2019 IFS Agronomic Conference

12 Dec 2019 – 13 Dec 2019

The 2019 IFS Agronomic Conference will be held at Robinson College, Cambridge on 12-13 December

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The Conference will feature eleven papers, covering topics such as measuring N indicators and budgets, the role of cover crops within crop nutrient regimes, new technology to manage the application of nutrients in manure in real time, the nutritional role and contribution of silicon, and a review of the definitional challenges of soil quality. We are particularly pleased to host a paper by Jaap Schröder, recipient of the 2019 Francis New medal for lifetime achievement. This paper will take a 'hard' look at the realities of developing a circular agricultural system.

The presentations will again be augmented by a varied display of posters, while the Conference will host the final of the 2019 Brian Chambers International Award for Early Career Researchers in Crop Nutrition.

If you would like to submit an abstract of a poster that you wish to display at the Conference, please e-mail this to the Society Secretary at the address in the footer at the bottom of this page.

There will also be ample opportunities for valuable networking, including the Conference dinner.

For those of you in the UK, attendance at this conference is worth **ten** BASIS FACTS points.

To help you with your travel plans, many delegates consider the Conference to start on the evening of Wednesday 11th December, when an informal dinner provides excellent opportunities for networking. On Wednesday, dinner is from 19.00, with the popular team quiz running from around 20.30, for one hour.

The formal proceedings run from 09.00 to 17.30 on Thursday 12th December, and 08.45 to 13.00 (followed by lunch) on the 13th. The Conference Dinner on 12th December starts with a drinks reception at 19.30. The dinners on the Wednesday and Thursday evenings are both inclusive of wine and thus provide excellent value.

Registration for the conference is now open. This can be done either by downloading the registration form as a **Word document**, and then sending this to the Secretary, or by completing the **online version of the form**.

Paper abstracts can be read below.

Farm nitrogen budgets provide NUE indicators at farm level in Europe

Prof. Miguel Quemada, University of Madrid, Spain

This paper will be based on a EUNEP paper to be released during summer 2019.

Nitrogen (N) budgets at the farm gate level account for all N inputs and outputs in a particular farm. Indicators derived from the N budgets are crucial for characterising farm performance, due to the important role of N in food production and environmental sustainability. However, comparisons among farm N indicators from different farms, farm types and regions require conducting systematic monitoring of N budgets following a standardised and solid approach.

Because of this, the EU N Expert Panel (EUNEP) developed a guidance document to estimate N inputs and outputs at the farm gate and calculate the N , the

EUNEP approach was applied to 1,240 farms from various case studies in Europe, with the aim of increasing understanding of the factors that contribute to differences in N indicators at the farm level, and to derive possible target values. Farm level data were collected from six countries located in five different environmental zones in Europe: Atlantic Central (France, Ireland, The Netherlands), Atlantic North (Denmark, Germany), Continental (Germany), Mediterranean North (Spain) and Mediterranean South (Spain). The N budgets were calculated for each farm, and the data were analysed to calculate three related indicators: Nitrogen use efficiency (NUE), N output and N surplus.

The results show remarkable variations in N indicators across Europe. Arable farms had the lowest mean N input and N surplus and the highest mean N output and NUE, whereas livestock farms had the highest mean N input and N surplus, and the lowest mean N output and NUE. Median NUE was 61% for arable farms, 28% for dairy and 43% for pig farms. Externalisation had a large effect on animal farm N indicators, and the results highlight the need to introduce correction factors when calculating and interpreting the farm balance. After accounting for externalisation, median NUE decreased to 19% for dairy farms and 23% for pig farms.

Therefore, several options were proposed to better consider feed production and manure management in N indicators calculations. Overall, the differences in NUE between farms were mainly related to differences in farm type, management (production intensity and practices) and probably also soil and climate conditions. Nitrogen indicator targets for specific farm types and linkages with agricultural or environmental policy may contribute to optimise NUE and reduce N surplus at the farm level.

Assessment of required increases in nitrogen use efficiencies to reconcile agricultural productivity with water and air quality objectives in the EU-27

Prof. Wim de Vries and Lena Schulte-Uebbing, Wageningen University and Research, The Netherlands

Agricultural nitrogen (N) losses to air by ammonia emissions. to ground water by nitrate leaching and to surface water by N runoff largely affects air and water quality across Europe. Using a spatially explicit N balance model, we assessed where agricultural N losses currently lead to an excess of critical N deposition levels on terrestrial ecosystems, critical NO_3 concentrations in groundwater in view of drinking water quality and critical N concentrations in surface water in view of eutrophication impacts.

We then calculated the N inputs at which critical N depositions or concentrations are just not exceeded ('critical' N inputs). Meeting air or water quality objectives by reducing N inputs to 'critical' N inputs, however, implies a reduction in yields. Even though Europe is one of the most food secure regions worldwide, yields will probably need to increase in the future in order to meet European and global demands without conv

crop land.

This can be achieved by closing the gap between current yields and the biophysical "yield potential", defined as the maximum yield for a given climate and soil, assuming optimal management.

We derived water-limited yield potentials (Yw) for 30 crops in Europe and assessed the required N inputs in order to achieve 80% of Yw at current N use efficiency (NUE). Wherever current or required N inputs exceeded critical inputs, crop production and water quality goals can only be achieved simultaneously through an increase in NUE. We calculated the increase in NUE that is needed to avoid exceeding critical N concentrations in groundwater and surface waters, whilst also obtaining current yields or 80% of Yw. In addition, the required reduction in ammonia emission fractions is calculated to avoid exceeding critical N deposition levels on nature areas.

At the conference, the approach is presented and resulting maps of the spatial variation of the actual, required and critical nitrogen inputs are discussed. In addition the spatial variation in required NUE to sustainably intensify agricultural production in EU27 as compared to the current NUE is presented, thus illustrating the areas where improved nutrient management requires additional attention.

Lessons for Nitrogen Use Efficiency from the national Swedish 'Focus on Nutrients' project

Stina Olofsson, Head of 'Focus on Nutrients' project, Swedish Board of Agriculture

'Focus on Nutrients' is a large scale project that has been running since 2001. It involves the latest knowledge and technology on fertilisation, precision farming, etc. being taken out into practice by farm advisors all over the country. This provides an interesting example of how collaboration between authorities, universities, advisory systems, the fertiliser industry and other players can achieve results over time – changing behaviour and preventing negative legislation.

The results are continuously followed up and analysed. This paper will present new and interesting data, relating to positive changes in N-balances, leakage, P-balances, soil carbon content, emissions, and so on.

Slurry nutrient composition measured in real time using Near Infra-Red sensing

Prof. Wouter Saeys, KU Leuven, Belgium

To close the nutrient cycle, the nutrients in animal manure need to be valorized in plant production. However, due to its heterogeneity, the fertiliser value of animal manure can vary significantly between farms, and even between different loads obtained from the same farm. This means that the use of animal manure often increases the variability in soil fertility within a field, rather than reducing it.

In the context of precision fertilisation, one could try to compensate for this variation based on crop measurements. However, it would be far better if the nutrient content of the manure was known at the time of application. This would enable the application rate to be adjusted to allow for both the nutrient content of the manure and the needs of the crop. NIR spectroscopy has the potential to bridge this gap, through online measurement of the manure composition. In this paper, our experiences with the calibration of NIRS systems for online measurement of manure composition in slurry tankers will be presented. Some interesting observations on the variation in manure composition between different loads from the same storage facility, and even within a load, will be discussed, together with scenarios on how this information could be used efficiently in practice.

Soil quality: the concept needs elaboration to be adopted by farmers

Hein ten Berge and Jaap Schröder, Wageningen University and Research, Wageningen, The Netherlands

Policy makers know that agricultural soils have more functions than the production of crops. Examples of these other functions are the recycling of nutrients, regulation of the hydrological cycle and the quality of outgoing water, regulation of the emissions and sequestration of greenhouse gases, and providing habitats for flora and fauna. The capacity of soils to provide these attendant services is often referred to as 'soil quality', which suggests that the specifications needed to perform one given function should fully coincide with those needed for any other function.

However, European farmers give little attention to the multifunctionality of their soils and prioritise what is best for the next few harvests. This paper will unravel the underlying causes of this focus on productivity. We conclude that there is an urgent need to acknowledge that not only synergies, but also trade-off's, exist between these functions. Therefore, full exploitation of the multifunctional dimension of soils requires a fair remuneration by consumers or taxpayers when production costs increase or yields are reduced. In addition, the evidence base for the long term impact of threats to the functioning of soils needs corroboration, if only to justify when and where regulations are needed.

Silicon: its role in crop nutrition and abiotic stress reduction

Martin Hodson, Oxford Brookes University, UK

Silicon (Si) is the second most abundant element in the Earth's crust, and is an important component of mineral soils. Crystalline forms of Si are sparingly soluble and amorphous forms are somewhat more so. The main soluble form of Si in soils is monosilicic acid (H_4SiO_4) which is the form taken up by plant roots. Plants vary considerably in the amount of Si that they accumulate, with grasses and cereals being particularly high and most

dicotyledons being much lower. Once in the plant Si is transported in the xylem and most of it is deposited in the leaf cell lumina and walls as solid amorphous silica. These deposits are commonly known as phytoliths.

Plant scientists do not consider Si to be an essential element, and most plants can complete their life cycles in its absence. However, Si is important in defence against grazing, pests and pathogens. It also has roles in the amelioration of abiotic stresses such as aluminium and heavy metal toxicity. Si fertilisation is very important for rice, and is also used for other crops such as sugarcane on occasions, but is rarely employed in Northern Europe. There are, however, some concerns that soluble Si availability may become depleted in some situations where plant amorphous silica is not returned to the soil. Most recently there has also been interest in the potential of phytoliths to sequester carbon in soils thereby helping to combat climate change.

This paper will describe the availability of Si in soils, the uptake and deposition of Si within plants, and the roles of Si in decreasing abiotic and biotic stresses. It will then focus on the management of Si in soils, worries about decreased Si availability in the future, and the possibility that phytoliths may be important for carbon sequestration.

Maximising the benefits from cover crops

Charlotte White, Anne Bhogal (ADAS) and Nathan Morris (NIAB), UK

Cover crops are grown primarily for the purpose of 'protecting or improving' between periods of regular crop production. Cover crops can contribute to sustainable intensification of crop production through several mechanisms including; increasing soil nutrient and water retention, improving soil structure/quality, reducing the risk of soil erosion, surface run-off and diffuse pollution by providing soil cover and by managing weeds or soil-borne pests. The most appropriate cover crop species/management will depend on what the grower wants to achieve.

The benefits of cover crops are often not realised on farm because of a lack of evidence about which cover crop species or mix is best and how to manage the crop in different situations. Understanding the effects of different cover crops on soil properties, yield and other ecosystem services is critical to realise the potential benefits. Practical science based information on cover crop selection and management in UK conditions is required.

This paper outlines the key findings from the AHDB Maxi cover crop project and pulls together the 'state of the art' for cover crops in the UK. Focusing on the effects of cover crops on soil properties, nitrogen and phosphorous cycling, cover crop growth, impacts on the following cash crop and establishment and destruction of cover crops.

Measurement and sensing of cover crop growth and nitrogen credits in conservation agriculture

Dr Luca Bechini, University of Milan, Italy, et al.

This presentation will focus on research activities carried out in an intensively cultivated area (northern Italy) where maize is the most important crop, and winter cover crops are grown by farmers adopting conservation agriculture.

We compared the growth, nitrogen uptake and weed suppression of pure stands of winter-hardy and winter-killed cover crops (seven species in total) in six field experiments running from September 2017 until August 2019, and evaluated the nitrogen made available to the subsequent maize crop. We also evaluated the potential to estimate these variables using multi-spectral images collected with a drone, and to estimate the cover crop nitrogen concentration via near infrared spectroscopy. Finally, we estimated the cultivation costs of cover crops and quantified their economic benefits.

Use of nitrification and urease inhibitors as a mitigation strategy in agriculture

Dr Laura Cardenas, Rothamsted Research North Wyke, UK
Prof. Tom Misselbrook, Rothamsted Research North Wyke, UK
Prof. David Chadwick, Bangor University, UK

The demand for food is increasing rapidly as a consequence of global population growth and changes in patterns of food consumption. One of the most important changes in the global agri-food system has been the intensification of production systems and the increase in fertiliser nitrogen (N) use. Improved grasslands are an important part of this intensification process and constitute a significant share of the agricultural area in some temperate countries. It is expected that further intensification will occur to meet the increasing global demand for livestock products, putting pressure on farming that will likely result in increased N use.

N fertiliser use is directly related to productivity, but it also has major environmental effects. In many cases fertiliser rates exceed crop requirements, leading to an N surplus, reduced N use efficiency (NUE) and risking losses to the environment through nitrate leaching and gaseous emissions of nitrous oxide and ammonia. In grazed grasslands, risks of losses are even higher, due to the excreta N deposited during grazing. Improved NUE is needed to reduce the negative effects of an N surplus while preserving productivity and soil fertility.

Nitrification inhibitors (to reduce nitrous oxide emissions) and urease inhibitors (to reduce ammonia emissions) are two commercially available options for reducing losses to the environment and improving NUE. This paper will summarise the latest research testing both. It will cover factors that control the efficacy of the inhibitors on losses and also pasture yields, including the economic costs and benefits o

Ammonium sulphate and emissions of ammonia: a review

D.S. Powlson, Department of Sustainable Agriculture Systems, Rothamsted Research, UK

Emissions of ammonia gas to the atmosphere are environmentally harmful and contribute to human health problems through the formation of particulates in the air. It is well known that, under certain conditions, substantial emissions of ammonia can occur from ammonia-based fertilisers and urea. Urea is currently the dominant form of nitrogen (N) fertiliser globally, with ammonium sulphate making only a small contribution, so measurements of ammonia emissions have focussed on urea. However, ammonium sulphate is now the main fertiliser form for supplying sulphur (S) to crops; this will inevitably lead to some volatilisation of ammonia. This paper reviews published data on ammonia emissions from ammonium sulphate as a basis for rational decision making on S fertilisation with a view to minimising contributions to global ammonia emissions. In soils of pH <7, ammonia losses were small: often <10% of applied N. However, when applied to soils with pH >7 and/or a high calcium carbonate content, losses equivalent to >20% of the applied N were common and up to 60% in a few cases. Ammonium sulphate is an excellent source of S for crops in soils of lower pH but in soils with pH >7, to avoid ammonia volatilisation, it would be preferable to use alternative forms such as potassium or magnesium sulphate or polyhalite.

31st Francis New Memorial Lecture 2019 – 'Circular agriculture: easier said than done'

Dr. Jaap Schröder, Senior Researcher in Nutrient Management at Wageningen Plant Research

Uncontrolled climate change, loss of biodiversity and depletion of finite resources require a comprehensive response from society. Agriculture must play its role too, if only because of the relationship of these issues with fertilisers. Circularity is often presented as a kind of panacea to reduce emissions, save wilderness and avoid further use of fossil resources.

However, wherever crops are no longer grown, processed and consumed in each other's vicinity, re-establishing circularity is a complicated task and not self-evident. In as far as circularity is proposed to stop local leakages, the present intensification of agriculture in developed countries may need reconsideration. However, this can have serious implications for land claims at the expense of wilderness, the role of animals and manures, the composition of our diets or the aspired transition to a bio-based instead of oil-based economy. Technological progress will help to find solutions but probably only within limits. The 2019 Francis New Memorial Lecture will try to shed some light on the numerous dilemma's and challenges of a circular agriculture.

We are grateful for the support being provided to the Conference by these organisations.

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2020 IFS TECHNICAL CONFERENCE

The 2020 IFS Technical Conference will be held at the Hotel Casa 400, Amsterdam, on 26-27 May.

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RECENT NEWS

18 Dec Investigative work into potential new materials to reduce slurry emissions wins the 'Most Noteworthy Poster' award at the 2019 IFS Agronomic Conference

02 Dec The 2019 IFS Agronomic Conference is on track to attract a record number delegates

14 Oct The finalists of the 2019 Brian Chambers Award have been announced

25 Sep Dates and venue announced for the 2020 IFS Technical Conference

02 Sep New themed collection of IFS Proceedings on Soil Management

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02 Jul

Dr. Jaap Schröder is the recipient of the 2019 Francis New Memorial medal

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