, the spores of wheat pathogenic fungi are microscopic particles that spread by travelling through the air. Little is known about their airborne habits, and so the disease development forecasting models cannot predict when infections will break out in a field of wheat. The point is that by the time the symptom appears the plant is already infected and some of the yield potential has already been lost.

CRA-W attempted to measure spore movements for the main wheat pathogens before the plants were infected. This was done by establishing spore sensors in a network throughout Wallonia's main field crop growing areas which were connected to weather stations, enabling the spore concentration in the air for each of the main wheat diseases to be assessed daily. Trials were set up in the vicinity of each sensor to monitor the emergence and development of disease and to test protection methods.

This approach resulted in significant progress in understanding the epidemiology of wheat glume blotch by showing that the epidemiological phase includes sexual cycles that produce spores which are dispersed by the wind and can directly infect the upper leaf levels, in addition to spore dispersal by rain splashes. Also, the profiles obtained for brown rust of wheat showed us that the aerial inoculum could be a limiting factor in the development of severe epidemics in our region.

Ultimately, considering the aerial inoculum would make it possible to refine the seasonal advice given to farmers, allowing them to adjust the protection to the threats measured... in the air!

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CRA-W WORKS MORE CLOSELY WITH INTERNATIONAL ORGANISATIONS TO REDUCE THE RISKS OF PESTICIDE USE

In the last two years CRA-W has stepped up its cooperative links with international organisations such as the WHO, FAO, the Global Fund to Fight AIDS, Tuberculosis and Malaria, the United Nations Development Programme (UNDP) and the Collaborative International Pesticides Analytical Council (CIPAC). This comprises various activities, such as developing lines of conduct and reference documents, drawing up physico-chemical specifications published by the WHO and FAO, developing new analytical methods, pesticide quality control and arranging training and conferences on all these aspects.

CRA-W is more determined than ever to continue this work with the unwavering aim of improving pesticide quality and reducing the risks to public health and the environment.

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Aim 4.

Managing livestock farming systems with a view to improving sustainability



POST-WEANING PIGLETS' VALINE REQUIREMENTS

Economic and environmental constraints are reducing the dietary protein content for piglets, whose performance can depend on a number of amino acids (AA). Synthetic AA like lysine (Lys), methionine, tryptophan and threonine are commonly used to counter this. Apart from these AA, valine (Val) is also limiting in such conditions, but the scant data in the literature need to be corroborated.

Two trials have been conducted in cooperation with ORFFA Belgium and Ajinomoto Eurolysine to validate the Val level that optimises growth in a newly weaned piglet fed low-protein rations. The first step was to verify that a level of 0.95% standardised ileal digestible (SID) Lys and a Val/SID Lys ratio of 60% were limiting in post-weaning piglets (Trial 1). Then, a Val dose-response test on post-weaning piglets was carried out to establish the Val/SID Lys ratio that optimizes expression of the growth potential (Trial 2).

Trial 1 showed that a low-protein diet deficient in Lys and Val restricted animal performance. Performance was improved when the diet was supplemented with those AA. Trial 2 established the optimum Val/SID Lys ratio for expression of the animals' growth potential in these conditions as being about 70%.

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SHOULD ENTIRE MALE PIGS BE HOUSED IN MIXED FATTENING STALLS?

Live surgical castration of piglets is routinely carried out on European farms. It is a means of preventing undesirable boar taint in pork meat. However, the practice is now being questioned because of the pain caused to the piglet. One alternative being considered is producing males (entire male animals). This is attractive from the point of view of production performance and economic benefits for farmers.

Farmers often ask about the advisability of mixing males and females in the same pen. They want to know what impact this would have on managing animal behaviour, performance levels and carcass and meat quality, including the risk of boar taint. To provide some answers an experiment was conducted on 264 pigs fattened to a live weight of about 115 kg.

As regards production performance, carcass and meat quality, behaviour and injuries, mixed housing appeared to favour the males overall. It limited the serial disturbance effect found in all-male fattening groups and reduced the instances of mounting and, thus, the injury scores. Females, on the other hand, appeared to suffer somewhat from cohabiting, as their injury scores were higher. Also, there were instances of gestating at slaughter and that presents an ethical problem.

With regard to boar taint, mixed housing increased the risk of undesirable odour as determined by measuring the androstenone and skatole content of a fat sample. Carcasses containing these substances at levels higher than 2 ppm and 0.2 ppb respectively (carcasses removed from the fresh food chain) represented 12.5% in the case of males fattened with females as against 6.5% for single-sex males. This boar taint level appears relatively high compared with the average values of 3 to 5% usually quoted.

Contact: José Wavreille, j.wavreille@cra.wallonie.be

Aim 5.

Characterising and assessing the impact of agrosystem management methods and rural development policies on the production of ecosystem services

RECONCILING PRODUCTION AND REGULATORY SERVICES, A CHALLENGE FOR SUSTAINABLE MANAGEMENT OF PERMANENT GRASSLAND

In the context of sustainable agriculture, the ecosystem approach identifies all the services linked to an ecosystem and points up the need to find a compromise between production services and regulatory and cultural services.

Flora monitoring by the De Vries method in 28 hay meadows spread throughout Ardennes, Famenne and Pays de Herve indicates that the average floristic diversity, in terms of species significantly in abundance, in the less intensive grassland cut after 15 June is close to that of the high biological value grassland and 1.5 as great as that occurring in the intensive hay meadows. A few grasses predominate in the latter, namely perennial rye-grass (*Lolium perenne*), cock's-foot (*Dactylis glomerata*) and tufted grass (*Holcus lanatus*). In the less intensively managed plots these grasses are accompanied by a number of legumes such as red clover (*Trifolium pratense*), white clover (*T. repens*) and tufted vetch (*Vicia cracca*). In comparison with the intensive grassland, the average pastoral value of this less intensive, more diversified grassland is maintained, unlike the high biological value grassland, the pastoral value of which is declining significantly.

With a view to reinforcing the regulatory services while preserving a quality forage production service, less intensive management of the permanent grassland allowing legumes to develop is an asset, in view of their positive contribution to both grassland fertility and carbon trapping, while at the same time providing important food sources for pollinators.

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MAPPING MARGINAL GRASSLAND IN WALLONIA

This study involves using a Geographical Information System to determine the role of marginal grassland in Wallonia.

Grassland provides a number of ecosystem services related to its management and place in the countryside, but grassland can also compete with food crops. That makes it expedient to determine how much of that grassland is marginal, that is to say, where the soil and weather conditions limit the development of crops or where tillage would involve undue environmental risks (erosion, loss of biodiversity, etc.). Having determined and located such 'marginal' grassland it would then be possible to define the status of cattle farming in the countryside.

We have used three criteria to map this marginal grassland:

1. the ecosystem service provided by permanent grassland in controlling erosion;
2. the suitability of the soil for crops;
3. the areas of biological interest.



Initial results show that marginal grassland represents an area of 343,000 ha, slightly greater than that recorded in the SIGEC system (code 61: 334,000 ha). There is nevertheless a mismatch of approximately 80,000 hectares between the projected areas and the actual areas. There are also big differences between the north and the south of the Sambre-Meuse valleys. Mapping in this way could facilitate targeting of agricultural areas for specific management and/or conservation measures.

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RESEARCH TOPICS

MANAGING RISKS
AND ADAPTING
TO CHANGES



Aim 1.

Analysing the contribution of agricultural systems to global changes and their scope for adaptation

METHAMILK: MEASURING, UNDERSTANDING AND REDUCING METHANE EMISSIONS FROM DAIRY COWS

The Methamilk project has led to the development of an equation for estimating the daily methane emission eructated by a dairy cow from the milk composition as predicted by mid infrared spectrometry (MIR). The equation currently has nearly 530 reference data, with a calibration R^2 of 0.74 and a standard calibration error of 66 g CH_4 /day. It offers the possibility of performing large-scale studies by utilising milk recording data and thus gaining a better understanding of how the year, season, production region, genetics (line - heritability) and type of ration impact on methanogenesis. Also, determining the links between methane emissions and other production parameters, such as milk production or fertility, will enable strategies to be devised for significantly reducing CH_4 emissions (breeding, adapting rations, etc.) by controlling the effects on the other livestock farming parameters. The results have aroused interest from other research teams internationally and cooperative links have been established, thus ensuring the continuing use and improvement of the equation.

Contacts:

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WEATHER RISKS AS DRIVERS OF INNOVATION IN AGRICULTURAL ECOSYSTEM MANAGEMENT

Extreme weather events, which are expected to increase in both frequency and intensity due to climate change, can act as environmental innovation factors in the context of agricultural ecosystem management, with a view to making such systems more resilient.

The methodology used (MERINOVA project) at national level for characterising the vulnerability of agricultural ecosystems to extreme weather events is based on fuzzy logic. The work involved identifying the different factors that characterise vulnerability (such as area under crops, slope, erodibility, soil depth or sealing, the river network), collecting spatial data for these different factors and combining them, taking their relative significance into account. Finally, risk maps were produced by combining vulnerability maps with extreme weather event occurrence maps. These serve as decision supports for the authorities and the insurance sector.

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TAKING A CLOSE LOOK AT THE SUSTAINABILITY OF WALLONIA'S AGRICULTURAL SECTORS

How can economic, environmental and social performance be reconciled in the context of food and energy production? This was the challenge taken up by the systemic approaches, using the life cycle analysis (LCA) method and specific regional features, developed by CRA-W.

In that context it was shown that the practices followed in Wallonia and the high production levels achieved are associated with relatively low environmental impacts per unit of product. For instance, producing one kilo of wheat causes 412 g CO₂eq. emissions, as against 574 g CO₂eq for the European average. Reference values for the environmental impact of producing milk and beef have also been generated. Their considerable variability indicates room for progress. Also, with the aim of considering the three pillars of sustainable development, the social aspects of Wallonia's cereal sectors have also been explored. The results show, for example, that the added value created by a farm is not directly linked to the farmer or farm manager's educational level or to the number of years it has been operating.

Finally, this progress has been applied in cooperation with the industry advisory bodies in order to develop online decision support tools (Decide, etc.). These will provide benchmarks for farmers and guide them towards more sustainable practices.

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Aim 2.

Identifying and managing recurring or emerging agricultural plant health risks

BIODIEN: DETECTING ENDOCRINE DISRUPTORS IN WATER WITH A VIEW TO PROTECTING PUBLIC HEALTH AND THE ENVIRONMENT

The WHO defines endocrine disrupting chemicals (EDCs) as exogenous substances that alter functions of the endocrine system and cause adverse health effects in organisms or populations. These substances are thus a special class of emerging pollutants that are considered especially concerning and knowledge of which in terms of environmental presence and effects on health and/or the environment is still relatively limited. Because of that, they are included in the European list of priority substances for surface water and they are on the European watch list.

Launched at the instigation of SPW-DGO3, the BIODIEN project aims to carry out initial screening for EDCs in Wallonia's water and brings together three Walloon public laboratories (ISSeP, CRA-W and SWDE) formed into the scientific interest group GISREAU (Walloon reference scientific interest group for water quality). Industrial substances (alkyl phenols, phthalates, perfluorinated compounds, chlorophenols, etc.) and pesticides (pyrethrinoids, carbamates, imidazols, etc.) are both being targeted. Representative samples of a selection of groundwater and bottled water along with surface water, runoff water and treatment station discharges will be used to complete the inventory of Wallonia's water quality, assess the level of (anti-)oestrogenic and (anti-)androgenic activity, evaluate the potential of bio assays as screening tools, and compare their efficiency with other types of test.

The project will enable tools to be made available for showing the presence of endocrine disruptors in the water cycle in Wallonia and Brussels.

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ASH DIEBACK, A DISEASE THAT HAS COME INTO THE REGION

Ash trees showing severe symptoms of dieback have been observed in Europe in the last few years. These trees are infected by an emerging fungus, *Chalara fraxinea*, of unknown origin. Young trees rapidly die, whereas adult trees, heavily stressed by repeated fungal attacks, often succumb to weakness pathogens (notably honey fungus).

CRA-W has developed a rapid detection test for this fungus in order to assess the presence of this new disease (called ash dieback) in Wallonia. Monitoring was set up in 2008 and the first cases were recorded in 2010. Today the disease is present throughout Wallonia and is a cause of concern for the forestry sector. Awareness-raising campaigns have been targeted at nurserymen and forest and park managers to give them information about this new issue. In cooperation with Wallonia's forest health watchdog, l'Observatoire Wallon de la Santé des Forêts, airborne spore sensors have been installed for this fungus and adult trees have been monitored in populations affected by ash dieback. Appropriate forestry practices for the management of infected trees have been established as a result of this work.

Research is currently ongoing to limit fungus spore production in the leaf litter, as their presence in large numbers at the foot of the ash trees is responsible for trunk base infections that cause cortical lesions, which are highly damaging to the tree.

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Aim 3.

Research into methods for detecting and strategies for managing contamination in the food industry and the environment

PARTIAL REINTRODUCTION OF PROCESSED ANIMAL PROTEINS

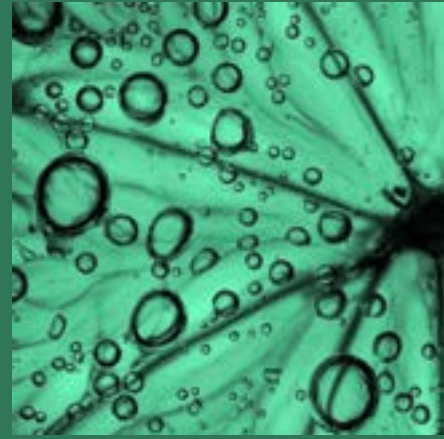
The mad cow crisis resulted in the almost complete banning of the use of processed animal proteins in animal feed. However, since 1 June 2013 processed animal proteins from non-ruminants have once again been authorised in fish farming. This change to the European legislation was made possible by applying analytical progress to the detection of processed animal proteins in feedstuffs. EURL-AP, the European Union's reference laboratory for animal proteins in animal feed, which is hosted at CRA-W, guarantees the reliability of the techniques thus deployed. Previously, conventional microscopy was the only official method for detecting processed animal proteins in animal feed. However, this method has the drawback of only being able to distinguish between particles of fish origin and particles from terrestrial animals. An alternative technique therefore had to be found. The method used is gene amplification by PCR (polymerase chain reaction). This method can detect fragments of DNA characteristic of a particular animal species or higher taxonomic group, such as ruminants in this case. The initial detection test for ruminants was set up by a Dutch laboratory (TNO, Zeist, Netherlands) and subsequently adapted by EURL-AP for use in a network of laboratories by implementing the cut-off concept resulting from calibrating the equipment. The test is in fact so sensitive that there is nearly always a signal and the cut-off, which is set in a standardised manner, distinguishes the positive from the negative.

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PROGRESS IN DETECTING UNKNOWN GENETICALLY MODIFIED ORGANISMS (GMO)

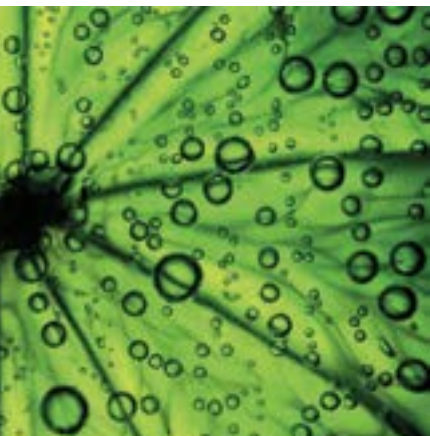
The authorities are particularly interested in prohibited GMO and their derivatives, because such unauthorised transgenic events potentially carry the greatest risks, either to consumers, or to plant and animal health, or - in the case of living organisms and not derivatives - to the integrity of the environment. Among these unauthorised GMO there is one particular category that is of growing concern: unknown GMO. During the past three years CRA-W has participated, along with ILVO (Instituut voor Landbouw- en Visserij Onderzoek) and under the aegis of ISP (Institut scientifique de santé publique) in a project funded by Federal Public Service Public Health, Food Chain Safety and the Environment (the UGM-Monitor project), which focuses on this type of question, among other things. One of the techniques recommended is increased screening, that is to say, looking for genetic components such as promoters, terminators or coding regions frequently used in transgenic constructs. The 2013 discovery of nine transgenic papaws at CRA-W in the course of analyses performed by CRA-W on behalf of FASFC shows the value of screening techniques. The fruit concerned was clearly transgenic, but the screening component profile did not match any of the known descriptions. Detailed characterisation of the unknown transgenic event thus brought to light was carried out at the Ispra Joint Research Centre in Italy, using genetic material largely isolated by CRA-W, and this work will be published soon.

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MANAGING AND DEVELOPING PRODUCTION





Aim 1.

Development and control of biomass conversion processes

THE POTENTIAL OF BIOMASS THERMOCHEMICAL PRETREATMENT FOR THE BIOMATERIALS SECTOR

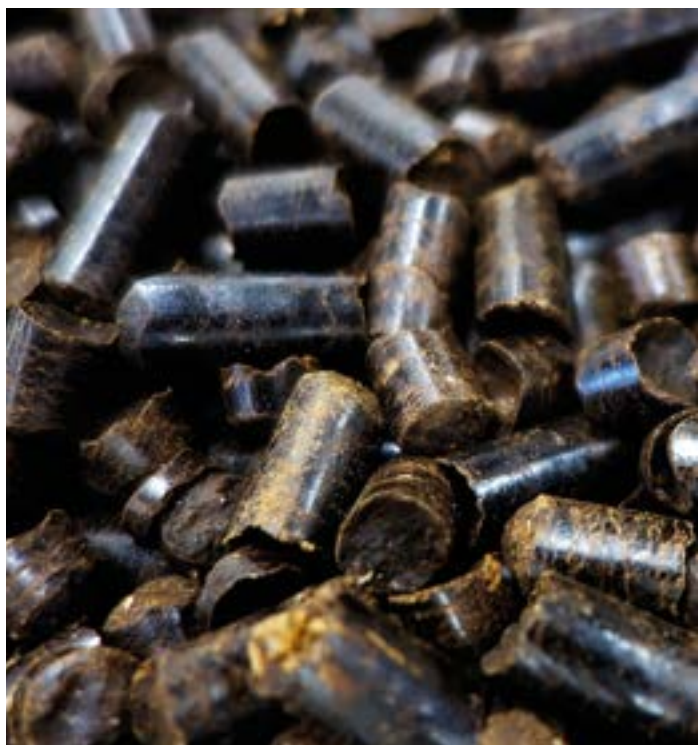
A CRA-W joint project with the National Renewable Energy Laboratory, Denver, Colorado, U.S.A.

In order to build a more sustainable society it is essential to identify and develop technologies for producing bio-based products by biorefining. Biorefining covers the operations of fractionating and converting biomass into energy sources and/or bio-based products. Such bio-based products include biomaterials, food products and synthesized chemicals produced using green chemistry technologies necessitating basic molecular units (synthons). Biorefining is also expected to increase the added value of products and fibrous agricultural residues by exploiting their specific properties in new and more effective ways.

The BioThermoRaf project focuses on characterising the first part of the biorefining conversion process. Generally, this is the thermochemical pretreatment stage, in which the release of sugars (glucose and xylose) from plant fibres (cellulose and hemicelluloses) is maximised. Without this essential stage the plant fibres are inaccessible and non-reactive because of the lignin (another plant fibre) in them. The sugars can then be converted into liquid biofuels and/or bio-based products by biorefining.

This project has also shown that in the case of sorghum an initial pretreatment with diluted alkali and/or using mutated sorghum clones (Brown Mid Rib – BMR) significantly increases sugar release from the plant fibres. BMR mutation has been developed by chemical mutagenesis. It offers a way of lowering the lignin content of a plant biomass while maintaining usual biomass productivity.

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INNOVATIVE NON-FOOD DEVELOPMENT ROUTES FOR BIOMASS

A multidisciplinary project in partnership with Ulg and two private firms, funded by DGO4.

The growing use of biomass for energy is placing some resources under extreme stress. It is also creating economic competition between the different development routes. The fact is that the resource is limited, both in Wallonia and globally. That indicates a need to diversify resources, adapt the development methods accordingly and innovate. Innovate by making available new fuels obtained from high energy yield processes and routes. Innovate further by combining the routes with a view to global energy optimisation. Innovate, lastly, by developing tools for online characterisation of processes and using life cycle analysis as a tool for comparing routes and combinations of routes.

InovaBiom takes up these challenges by looking at five biomass resources and four biomass utilisation processes: conversion to second generation bioethanol, roasting, biomethanisation and combustion. The resources studied are wood and maize (because these are available in large quantities at global level) and also sorghum, bamboo and fescue, because of their potential in Wallonia. These resources and processes have been characterised with the aid of infrared spectrometry tools which support online management and technical optimisation of production.

The first generation bioethanol production process is technologically mature. However, the use of resources that could be used for human food, population growth and the limited land area available for growing crops stand in the way of its sustainability. Bioethanol obtained from plant cell walls (second generation bioethanol) offers an attractive solution. Through the InovaBiom project it has been determined which biomasses should be selected and how they should be used in order to optimise the ethanol production yield.

Combining roasting and pelleting produces a product with an energy content of 22 to 25GJ/tonne. However, there are very few units producing roasted wood pellets on an industrial scale and there are still technological barriers to be overcome. An experimental pilot plant has been designed as part of the InovaBiom project to meet these challenges.

Biomethanisation currently appears increasingly attractive as a biomass conversion technology. As a contribution to its rise InovaBiom has looked at producing specific starters that are rapidly effective, setting up monitoring protocols to limit the non-productive times, boosting the productivity of biomethanisers and investigating the effects of pretreatments on yield and the methanisation rate of the starter materials. Any environmental assessment of a product must take account of all the stages in its life cycle. LCA is the most successful and the most widely used tool in this area. It is based on a multicriteria investigation and environmental assessment methodology. InovaBiom has enabled basic data to be collected for material flows, energy flows and environmental impacts of the processes concerned.

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Aim 2.

Developing analytical methods for characterising agricultural products and their suitability for processing

For many years CRA-W has been a proactive player in the characterisation of agricultural products, monitoring conversion processes and characterising end products, in terms of both reference methods using conventional analytical chemistry and developing rapid analysis methods. That experience gives CRA-W special status with respect to the various food industry sectors. The first example deals with measuring the amylase activity of wheat, a key factor for its utilisation in milling and bakery. The second example has to do with characterising ready meals by spectroscopic methods.

ENZYME ACTIVITY OF WHEAT

Factors of relevance to the milling and bakery sector include the intrinsic composition (fat, protein and vitamin content, absence of undesirable components, etc.) as well as technological criteria relating to the working up of the raw material, such as moisture level on arrival (grain storage), hectolitre weight and Hagberg falling number. The latter is an assessment of the alpha-amylase activity in the cereals and is a means of showing pregermination. When the weather conditions prevent the ripe grain from being harvested, the grain can start to germinate, impairing or ruling out its use for breadmaking.

The Hagberg falling number is obtained by measuring the time taken for a calibrated piston to fall through an aqueous suspension of flour heated to 100°C. In the case of milling wheat, a minimum falling time of 220 seconds is required if it is to be used for breadmaking. A wheat batch below that value will be sent to other applications. For some years now CRA-W, in cooperation with the Temperate Regions Crop Husbandry Unit at ULg Gx-ABT, has been carrying out intermittent sampling of some wheat varieties grown at Gembloux in order to monitor the Hagberg trend and keep the industry informed. A low Hagberg number at the beginning of harvesting indicates insufficient ripeness, and after ripening it shows that pregermination has started. Helped by the weather

conditions in 2014, pregermination started around 7 August, causing the Hagberg number to drop drastically. In 2015, by contrast, there were no special problems.

While the Hagberg number enables batches to be classified, it does not distinguish between the endogenous enzymes' contribution and the intrinsic viscosity linked to the starch structure in the absence of enzymatic activity. The latter can be assessed with the aid of the Rapid Visco Analyser (RVA) by measuring the viscosity of the flour firstly in water and secondly in the presence of silver nitrate (AgNO₃), an alpha-amylase activity inhibitor. This additional technique offers finer discrimination than the Hagberg number and facilitates understanding of the different factors involved in endogenous alpha-amylase activity. The RVA profiles obtained in water and in AgNO₃ make it possible to distinguish between the enzymes' contribution to viscosity and that of the intrinsic properties of the starch. These are determining aspects when selecting wheat batches for different applications.

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WHAT'S IN READY MEALS?

Eating habits have changed greatly in recent years, mainly in developed countries. Our modern lifestyles leave us with less and less free time,

and most people are increasingly relying on ready meals.

Generally speaking, ready meals are not well balanced from a nutritional point of view and they contain high levels of fat and sugar. That therefore gives rise to serious obesity problems for a section of the population. Obesity is a major risk factor in diseases like diabetes, cancer and cardiovascular disease. Accurate labelling with clear, detailed data is therefore an effective way of providing consumers with information. It is now also a statutory requirement.

In this context the availability of a rapid, economical and accurate analytical method like near infrared spectrometry (NIRS) is obviously very advantageous in determining the main components of ready meals. In this study, 150 samples spanning a wide range of ready meals (rice, tabbouleh, pasta-based dishes, lasagne, and so on) were chemically analysed to determine the dry matter, protein, fat and energy content (by calculation). In parallel to this, the NIRS spectra of the same samples were measured. NIRS calibrations were then developed from these 150 samples. The results enabled the relevant parameters to be quantified relatively precisely. NIRS is thus a very useful tool for determining the main components of ready meals.

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Aim 3.

Study of production methods, characterisation and authentication of differentiated quality products and detecting fraud



ANALYTICAL SUPPORT FOR CONTROL PLANS IN THE WAKE OF THE HORSE MEAT CRISIS

One of the most significant events of the last three years was the scandal of horse meat being wholly or partly substituted for beef in various food products. In the wake of this crisis the European Commission decided to set up a control plan throughout the European Union member states. As there was no laboratory appointed as reference laboratory to coordinate fraud investigations and verification of product authenticity, the European Union turned to laboratories with some experience in this area. As it happens, CRA-W – having been a European Union reference laboratory for the detection of animal protein in animal feed (EURL-AP) since July 2006 – had devised a real-time PCR method for specifically detecting horse DNA. As the European Union was looking for a verified method that could be made publicly available, the EURL-AP method was therefore of interest. However, it turned out that simply detecting horse DNA was not enough; the method had to be, if not quantitative at least semi-quantitative. So what was originally a straightforward qualitative test had to be converted in a short time into a semi-quantitative test able to determine whether the 1% horse meat limit had been exceeded in a particular case. The test concerned was published in the public section of the EURL-AP website and, although optional, was adopted by several member states.

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NEW PLANT PROTEIN SUPPLY SOURCES FOR OUR LIVESTOCK FARMS

In cattle farming, good health depends greatly on the use of wholesome, good quality feed. The rising cost of most raw materials in current use has prompted a search for new raw material sources for animal feed. Such new sources may be new raw materials and/or existing raw materials obtained from new geographical areas. One of the aims of the QSAFFE project, funded by the European Commission's 7th Framework Programme, was to provide better tools for testing these new feed sources and detecting any fraud or contamination.

The research involved authenticating the botanical and industrial origin of wheat or maize draff from bioethanol production, used as an alternative protein source. The aim was to be able to rapidly trace the origin of the draff supply. This work showed the potential of mid-infrared spectrometry (ATR-FT-MIR) in distinguishing draff sources based on analysis of the oily fraction composition. The original feature of the process is the in situ oil extraction, without using solvents or chemical processes, thus avoiding any impacts on the oil composition and considerably shortening the analysis time. On this project CRA-W thus contributed to devising new analytical strategies guaranteeing the quality of various plant protein supply sources for farmed livestock at laboratory level.

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Aim 4.

Enriching agricultural products with substances with human or animal health benefits

Against a background of general dissatisfaction with the effectiveness of synthetic substances and the industry's difficulty in creating new substances, natural resources of plant, animal or microbial origin are increasingly coming into consideration as a valuable source of substances for nutritional, therapeutic or cosmetic applications. These new outlets for agriculture open up new avenues for diversification and provide a better income for producers.

CHARACTERISING VALUABLE SUBSTANCES IN THE PLANT KINGDOM...

CRA-W is very active in conserving and developing fruit tree germplasm for apples, pears, plums, peaches, vines and cherries. Its extensive work on assessing varieties and improving fruit species has brought it recognition at both national and international level. One of its main collections, namely the cherry collection, thus came to be utilised by characterising its content of **bioactive substances of great importance to human health**. In collaboration with ULg-CHU (C. Kevers, J. Pincemail), four units at CRA-W joined forces to launch this innovative undertaking, in the course of which more than 160 varieties have been studied. The figure below shows the role played by each unit in this project.

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...AND THE ANIMAL KINGDOM

Animal products are a source of essential nutrients for our bodily health. Milk, for example, contains vitamins, calcium and polyunsaturated fatty acids (3, CLA, etc.) in concentrations that depend directly on how the cows are fed. In this context, grass products are very important in giving the milk a high health value.

Legumes, which are attractive from an environmental point of view in that they reduce the level of nitrogen fertilisation needed, are rich in **phytoestrogens**. Some of these substances are metabolised in the cows' digestive system to produce one specific compound, equol. Whether they enter the milk as such or in the form of equol, **these substances are believed to act positively on human health**, reducing the risks of developing certain hormone-dependent cancers, cardiovascular diseases or osteoporosis and alleviating menopausal symptoms.

Two trials have been conducted to investigate the possibility of increasing the milk equol content by adding red clover to the cows' ration (GrassMilk, SPW). This had the effect of considerably increasing the quantity of equol secreted into the milk, both when the clover was grazed and when it was fed in partially dried form. The conditions for optimising the milk equol content, the variability of that content in practice and the effects of milk processing on this valuable substance still remain to be studied.

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YOU CAN FIND MORE INFORMATION ON THESE AND ALL THE CRA-W'S OTHER PROJECTS ON THE WEBSITE CRA.WALLONIE.BE

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