THE ORGANIC RESEARCH CENTRE

ELM FARM

In this bumper issue:

Cover photo

Winter grazing of sheep on wheat as part of trials at Shimpling Park Farms (p8)

Organic Research Centre

Bulletin

No. 121 – Autumn/Winter 2016

News in brief

OK-Net Arable launches new platform

The web platform http://farmknowledge.org is part of the OK-Net Arable project, which is coordinated by IFOAM EU and involves 17 partners from 12 countries throughout Europe, including ORC. It is aimed at filling the gap in exchange of information between farmers across Europe. The complexity of organic farming requires farmers to have a very high level of knowledge and skills. But exchange on organic farming techniques remains limited.

Dr Susanne Padel, Senior Programme Manager at ORC said "The new platform will work across borders and allow organic arable farmers in one country to also benefit from trials and experiences that have been gained elsewhere."

Farmers' needs were taken into account at every stage of development in order to make it easy to use. The solutions are divided according to the most relevant topics in organic arable farming: soil quality and fertility, nutrient management, pest and disease control, weed management and solutions for specific crops. Not only can we find solutions and engage with each other via this platform, we can also propose solutions. We hope this will help improve exchange of knowledge among farmers.

Cover crop mixes increase agroecosystem services

Planting a multi-species mixture of cover crops - rather than a cover crop monoculture – between cash crops, provides increased agroecosystem services, or multifunctionality, according to researchers in Penn State's College of Agricultural Sciences, in the US. That was the conclusion drawn from a two-year study of 18 cover-crop treatments, ranging in diversity from one to eight plant species. Cover crops were grown preceding a corn crop. The researchers measured five benefits provided by cover crops – ecosystem services – in each cover crop system to assess the relationship between species. Those services included weed suppression and nitrogen retention during the cover-crop season, cover-crop aboveground biomass, inorganic nitrogen supply during the subsequent cash-crop season and subsequent corn yield. The research, published in the September issue of the Journal of Applied Ecology, shows that designing cover-crop mixes will involve trade-offs to achieve desired levels of ecosystem services, explained lead researcher Denise Finney. "For example, nitrogen cycling is an area where trade-offs can occur among services," she said. "In our research, we have found that cover-crop mixtures that excel at nitrogen retention can decrease soil nitrogen supply to cash crops and limit their yield. However, bi-cultures – correctly formulated to combine legume and nonlegume species – can both supply inorganic nitrogen and retain nitrogen."

Seed co-op share launch

Biodynamic and Organic Plant Breeding and Seeds Limited, trading as Seed Co-operative, have just launched a Community Share Offer to secure the future of their new home at Gosberton Bank Nursery in Lincolnshire and the future of organic and biodynamic vegetable varieties and seed production in the UK. www.seedcooperative.co.uk

No patent on seeds!

In a long awaited explanatory statement, the EU Commission has taken the view that plants and animals that are obtained by means of 'essentially biological' breeding are non-patentable. This statement is in strong contradiction to the current practice of the European Patent Office (EPO), which has already granted more than 100 patents on conventional breeding, e.g. on tomatoes and broccoli.

The alliance *No Patents on Seeds!* is also demanding further clarification on the legal details needed to render the prohibitions effective: the legal definition of 'essentially biological' breeding should include all methods and biological materials used in conventional plant breeding. In addition, further legal measures are required to make sure that the prohibitions cannot be circumvented by clever wording of the claims. For example, it has to be made clear that plant characteristics derived from conventional breeding and plant varieties are not within the scope of patents granted on methods of genetic engineering.

Call for sheep and goat farmers

Are you are a sheep or goat farmer (or both) and interested in assessing the sustainability of your farm and/or would like to take part in case studies, group discussions or testing your own innovative ideas? As part of iSAGE (Innovation for Sustainable Sheep and Goat Production in Europe), in collaboration with the National Sheep Association and AHDB, ORC aims to holistically assess the sustainability of sheep and goat farming in the UK. The sustainability assessments will focus on animal welfare, environmental, social, economic and governance issues. In addition we are planning to carry out on-farm trials, comparative case studies and if needed discussion clubs and focus groups to test or discuss innovative farm practices. The topics covered will include: nutrition, breeding and genetics, health, market development & adding value and farmer succession.
If interested please contact Dr Konstantinos Zaralis at ORC.

Easier access to information on pestcides

The EU Court of Justice has announced that information about pesticides, their ingredients and their effects on the environment can no longer be hidden behind commercial confidentiality clauses and instead will have to be made available to those requesting it. The Court ruled that the use of pesticides falls under the definition of emissions to the environment and should be subject to the same provisions as any other emission to the environment as laid out in the Aarhus Convention. This ruling should allow greater access to information and transparency about the effects of pesticides and allow for far more thorough independent scrutiny of the ways in which people and the environment are exposed to, and affected by, them.

For more details on items on this page, including links to the publications, visit the News link at www.organicresearchcentre.com or, to receive more frequent updates, register for our E-bulletin service and follow us on Facebook, Twitter and Flickr.

About us

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Bulletin editor
Phil Sumption

The Organic Research Centre is a leading, independent, research charity working for better farming, food and health, promoting environmental sustainability, quality food and health and wellbeing for all. We work in the UK and internationally to: research and develop practical, sustainable land management and food production systems based on organic and agro-ecological principles; foster knowledge exchange with and between current and future producers, food businesses and related professionals; and influence policy and public debates on the future of food and farming based on sound evidence.

Registered in UK as
Progressive Farming Trust Ltd.
Company No. 1513190
Charity No. 281276
VAT No. GB314668159

Registered address
Organic Research Centre
Elm Farm
Hamstead Marshall
Newbury RG20 0HR

T: +44 (0)1488 658298
F: +44 (0)1488 658503
elmfarm@organicresearchcentre.com

Twitter: @OrgResCent
Facebook: @OrganicResearchCentre

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Editorial: 2016 – can it get any worse?

As we approach the end of a year that has seen so many political shocks, we go to print when the negotiations over the new EU Organic Regulation seem destined to collapse irretrievably. Just as the UK organic movement starts rebuilding both its production base and key organic markets, it seems policy makers and regulators are doing their best to halt the progress. While UK organic organisations agree the current EU Regulation is an essential basis for UK regulation and trade in organic products after Brexit, there is real concern that a disastrous replacement Regulation might be the worst possible outcome. As a result, ORC is joining with other UK organic organisations in urging Defra to help bring an end to the current process.

Without question, the Brexit referendum result has opened up a significant debate about the future of agriculture in the UK, and the place of organic food and farming within it. It's also created huge uncertainty for producers and other organic businesses, in terms not only of access to, and continuation of, conversion and maintenance support, but also how exchange rates and regulations might change and the impacts that will have on both domestic markets and export opportunities. Research and other organisations supporting organic businesses are facing similar challenges, as access to European funding for research, promotional and other initiatives comes into question.

But there are reasons to be cheerful. Firstly, the organic organisations in the UK (involving collaborations between organic umbrella groups in England, Scotland and Wales) have committed to working together to present a unified policy response to the UK governments on Brexit and related issues. In England, all key organic organisations and the NFU have signed up to a letter to Defra Minister of State George Eustice MP identifying key priorities. For those who have lived with the fragmentation of the organic movement over many years, this is a real cause for optimism.

Secondly, there is increasing recognition of the potential of ecological approaches to farm management, including organic farming and agroforestry, in part stimulated by our report on the Role of Agroecology in Sustainable intensification. When might there be a better time than in the process of rethinking UK agricultural and environmental policies post Brexit to bring about a fundamental shift in policy to emphasise ecological rather than technological solutions?

So the timing of our conference *Rising to the Challenge* (1-2 February 2017 at Aston University, Birmingham) is ideal to address many of the issues that are coming up. How can we rise to the challenges which Brexit represents? Can we make our work and businesses more resilient to the changes that will take place in the next few years? What opportunities will the new situation present that we should be welcoming with open hands? What should we be asking of policy-makers to ensure a vibrant organic community in future, delivering both environmental and other public goods, as well as contributing to the economic wellbeing of the UK? Can we build bridges with others facing similar challenges and aspirations?

The conference will provide an opportunity to discuss and agree policy priorities at all levels, continuing the work of the IFOAM UK groups and the English, Scottish and Welsh organic forums. We really hope that our readers will get involved in the debate and help us shape a new vision and a vibrant future for organic food, farming and growing in the UK.

Nic Lampkin

Compost making and compost tea – all muck and magic?

*Innovative Farmers, a not-for-profit network funded by Prince Charles's Charitable Foundation and supported by Waitrose through sales of Duchy Organic, has been supporting a field lab on the use of compost tea. Interest in compost teas as growth promoters and soil biology improvers is increasing but are they the panacea they are claimed to be? Although relatively commonly used in amenity grassland, can they be used to good effect in arable cropping systems and more importantly, can consistent quality compost be made on farm as a feedstock? ORC crops researcher **Dominic Amos** outlines work being done in both areas through Innovative Farmers.*

Compost tea

Compost teas have been the subject of a lot of attention recently and many bold claims have been made about the benefits for crops and soils but there is very little academic research proving their efficacy.

Compost tea is made by 'brewing' compost in water and consists of a dilute solution of microbes and some nutrients that can be applied as a spray to the soil or to the crop. The theory is that beneficial bacteria and fungi present in mature compost are multiplied by the brewing process and can then be applied as a tea to help improve and correct any microbiological deficiencies in the soil and balance out the ratios of microbes to provide a healthier ecosystem. This in turn is supposed to improve plant health by creating microbiological associations and increasing nutrient availability. The beneficial microorganisms are also supposed to compete with pathogens in the soil and on the crop to help suppress both soil-borne and foliar diseases.

Inspecting the compost tea brewer at Hemsworth Farm, during Innovative Farmers' field lab.

Field labs

An Innovative Farmers' field lab group was set up to look into some of the possible effects on arable cropping. After the first year, testing on three farms, attention was focused on one farm in Dorset where the farmer Sophie Alexander has invested in her own brewer and is now regularly applying homemade compost tea to her spring cereal crops, and plans to continue doing so.

In the first year she applied compost tea three times in spring to a crop of spring barley and this year used the same approach on a spring oat crop. Sophie makes her own tea on farm using a brewer designed by Growing Solutions incorporated in the USA and distributed by Martin Lishman in the UK. The brewers provide oxygen that acts as a catalyst for microbes.

Spraying compost tea at Hemsworth Farm

The field lab, as well as looking into the compost tea making process and soil testing, has sought to investigate effects on the crop and most importantly on grain yield. Experimental design has been very simple in order to allow testing to take place within the farming system and to fit with commercial scale equipment and with a contractor, who takes care of all the spraying. This year two fields were included in the trial, with a central strip left untreated and compost tea applied to the rest of the field. While this sort of trial design doesn't really allow for advanced statistical testing of treatment effects it can provide an element of pseudo replication to help with preliminary, introductory observation.

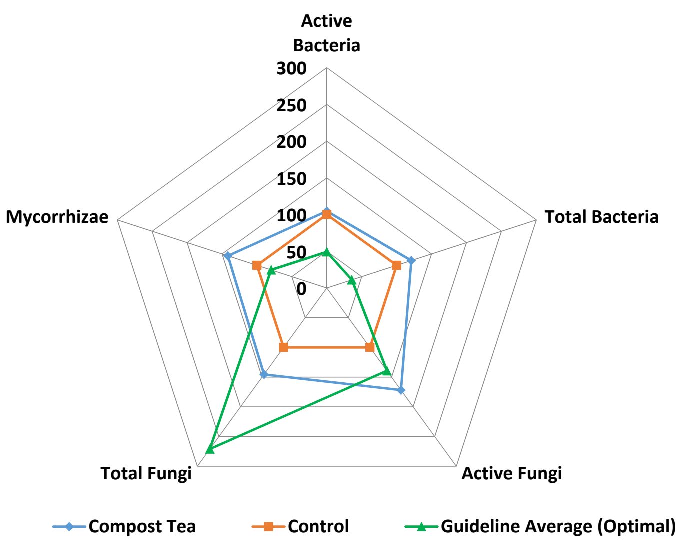


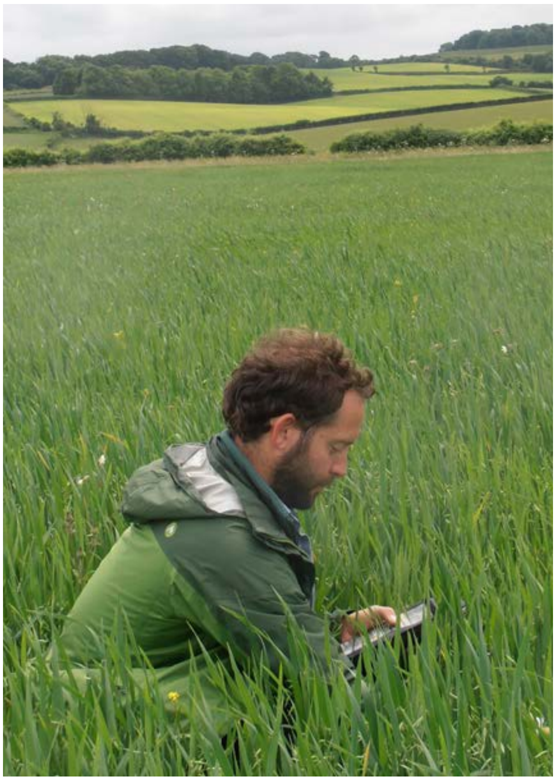
Figure 1: Soil microbiology analysis from Hemsworth Farm from June 2016 showing effects of compost tea on soil microbes and the guideline amounts.

In early summer, assessments of root length and mass, crop height and canopy (LAI) were measured. Later on in the season, close to harvest, destructive sampling was performed to look into yield traits such as spikelets and grains per panicle as well as grain and straw dry weights to determine harvest index.
At harvest, combine strips were cut and weighed to compare 0.5ha areas of treated and untreated crop in both fields. Thousand grain weight and specific weight were also measured post-harvest.

Results

Crop effects have been limited so far with only one significant trend observed, although the trial is of a very basic design which would be unlikely to tease out any significant treatment differences. One result that was encouraging from this year's trial on the spring oats was an apparent improvement in specific weight that may have implications for achieving the milling premium, though this effect needs investigating much more thoroughly.

The soil biology results are starting to look compelling ,with improvements in active fungi (Figure 1) from compost tea application that have been observed in both years. It's often fungi that arable soils are most deficient in given that tillage practices tend to destroy them so potentially being able to manipulate soil fungi populations could have implications for arable soil health.



Dominic Amos assessing leaf area index of oats as part of the compost tea field lab at Hemsworth Farm

Controlled Aerobic Composting

ORC are working as researchers with the Land Gardeners' controlled aerobic compost (CAC) field lab, looking into whether CAC can be used to fully digest and humify organic matter in 6-8 weeks, under varying conditions, and whether the end product contains a proper diversity of humifying aerobic microbial life.

If the mature compost used is not of sufficient quality and doesn't contain the right populations and balance of microbiology then any tea made from it will also be of poor quality and is unlikely to have any beneficial effects.

While compost can be bought in it is far better to use farm produced material to act as a feedstock for the tea and so the method used to make the compost becomes very important. Austrian scientists have pioneered an approach known as Controlled Aerobic Composting which relies on accurately monitoring temperatures and carbon dioxide levels in the pile in order to turn it whenever certain thresholds are reached to keep the process as aerobic as possible. The Luebke-Hildebrandt method of composting should, they claim, ensure compost of the highest quality with a rich and diverse microbiology that will lead to the best possible compost tea.

The method can be used at all scales, either in a small hand turned pile in a back garden or at a more commercial scale with a mechanical turner, but where the true scalability comes from is by using the aerobic compost to make a tea which can cover and treat much larger areas than the compost alone.

The scientists who have developed the method are convinced that all soil health is underpinned by biology and everything else follows from that. The compost produced by their method will, they say, transfer humifying abilities to the soil to help in the natural conversion of raw organic matter into highest quality humus. The end product, it is hoped, will help create a balanced healthy soil ecosystem providing for healthy crop growth.

The field lab has now started, with the Land Gardeners, cut flower producers and garden designers in North Oxfordshire, having made their initial test piles and microbial analysis having been performed by SoilBiolab using methods and guides based on Elaine Ingham's soil food web. The trials will consist of a static 'control' pile with which to compare the CAC pile. The piles will be made to the same 'recipe' with the CAC method providing detailed instructions on the content of piles, with a target C:N ratio of 30:1 and the need to include 10% by volume of clay/ loam soil.

A two day workshop was held at the end of September 2016 introducing all aspects of the CAC process and participants will begin making and monitoring their own compost piles in early spring 2017.

Whether the application of compost tea has any major benefits to crop quality and yield may still be in question but what isn't in doubt is the necessity of producing mature compost of a consistent high quality in order to use as the feedstock.

One question that should probably be asked, in the context of soil health and also soil borne disease suppression, is whether applying compost as a tea is any better than applying mature compost directly to the soil. The tea contains a lot of microbiology but very little else and may be considered a short-term fix by some while additions of compost as a soil amendment can provide the same biological benefits whilst also helping to improve physical and chemical properties of the soil. On the smaller scale it may well be better to add compost directly but in large-scale arable cropping it may be impractical and expensive to add compost directly, which is part of the rationale for using compost teas.

Next steps

For compost tea, many claims have been made about increased yields, improved root growth and drought tolerance and plant disease suppression but while the jury may still be out hopefully the field labs can help to investigate some of these potential benefits further.

The field labs will continue to run in 2017, with field days planned and results to be reported. After two years of preliminary testing at Hemsworth an improved trial design should help to test compost tea effects with more certainty. Enough interest has developed to allow for the possibility of a Masters project to be set up to allow for more in depth investigation of soil biological effects.

For more info: www.innovativefarmers.org/

For more information on testing the microbiology in your soil contact Simon Parfey at SoilBioLab. http://www.soilbiolab.co.uk/

Equitable or equal? Or disaster?

*It is expected that by the end of December 2016 we will know the key outcomes of the trilogue negotiations in Brussels about the revision of the EU Organic Regulation. Here **Chris Atkinson** and **Susanne Padel** try to provide some background on this frustrating and drawn out process even though it remains impossible to predict what will happen.*

A year ago (ORC Bulletin 119 from Nov 2015) Susanne Padel gave a summary of the background and context for the review of the EU Organic Regulation. A year on we are no closer to agreement –in fact the process appears to be in meltdown.

The Trilogue

The last year has involved a critical phase of the legislative process known as the Trilogue. TheTrilogue is a relatively new way of thrashing out the high level detail of European legislation and agreeing how, and by whom, the fine detail and any subsequent amendments can be made during the lifetime of the legislation. The original article also expressed what, as we will explain, now seem to be well-founded doubts about the ability of anybody to predict the outcome of the process.

The parties to the Trilogue are the European Commission (EC, the EU Civil Service), the European Parliament (EP, representing citizens and subjects of the Member States) and the Council of Ministers (representing the governments of the EU 28 countries). In theory, the Commission should play the least active role in the Trilogue. Their primary task should already have been completed when they revealed their proposal for a new organic regulation in March 2014. Their primary role is to initiate new legislation as and where needed, and fulfil the objectives of the Treaties of the EU under the guidance of the responsible Commissioner, which at the time was the Romanian Commissioner Ciolos. The EC is supposed to ensure that their proposal is necessary, well thought through, technically sound and tackles any difficult issues through progressive and innovative approaches that are likely to be supported by Parliament and Council. In the Trilogue the EC is meant to facilitate the debate and to play a technical and administrative role in ensuring that the text remains legally correct and technically sound.

Negotiating positions

Before the Trilogues kick off the Parliament and Council need to set out what their negotiating position relative to the Commission proposal is. They generally take a few weeks to work out what the big issues are from their point of view, where their red lines are and which topics they are prepared to give ground on and where they are prepared to accept a better suggestion from the other parties to the discussion.

The European Parliament arrived at its negotiating position by adopting amendments to the initial text, compiled into a report on the proposal by Green MEP Martin Häusling (the Parliament Rapporteur for the proposal for a new EU Organic Regulation) working through the EP Agriculture Committee.

The Council of Ministers reacted to the EC proposal by agreeing on a 'General Approach' which is essentially a detailed negotiating mandate for the 6 monthly rotating

Presidency of the EU. The Presidency plays a critical role in the Trilogue negotiations as it is choreographs and coordinates the Trilogues and necessary technical meetings which might be needed to help develop compromise texts that can be presented at the Trilogues.

The process of revision of the EU regulation has taken so long that the presidencies of Greece, Italy, Latvia, Luxembourg, Holland and currently Slovakia all have been involved, with Malta taking over the reins for the first half of 2017). This all seems to be very sensible and streamlined in theory, but most readers will already have spotted that the Trilogues didn't start until 18 months after the initial proposal was revealed and they have already been going on for more than a year. These long delays in arriving at the EP Report and Council's General approach and the fact that the Trilogues have not concluded gives an enormous clue to the fact that there are problems with the proposal and the ability of the legislative process to react to a relatively detailed proposal.

So, when did this all start to go wrong?

Organic standard setting is not an easy process and it is very difficult for anybody to have a full overview of the likely consequences of any change in the rules. It is important that the demands of all different parties, including consumers, farmers, processors, and regulators are considered. There is also a need for practicality, stability and coherence. The Commission carried out its own internal impact assessment of the proposed Regulation, mainly based on a survey of consumers, but its consultation with organic stakeholders was less formalised. It felt as if there is an underlying belief that anybody, who has a business interest in organic farming will want to water down the rules. In our view, this is not justified. Most companies that sell organic products have a shared interest in upholding the good reputation of 'organic' and they also have lots of experience on what works and what does not. There is growing frustration with the process in the organic sector and what businesses really don't like is years and years of uncertainty. At the European LeveI, the IFOAM-EU Group has worked tirelessly to influence the negotiation at various levels and has achieved some success. The UK delegation from Defra has been brilliant, working in collaboration with the sector. But we do now also have another challenge ahead of us through Brexit, which adds even more uncertainty than what has been created through this revision. In an open letter to the Minister of State George Eustace MP the English Organic Forum asked that the UK continues to meet European Organic Regulation Standards (see article on page 20). But, at present, we cannot be sure which European organic standard that will be.

Trilogue suspended

On 8th December, amid calls for the process to be abandoned completely, Martin Häusling said "The trialogue negotiations held yesterday under the Slovakian Presidency have failed for the time being. The talks about a new EU Organic Regulation can't be continued from my point of view. The reason is that neither the Council nor the Parliament have been able to accept compromises submitted, *inter alia*, on the central issues of pesticides, cultivation under glass or seed. The trilogue is thus suspended until further notice. The EP should also examine whether improvements can be incorporated into the existing regulation. We also want to invite interested associations in January to discuss how such a development might look."

The organic regulation review has reached a dead end says IFOAM EU

Continuous improvement is part of the organic mindset and the organic movement welcomes initiatives to help organic farming and food develop. A review of the existing organic regulation had the potential to improve the legal framework; to support farmers who want to go organic; to guarantee fair competition and improve the functioning of the single market; to make application of the rules simpler and clearer; and to sustain the already high level of consumer confidence among EU citizens. There were positive proposals from the EU institutions (Commission, Council and Parliament), such as the establishment of environmental performance criteria for traders and processors, and new means to increase integrity in the controls and in the import rules governing organic.

Nevertheless, thirty-three months since the initial Commission proposal and twelve months since the start of trilogue negotiations, the innovative aspects are no longer on the table and there is no positive development in sight. Unfortunately, much time and energy has been spent essentially rewriting the proposed rules to match what already exists. In addition, some important elements of the current regulation are under fire. For example, annual inspection of all organic operators is crucial for helping those implementing the regulation to stay on track, while simultaneously ensuring consumer confidence.

There have also been setbacks in comparison with today's rules. For example, those who expressly reject the use of chemical substances are at risk of being made to pay for their presence in the environment – very difficult to completely avoid when 94% of agriculture allows for their use. As well, instead of improving the way the regulation was implemented for organic imports from abroad and supporting the development of the organic markets abroad, the new proposal focuses solely on the EU regulation – forcing smallholders in developing countries to fulfil the regulation developed for the EU conditions.

Despite the uncertainty created by the current situation, farmers and citizens are increasingly choosing organic. To strengthen their impact and to deliver on the environmental and social goals the EU has set for itself concerning agriculture, what is needed now is a legal framework that goes beyond today's regulation and that actually supports organic development.

The ingredients currently in the mix will not help achieve this development and the negotiations have reached a dead end. IFOAM EU calls on the EU institutions to really reflect the best way to proceed: either stop the process or start again based on the day-to-day reality of farmers, processors and citizens.

http://www.ifoam-eu.org/

Keep updated on ORC's news page and social media.
www.organicresearchcentre.com

Can black grass be controlled by grazing sheep?

The Organic Research Centre has been working with John Pawsey of Shimpling Park Farm carrying out research trials funded by the Duchy Originals Future Farming Programme (DOFF). The aim of the research was to examine the efficacy of sowing timings and sheep grazing for the control of black grass in an organic cropping system. Having recently reintroduced stock back onto the farm this created a fantastic opportunity to investigate the role of livestock as an integrated approach to weed control, assessing the once traditional method of grazing winter cereals in early spring. ***Dominic Amos, Nick Fradgley*** *and* ***Ambrogio Costanza*** *report.*

The black grass problem

Black grass *(Alopecurus myosuroides)* is a major issue in UK arable cropping systems and has become more problematic due to winter heavy crop rotations and increasing herbicide resistance. Organic systems rely on cultural weed control and use crop rotations to help avoid major weed issues but many non-organic farmers are also turning to an integrated approach combining cultural methods with chemical treatment.

A lot of work has looked at cultural control methods and in particular effects of delayed drilling in the autumn and comparisons between autumn and spring cropping. However, delayed sowing implies increased risks of adverse weather affecting drilling operations, crop establishment and yield, particularly on the heavy lands that are also most affected by black grass infestations. On the other hand, early sowing dates can improve yields and limit climatic risks of delayed drilling, but are at odds with black grass control. This implies that more complex strategies have to be explored.

This work addressed the traditional method of grazing cereals in early spring, once more common on mixed farms, especially in the west of England, and still widespread in countries like the USA and Australia. Grazing a wheat crop in early spring can provide green forage during the winter feed gap as well as offering weed control, disease control by reducing disease loci and reduced lodging risk by shortening crops.

Setting up the trial

The idea for the research came from discussions with John Pawsey about the black grass problem on his farm and methods of control, such as the importance of crop competition. He has previous experience of grazing wheat with sheep in the spring, with the aim of trying to investigate potential yield losses. He observed a negative effect on crop competitiveness from reduced crop cover later in the season.

The trials were designed to test the effects of sheep grazing on black grass abundance and on wheat crop performance in a normal and early sowing date.

The research was carried out at Shimpling Park Farm in Suffolk, over the 2014/15 and the 2015/16 growing seasons. Several key parameters were assessed over the course of the trials, including black grass head numbers, crop height, crop tiller counts, grain yield and grain quality assessments such as thousand grain weight and specific weight.

In both years' trials, two drilling dates were included as factors. A 'normal' sowing timing around mid-October was chosen to mirror the farmer's practice and act as a control

Figure 1: Sheep grazing plots in Mill Field in April '16 (Year 2)

and an 'early' sowing in both years was carried out 3-4 weeks before the normal sowing date. Drilling rates were adjusted according to the sowing timing as is normal practice (170kg/ha and 220kg/ha for early and normal sown respectively).

Grazing method

Sheep grazing took place in early spring and was left up to the farmer's judgement as to when, for how long and at what stocking rate. The only major stipulation was that grazing had to be suspended before the onset of wheat stem extension (BBCH 30), to avoid any damage to the apical meristem which would cause severe yield losses. Stocking rates in year one were 6.3LU per ha (Livestock Units) with the sheep left to graze for four to five days. In year two the decision was taken, due to bad weather, to increase the stocking rate (12.5LU per ha) and reduce grazing time to three days, allowing for a shorter grazing window. John removed the sheep from the plots when he felt that enough defoliation had taken place without causing undue stress and damage to the crop.

An important aspect of the trials was to work closely with the farmer and to let him take the management decisions that he would ordinarily take in his own system to give him control and create a more realistic situation.

One significant change to the trial was an adaption of the design from year one to simplify the drilling strips in order to reduce compaction from several passes of the drill. In each year and sowing time, we had three plots that were either grazed or ungrazed.

Data collected thereby were subject to analysis of variance (ANOVA) to separate the effects of grazing from the effect of the year and of the random variation in each sowing date.

Grazing effects?

Overall, grazing had a significant effect on black grass in the early sown crop (Figure 2). The density of black grass heads was nearly 20% lower in the grazed plots, whereas in the normal sown crop differences were not significant. This suggests that grazing may be an effective strategy to reduce a high pressure of blackgrass and buffer the risks associated with earlier sowing dates.

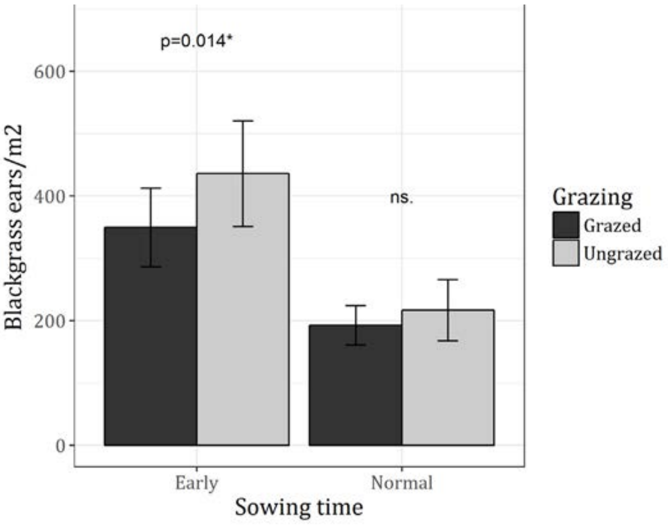


Figure 2: Effect of sheep grazing on blackgrass ear numbers for the two sowing timings. Bars are mean values over the two years (tot. 6 observations) ± standard error of the means. ANOVA p-values for the effect of grazing are shown.

Our study found a small reduction in grain yield from grazing but it wasn't found to be statistically significant for either drilling (Figure 3). However, the data suggest we can't be too certain that there is definitely no yield penalty for the normal sowing timing. These results suggest that a possible yield penalty from grazing in the normal-sown wheat was not mitigated by a significant reduction in blackgrass head numbers and an associated reduction in weed competition as was the case in the early-sown crop. An Australian review by Harrison et al. 2011[1], found that 270 dual purpose crop experiments (grazed or cut), revealed an average grain yield

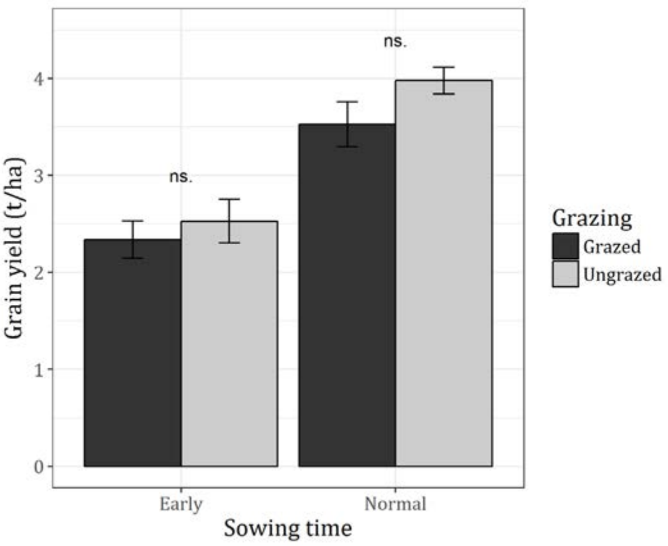


Figure 3: Effect of sheep grazing on grain yield for two sowing timings. Bars are mean values over the two years (tot. 6 observations) ± standard error of the means. ANOVA p-values for the effect of grazing are shown.

reduction of 7% (+/- 25%). Another consideration is that grazing took place on the same calendar dates (rather than days after sowing) so the crops were at slightly different stages of development. The less advanced normal sown crop may therefore have been less tolerant of grazing. It also means the black grass may not have been advanced enough to be damaged, hence the insignificant result for black grass ear numbers.

Related to these findings are the data from crop tiller counts which were not significantly affected by grazing in the early sown crop but which showed a strong trend towards reduction in the normal sown crop.

Another relevant finding is the significant reduction in crop height from grazing observed for both sowing timings, which may reduce the crop's competitiveness with some weeds but it didn't appear to be linked with black grass numbers since the shortest grazed crops were also the crops with the lowest black grass headcounts. Crop height reduction might be due to both a physical shortening and a delaying effect on crop development. The straw length at harvest retained much of this effect, resulting in a weakly significant 5% shorter straw in both early (p=0.09) and normal sown (p=0.07) crops (Figure 4). This effect might be relevant to the risk of lodging, which is associated with practices aimed at improving crop competition against weeds, such as increased sowing rates, use of taller varieties, and early sowing itself.

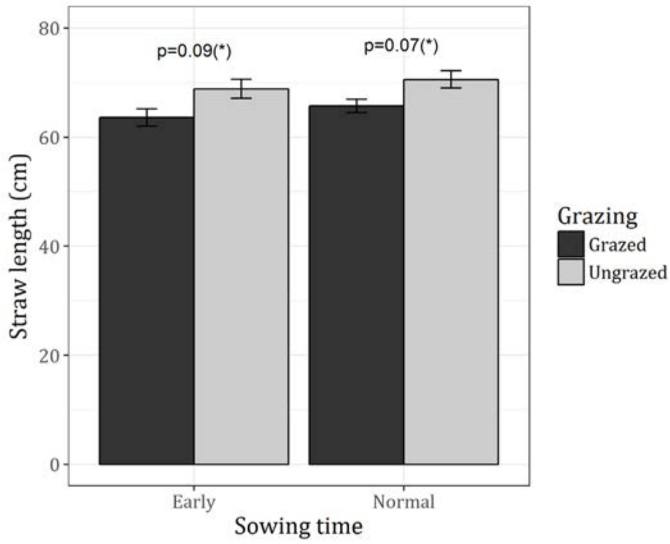


Figure 4: Effect of sheep grazing on mean straw height in July for two sowing timings. Bars are mean values over the two years (tot. 6 observations) ± standard error of the means. ANOVA p-values for the effect of grazing are shown.

Sowing date effects?

The trial design in year one allowed a comparison of sowing timings to be performed.

Year one data showed a 47% reduction in black grass head numbers from the later sowing date (early/mid-October). This figure is similar to data from a recent AHDB report[2] which showed a 33% reduction in black grass infestations from delayed sowing (though the study was conducted in non-organic cropping systems). The same study showed a 92% reduction in black grass numbers from spring sowing, highlighting the importance of moving away from autumn only rotations in intensive arable cropping systems where black grass is an issue.

Year one data also showed a significant increase in grain yield (p= 0.00) by 71% from 2.11t/ha to 3.61 t/ha, with reduced black grass density the most likely cause of this yield difference.

The other interesting result from the analysis of variance for year one data was a significant (p=0.05) interaction between sowing timing and grazing, which shows that the efficacy of grazing depends on the sowing date, with the biggest effect observed for the early sowing timing. Grazing is much less effective for black grass control on normal sown wheat.

Further rotational benefits from sheep grazing?

Beyond any possible weed control benefits of integrating sheep into an arable rotation there may be additional benefits that are harder to quantify and were beyond the scope of this study. These include but are not limited to: diversity of mixed farming systems, improved livestock nutrition (extra forage making the most of cereals as both forage and grain crops), added fertility from sheep, decreased soil weed seed bank and improved economics of making the grass ley phase of the rotation more profitable.

For those who might be interested in trying this practice an Australian review by Harrison *et al.*[1] lists the key management strategies (in order of importance) as;

1. Terminating grazing at or before BBCH 30
2. Matching crop phenology to environment type
3. Sowing crops to be grazed 2-4 weeks early
4. Ensuring good crop establishment prior to grazing.

Although point 3 is at odds with the findings of this study and many others suggesting that a later sowing date is preferable for black grass control (and a subsequent improvement in yield) in areas of high black grass pressure, the dual purpose technique may still be successful in farming systems where black grass is not a major issue.

Further investigation is needed in different cropping systems with different weed burdens to establish how and where the technique of sheep grazing winter cereals in spring can best be applied but it would appear from our findings and from other research that, if early sowing is a prerequisite of the technique, that it is probably not best suited to farms with a lot of black grass.

Interestingly the traditional technique may be more useful for those non-organic farmers taking an integrated approach as not only is blackgrass more of an issue in more intensive arable cropping systems that don't contain grass leys and are winter crop heavy, but it may have some extra benefits for those applying synthetic nitrogen by reducing crop height and therefore lodging risk.

The practice may also be tested on more traditional heritage varieties that may be better suited to the practice and to organic cropping systems, such as Maris Widgeon, which is taller than modern varieties and may therefore benefit from the reduced risk of lodging while still maintaining its competitiveness with weeds.

Conclusions

In terms of black grass control in winter wheat it wouldn't appear to make much sense to introduce sheep onto the crop since the data from both years show that sheep grazing is only effective at reducing black grass in a mid-September sown crop, and it is inadvisable in an area of high black grass pressure to sow your crop 'early'. Data from year one show that drilling date is far more important as a factor for black grass control (47% reduction in black grass ear numbers from an early/mid-October sowing) than grazing (21% reduction in black grass ear numbers).

This does not mean to say that the technique of cereal grazing can't be used to good effect for supplying extra forage during the winter feed gap or that it may not be useful in controlling other weeds and providing some of the other rotational and system benefits discussed.

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Field lab underlines importance of ruminating cycle

Conducted as part of Innovative Farmers, this field lab highlights the value of herd observation and analysis using the Obsalim® technique. ***Susanne Padel*** *provided some research support to the group.*

This field lab, held over the past two years, suggested the technique reduces feed costs and improves efficiency by making rumen stability better. Three herds participated in the field lab. An important finding for all herds was the need to establish a synchronised eating and ruminating cycle – helping to prevent overeating.

Edward de Beukelaer showing a selection of Obsalim cards

All dairy farmers are constantly observing their herds. But this group of Innovative Farmers used the Obsalim® technique to help analyse the physical condition of their animals. This technique allows the farmer to identify everyday signs (e.g. the condition of the coat or composition of their dung) and using a set of 'symptom cards' identify what is happening in the rumen. Following a diagnosis, changes to the distribution or composition of the ration, or to the management of the herd can improve the efficacy of the transformation of the ration, potentially reducing costs and making the herd more productive.

Christine Gosling at Berkeley Farm Dairy, near Swindon, was involved in the field lab. She said; "I had heard about the 'Obsalim®' technique, which was developed in France, from my vet Edward De Beukelaer and after using the technique for a while wanted to share my knowledge with other farmers so I initiated a field lab through Innovative Farmers to run a trial.

"Through the field lab Edward could teach us how to use the cards effectively and how to recognise the symptoms. It has taken a while to feel really confident in using and applying the system unaided but overall it allows us to reduce input costs whilst improving the efficiency of the herd."

The field lab was run through Innovative Farmers, a not-for-profit network that gives farmers the tools to run their own investigations into common farming problems. Through the Innovative Farmers network farmers are encouraged to share their experiences to improve their farming techniques and farm viability.

A large part of this field lab involved training from Obsalim® specialist, Edward De Beukelaer. Kate Still of the Soil Association facilitated the group, and together they were able to support the farmers involved in the field lab. Repeated meetings were held at each of the three farms to assess the herds and make suggested changes to management or feed rations.

It was noted that in order for the herd to find their rhythm and ruminate effectively it was important to allow them to synchronise. Splitting the feeds into morning and afternoon and establishing an undisturbed period of rumination in between improved rumen function.

Kate Still, animal welfare advisor at the Soil Association said; "This field lab has really shown us that to allow cows to make the most of the feed they are given they need both time to digest it effectively and structural fibre to aid that digestion. Establishing a system that allows the herd to feed together and then lie down and ruminate together, undisturbed, enables them to be more efficient at converting feed and healthier as a result. Cows that are disturbed by others feeding or by having feed constantly available are more inclined to snack and over eat, resulting in poor rumen function. Training calves to establish this rhythm early on results in healthy rumen function from the start."

The trial at Manor Farm, Waterhay, Wiltshire

At Manor Farm the ration was split into two feeds to help establish a synchronised ruminating phase from late morning until milking. As a result of more efficient feed conversion both silage and concentrate feed could be reduced with no drop in milk production, in fact Manor Farm had a 6,000 litre increase in production during the trial period over what was expected. The cows also had better overall condition with none needing to be dried off too early.

Other alterations to feed following observations and analysis included adding straw and hay to the diet to increase structural fibre and help with rumen stability.

Nick Freeth of Manor Farm commented: "Over the trial period we logged an extra 6,000 litres of milk, at the same time as reducing our feed costs. The cows looked healthier too. It's hard to put a price on that!"

All farmers involved in the field lab reported benefits to the herd and emphasised the importance of understanding their cows. The group is now looking for new members to continue to learn and share experiences.

To find out more about this field lab and how to join the Innovative Farmers network:
https://www.innovativefarmers.org/

Mind the gap – exploring the yield gaps between conventional and organic arable and potato crops

The OK-Net Arable project promotes exchange of knowledge among farmers, farm advisers and scientists with the aim of increasing productivity and quality in organic arable cropping in Europe. ***Janie Caldbeck*** *and* ***Phil Sumption*** *present the findings from some of the project outputs[1,2] so far, concerning the yield gaps between conventional and organic crops.*

What does research tell us?

An increasing yield gap between organic and best practice conventional agriculture is becoming evident. Reviews of global literature for temperate and mediterranean climate zones reveal the difference in yield gaps of organic and conventional farms range from 9-25% (see Table 1 below), with 20% identified in the two most comprehensive studies reviewed. The comparative ecological advantages of organic farming systems are considered relevant as long as the yield difference is no bigger than 20%. In this range of approximately 20% less yields in organic farming, N_2O emissions have been found to be equal in organic and conventional systems. However within the context of a growing yield gap, the role of organic farming could be questioned; some research findings have revealed that yields of organic crop rotations shrank to 50% even under good climate and soils conditions, in comparison to yields attained within good integrated farm practices. It is vital that best organic practices are combined with ecological, social and technological innovation in order to address this.

Table 1: Yield gaps calculated by different meta-analyses (all categories and all crops under consideration)

Study	*Category*	*Crop*	*Yield gap*
Lotter 2003	All	All	-10-15%
Seufert et al. 2012	All	All	-25%
Stanhill 1990	All	All	-9%
Ponisio et al. 2014	All	All (global)	-19%
de Ponti et al. 2012	All	All	-20%
Badgley et al. 2007	All	All (developed countries)	-9%

Applying an agroecological approach

The report *The Role of Agroecology in Sustainable Intensification[3]* also provides some valuable insights. Analysis of different farming approaches points towards agroecological approaches being able to maintain or increase productivity, with the exception of organic farming, where yields per hectare may be substantially reduced due to restrictions on the use of agrochemical inputs. However organic system productivity with respect to other inputs including labour, and in terms of resource use (other than land) per unit of food produced, may be similar or better.

Agroecological practices, such as using rotations and polycultures, biological pest control, or legumes to biologically fix nitrogen (N), can be used by farmers across all farming systems. Agroecology emphasises the idea of 'system redesign' rather than 'input substitution' for maximum benefit.

Low yields are perceived to be a disadvantage of the organic approach (although reductions compared with conventional systems reported in different studies have been highly variable). In the UK, organic wheat yields are typically little more than half those of conventional systems. However, this reduced productivity is exacerbated by the need for fertility building crops in the rotation, meaning that organic farmers cannot grow wheat every year. The additional land area required to grow a tonne of wheat may therefore be higher than a simple comparison of relative yields would suggest.

Some research suggests that with good management practices, particular crop types and growing conditions, organic systems can nearly match conventional yields. Studies have also found that multi-cropping (polycultures) and crop rotations when applied only in organic systems could substantially reduce the yield gap.

Why the gap exists

Crop yield is the result of a transformation of natural resources, farmer knowledge and system inputs. All three transformation processes differ between organic and conventional agriculture and the biggest differences are on the input side (see Figure 1).

1. Transformation of natural resources

Both conventional and organic systems rely on a starting point of site-specific natural resources: light availability, the inherent fertility of the soil, and local climatic conditions. However, conventional and organic systems do not necessarily respond identically to the same starting conditions. Higher soil microbial diversity and activity in soil commonly found under organic conditions may

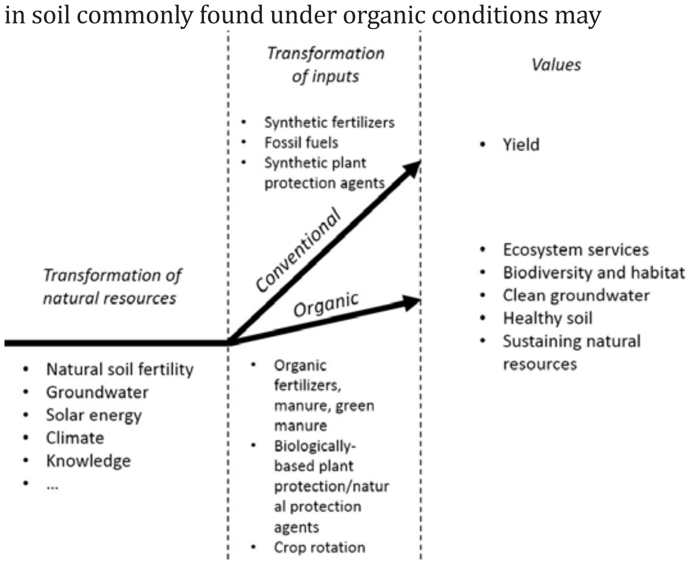

Figure 1: Cropping systems as a process of transformation: a conceptual model (farmer knowledge is mentioned under natural resource for simplicity of the figure only).

increase the bioavailability of nutrients and organic carbon stored in the soil to crops managed under these conditions. Organically managed soil also has advantages in dry conditions, with higher soil organic matter levels increasing soil water capacity. Compared with conventional approaches, organic agriculture provides a more attractive alternative under changing climate conditions; it increases carbon sequestration, has higher energy use efficiency and resilience to climate change, and reduces global warming potential.

2. Farmer knowledge

All farming systems depend largely on farmer knowledge. Organic and conventional farmers both use the best available and appropriate technology and the knowledge related to it. Conventional farmers however have more 'quick fixes' available, while organic farmers rely more on observations of agroecosystems, preventative planning, and traditional knowledge. Knowledge about organic agriculture is less widely available and more time consuming to acquire.

3. System inputs

As can been see in the model illustrated in Figure 1, conventional farmers have the upper hand in transforming inputs into yield. Applying this model to cereals, grain and forage legumes, oilseeds, and tubers, helps to explain why yield gaps reported in meta-analytical studies differ for these crop categories. Differences in inputs account for conventional/organic yield gaps, but each crop category is unique in terms of which inputs are most significant. Gaps are not determined by the average of yield losses imposed by individual factors, but by the factor that has the greatest influence on yield, i.e. nutrient availability for cereals and tubers, weeds and disease for legumes, insect pests for oil crops such as rapeseed.

Table 2: Yield gaps calculated by different meta-analyses (category 'cereals', different crops under consideration)

Study	*Crop*	*Yield gap*
Eltun 1996	Barley, oats, wheat	-30%
Eltun et al. 2002	Barley, oats, wheat	-35%
Gabriel et al. 2013	Cereals	-54%
Poutala et al. 1994	Cereals	-25%
Seufert et al. 2012	Cereals	-26%
Badgley et al. 2007	Cereals (developed countries)	-7%
de Ponti et al. 2012	Cereals (global average)	-21%
Cavigelli et al. 2008	Corn	-24-41%
Larsen et al. 2014	Corn	-50%
Poudel et al. 2002	Corn	NS
Wortman et al. 2012	Corn	-13-33%
Lotter et al. 2003	Corn (legume rotation)	-62%
Lotter et al. 2003	Corn (manure-fertilized)	+37%
Wortman et al. 2012	Sorghum	-16-27%
Cavigelli et al. 2008	Wheat	NS
Ryan et al. 2004	Wheat	-17-84%
Wortman et al. 2012	Wheat	-10-+10%
Arncken et al. 2012	Winter wheat	-42%
Bilsborrow et al. 2013	Winter wheat	-39%
Hildermann et al. 2009	Winter wheat	-38%
Mäder et al. 2002	Winter wheat	-10%
Mäder et al. 2007	Winter wheat	-14%
Mayer et al. 2015	Winter wheat	-36%
Posner et al. 2008	Corn, soybean, wheat	-10%

What does research reveal per crop type?

Cereals

The yield gap for cereals as a whole has been found to be generally lower than for vegetables, but higher than for legumes. As can be seen in Table 2, statistical analysis has revealed yield gaps for cereals fall within a range of 7-26%.

Maize has generally been found to have a smaller yield gap than the overall average for all crop types, whereas barley and wheat have larger yield gaps. It is possible that barley and wheat do not perform well under lower input conditions as they have been bred to thrive in high input conditions. The productivity of maize in organic systems may be explained by the necessity to wait for planting until the soil is warm enough and mineralisation activity is high enough. Weeds can be a major limiting factor, however, organic weed management can be very effective; the yield gap has been found to be as little as 1% in years where mechanical weed cultivation was successful; 26% when it was unsuccessful. Crop rotation can also have significant impact; organic maize grown in rotation with multiple cover crop species can yield over 100% more than organic maize grown in monocultures, attaining yields comparable to the county average for conventional maize.

Research has found nitrogen (N) availability is the primary factor limiting cereal productivity, and differences in N inputs account for the majority of yield gaps. Natural N mineralisation processes often do not correspond with the times of greatest N uptake in wheat, so N availability from natural sources has less impact than inputs that help to form crop yield. Synthetic N fertilisers can be better targeted to crop demand peaks in conventional systems, and cereal yields can be higher in these systems. However, it is possible to increase N availability by using organic best practices. Research shows that supplementing with farmyard manure can raise organic cereal yields in a N-limited system. Use of biogas slurry or green manure and management strategies that better match the timing of N availability to crop requirements can also increase N availability.

Protein content is often considered an important indicator of quality in cereals; it contributes to baking properties and has been the subject of many conventional/organic comparisons. Studies have found 3-23% lower protein content in organic wheat as compared to conventional, with N limitation being the key factor. However, other factors should also be considered e.g. quality rather than quantity of protein gives a better indication of the baking properties of organic wheat, and the practice used by conventional farmers of applying fertiliser late in the year to boost grain protein often leads to it leaching into groundwater and causing nitrate pollution.

Lampkin *et al.*[3] report interesting findings when the productivity of whole farming systems was assessed (and the total production of commodities from a system measured, rather than individual commodities), and applied to data for different farm types taken from the 2009 English Farm Business Survey (FBS). It was revealed that organic specialist cereal, general cropping and mixed farms performed less well compared to non-organic than dairy farms in terms of tonnes of wheat equivalent (tWe) produced per hectare. This may be related to findings that arable farms generally have much higher gross energy outputs per hectare than dairy farms. The results reflect the impact of using some land for fertility-building in organic farming, and emphasise the challenge for farmers of using the fertility-building phase of the rotation effectively. The performance with respect to farm business income per tWe produced and tWe produced per £ spent on inputs was found to be higher than conventional, despite the lower output per hectare. Greenhouse gas emissions were similar between organic and conventional with respect to tWe produced.

Lampkin *et al.*[3] also reflect on the extent to which yield differences can be explained by the N dependency of conventional systems. Research has found that increased N use in conventional production has widened the yield gap to organic. Non-organic UK wheat yields have varied with nitrogen use since the mid-1970s. N can be a major yield-limiting factor in many organic systems. UK organic wheat yields, at 4-5 t/ha, are comparable to conventional yields in the mid-1970s, and much higher than pre-war yield levels when no fertilisers were used. In the US, where conventional wheat is produced less intensively (with average yields about 3t/ha), studies show more similar yields. Within the UK, yield differences for crops such as oats and field beans, where less N is used conventionally, are also lower.

Legumes

Yield gaps are generally much smaller for legumes than for other crop categories. This is due to greater farmer reliance on natural sources of fertility (legumes obtain N primarily through the symbiosis with diazotrophic bacteria), crops requiring negligible inputs, other nutrients not usually being limited, and plant protection agents being seldom used. Lampkin *et al.*[3] highlight that better performance of legumes and perennials could be due to better N utilisation, rather than higher N levels. In many developing countries, resource-poor farmers unable to afford purchased N fertilisers have demonstrated potential to increase yields using organic/agroecological approaches. Grain legumes have been found to have a slightly higher yield gap than forage legumes, but the gap is still much smaller than for other crop categories, and yields can sometimes be higher under organic conditions. Beans have been found to have significantly higher yields under organic conditions. In developed countries, the yield gap for legumes has been found to be higher than cereals (see Table 2 and Table 3). Legume yields were 52% higher under organic conditions when considered globally.

Table 3: Yield gaps calculated by different meta-analyses (category 'legumes', different crops under consideration)

Study	***Crop***	***Yield gap***
Seufert et al. 2012	Legumes	NS
Badgley et al. 2007	Legumes (developed countries)	-18%
de Ponti et al. 2012	Legumes (global average)	-12%
Cavigelli et al. 2008	Soybean	-19%
Wortman et al. 2012	Soybean	-17%
Lotter et al. 2003	Soybean (legume rotation)	+96%
Lotter et al. 2003	Soybean (manure-fertilized)	+52%

Yield gaps can arise when inputs differ significantly. The way in which weeds and diseases are managed can limit organic yields if no biologically-based strategies are used. The largest yield gap calculated for soybeans has been attributed to pest and disease management and phosphorus limitation. The 19% soybean yield gap (see Table 3) was attributed entirely to weeds.

Oil crops

The yield gap between oil crops grown organically and conventionally is often small (see Table 4). Some crops such as oilseed rape can be impossible to grow under organic conditions due to insect pests. Sunflower is a crop for which organic yields levels can often equal conventional levels, contributing to the small yield gaps reported for oilseeds. Ponti et al. (see Table 4) found organic oilseed yields to be 26% lower than conventional due to insect herbivory and there being no effective organic methods of control for pests such as the pollen beetle. Oilseed rape however is unusual as almost all production in Central Europe is conventional. Yields can also be affected by weeds, particularly when crops are at sensitive developmental stages, but differences in plant protection agents have the biggest impact on the yield gap. This suggests that research into organic pest control methods should be prioritised.

Table 4: Yield gaps calculated by different meta-analyses (category 'oil crops')

Study	***Crop***	***Yield gap***
Seufert et al. 2012	Oil crops	NS
Badgley et al. 2007	Oil crops (developed countries)	-1%
de Ponti et al. 2012	Oil crops (global average)	-26%

Tubers

The yield gap for tubers is often greater than for cereals but can be more variable (see Table 5). Of 21 organic/conventional comparisons carried out of organic potato yields in Europe, the yield was found to be only 70% compared to conventional. Organic sugar beet and sweet potato yields however were 105%, raising the tuber average to 74% of conventional. In potatoes, the primary yield-limiting factor is nutrient availability. Pathogens such as P*hytophthora infestans* also have a big impact. Some research has found that 48% of the yield gap in organic potato could be attributed to N limitation, and 25% to disease for which no organic management is possible. Inputs of synthetic fertilisers and plant protection can therefore be primarily attributed to the higher yields found in conventional farming.

Table 5: Yield gaps calculated by different meta-analyses (category 'tubers')

Study	***Crop***	***Yield gap***
Eltun et al. 2002	Potato	-15%
Mäder et al. 2002	Potato	-36-42%
Badgley et al. 2007	Starchy roots (developed countries)	-11%
de Ponti et al. 2012	Roots/tubers (global average)	-26%

How do European yields compare?

Work with farmer innovation groups within OK-Net Arable has gathered data about the 14 organic farmer groups involved (located in 10 countries). All groups are formed from members who are a mix of new entrants and experienced organic farmers, and most groups include farmers who have farmed organically for over 10 years. The information below presents the average yields for each crop type recorded by the farmer groups, taken directly from the report *Description of farmer innovation groups*:

Wheat: In Bulgaria the reported variation in yields across the group ranges from 0.3 to 8t/ha. Excluding this group, yields range from 1 to 6t/ha with a likely average somewhere around 3t/ha.

Barley: The yield range is 1 to 7t/ha although only Belgium reaches yields that high with most groups reporting yields between 1.5 to 6.5t/ha.

Triticale: The picture is similar to barley with an overall range in yield between 1t/ha and 9t/ha. Again it is only the Belgian group that reports such high yields with the five other groups growing the crop failing to exceed 6t/ha. The lowest yielding group are BASE-ABC in France who yield as low as 1t/ha.

Rye: The range of yields is less variable (1.2-6.5 t/ha) with the highest yields from Sjaelland in Denmark, and the lowest in Bulgaria.

Spelt: Yields range from 0.8 to 5.5 t/ha with Hungary yielding highest and Bulgaria yielding lowest.

Oat: Yields range from 1.6 t/ha to 6.5t/ha with Vejle, Denmark having the highest yield and Estonia having the lowest yield.

Maize: Crop yields range between 0.8 and 15t/ha with Schlägl, Austria reporting yields of 10-15t/ha while Bioselena, Bulgaria reported yields of only 0.8 to 2.5 t/ha.

The only root crop grown by more than one group is potatoes and yields for these vary drastically in the Belgian group from 15 to 40t/ha. Yields are less varied in Austria (Schlägl), ranging from 15 to 25t/ha.

Faba bean: Yields vary from 0.5 to 5t/ha across all groups. The lowest yielding group farms in Bulgaria while the highest yielding group is Sjaelland in Denmark. Pea yields are less variable than faba bean yields, ranging from 1 to 4.5t/ha. Vejle Denmark has the highest yields, while RotAB, France has the lowest. Estonia also has quite low yields in comparison with the other groups.

Soya bean: Yields range from 0.5 to 4t/ha with a relatively small range of yields within each group. Hungarian yields are lowest, with both French groups yielding highest.

Grass/clover: yields between 5 and 12t DM/ha have been reported across the groups, with Belgium yielding highest and Schlägl in Austria yielding lowest.

Lucerne: Yields vary widely from 0.5 to 15t DM/ha. The Bulgarian group has the lowest yields while the highest yields are from the Italian group but there is a wide range of yields reported from this group of 4.5 to 15t DM/ha.

Table 6: UK Organic arable farm crop data (t/ha)[4]

Crop	Farm	2010	2011	2012	2013	2014	2015
First Winter wheat	1	5.5	4.2	2.4	3.8	3.8	3.2
	2	4.6	4.5	3.0	3.0	4.1	5.5
	4	3.5	3.8	3.0	2.7	5.1	4.4
	5			3.2	4.1	3.8	6.9
First W and S. wheat	3	3.4	3.0	2.4	2.6	2.6	3.2
Spring wheat	5			1.6	3.2	3.5	4.4
Second S. barley	4	4.5	3.6	1.9	3.9	2.2	3.8
W/S oats	2		5.5	5.7	4.5	3.7	4.2
Winter beans	1	3.3	3.4	1.1	3.8	3.2	4.6
	5			1.6	2.0	3.7	6.0

How do your yields compare?

Variation in yield is likely to be due to physical variations, i.e. climate and soil, and differences in management practices. Although there do not appear to be any clear trends in terms of climatic zones, northern temperate groups from Belgium and Denmark tend to achieve the highest cereal yields, while groups based in Bulgaria and Estonia tend to have lower yields. Though the highest yields achieved are comparable with conventional yields (particularly for grain legumes) there is a much bigger spread and greater variation.

The data suggests a need to improve yield performance and stability. A similar picture can be seen in some recently collated data from 5 UK organic arable farms (Table 6) representing a wide range of soil types. It also shows extreme variability for all crops, and reported yields of approximately 50% that of conventional yields for wheat.[4] All the data collated points towards the possibility of improving average yields through knowledge exchange aimed at improving agronomic practices. This highlights the value of the OK-Net Arable project and reiterates the importance of organic practices being combined with ecological, social and technological innovations.

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After Brexit, what can organic farming contribute to future agricultural policy?

*This article was written as a Briefing Note on behalf of the English Organic Forum, which is chaired by **Nic Lampkin**. It sets out our agreed views on the post-Brexit policies and priorities for organic food, farming and growing, as communicated in a letter to Minister of State George Eustice MP on 9th November 2016.*

Organic food and farming makes a positive contribution in terms of environmental and other public goods, as well as economically through the market for high value organic food.

The organic market in the UK is now back in strong growth for the third year running, growing at over 5% per annum, and we are seeing producers responding to the opportunities. Globally, organic growth was either not, or only barely, affected by the recession which started in 2008. The four largest organic markets in the world, in the USA, Germany, France and China, have continued to grow strongly – the latest figures show the US and Germany growing at 11%, and China growing at over 25% per annum.

To support the continued growth of the UK organic sector and take advantage of future opportunities, we believe that government, in partnership with the businesses involved, needs to:

1. Support the expansion of organic production and marketing initiatives

The high growth markets listed above are key export destinations for English organic food, and all of them present very significant opportunities for future growth in our exports. All of these markets are suffering from domestic organic production not rising as quickly as market demand, and that applies with equal force in England. These opportunities are directly compatible with current Government priorities, and future Government policies should continue to drive an expansion of English organic production and marketing initiatives (such as public procurement and trade missions, supported by better market data), to enable us to meet domestic demand, and to fuel organic exports.

2. Recognise and support the environmental and other public goods delivered by organic production

We strongly support the switch of public payments to farmers to focus on the delivery of public goods, supported by clear scientific evidence of impact. There is a strong scientific evidence base for the positive public impact of organic farming, which:

- delivers more wildlife and biodiversity, including soil organisms, plants, animals and birds,
- reduces reliance on antibiotics in livestock systems,
- delivers better water quality, with substantially less diffuse pollution because of the almost complete absence of pesticide use in organic farming and no use of manufactured nitrogen fertiliser,
- produces a varied and diverse landscape,
- helps reduce climate change impacts,
- builds soil organic matter and thus helps store carbon in soils,
- encourages the creation of high-quality and locally diverse food, and
- encourages a higher proportion of both women and young people into food production.

All of this is consistent with Government priorities, and was recognised in the joint Defra/organic sector Organic Action Plan published in 2004, as well as the evidence base considered for the current RDP Countryside Stewardship organic options. There is also much that can be learned from the experiences of organic producers, and their focus on ecological as well as technological innovation, to the benefit of all farmers and growers.

Organic farming standards require farmers to implement a change in farming system which delivers this wide range of public goods, and allows high value for money from public payments made in return for those public goods, as has been recognised by the National Audit Office in the past. Organic production should therefore continue to feature in future support arrangements to deliver both the public goods identified and enable farmers and growers to take advantage of the market opportunities.

3. Ensure that Countryside Stewardship organic conversion and maintenance options continue to be available until we leave the EU

An immediate priority, therefore, is to see the Countryside Stewardship scheme payments for organic conversion and maintenance in England continuing to be made available to all farmers who wish to convert to, or remain as organic. We await formal confirmation that this includes current organic support options from Defra. The organic CS options are not only consistent with Government policy priorities, they also offer value for money as the premium prices paid for organic products reduce the income foregone to deliver them, and therefore the extent of the support payments required.

4. Continue the legal basis for organic standards to ensure public confidence and continued access to global export markets

We welcome the comments Ministers have made about using existing inspection and certification schemes as a vehicle for paying for public goods in future. Organic farming and food is the only part of the agricultural industry covered by legally defined standards, with accredited independent inspection and certification. This is an essential basis for the consumer confidence and trust in organic labelling that has enabled the market, in the UK and globally, to expand as it has. We believe that this legal basis also provides a ready vehicle through which support for organic farming and growing can be channelled at minimal transaction costs and with no additional red tape.

Stability is required for businesses to build exports. We believe that continued adherence to the European Organic Regulation will help our export efforts. Given the rapidly growing demand for organic food in a number of European countries, particularly Germany and France, our proximity to those markets, and our existing exports to them, we would expect a large proportion of organic exports to continue to go to countries covered by European Organic Regulations.

Organic exports to both China and the USA, also of great importance, are helped by our adherence to European standards and the reciprocal recognition agreements that are in place. We will need to negotiate, ahead of any broader trade agreements, to ensure that current organic recognition agreements, for example between the US and EU, are maintained as bilateral agreements, which should be possible on the basis of regulatory continuity. On a similar basis, further bilateral organic-specific agreements could be possible, potentially ahead of similar agreements with the EU.

We therefore ask that the UK continues to meet European Organic Regulation Standards. We believe that the Great Repeal Bill will transpose the EU Organic Regulation into UK law, along with other EU legislation, as the Prime Minister has said, and we would welcome the certainty and stability that this offers. There will of course be opportunities to review the process of implementing these regulations, to reduce the burdens on Defra and organic businesses, which we would be happy to discuss.

Conclusion

In conclusion, in order to meet UK market demand, maximise export opportunities and deliver public goods, it is vital that organic farming continues to receive justified levels of public and government support, in return for the public goods delivered and the other contributions the sector makes to meeting Defra's strategic objectives. We would welcome recognition of this in the Farming and Environmental 25-year plans and the Food and Drink Policy currently under development in Defra.

The English Organic Forum aims to contribute a unified organic perspective into government policy debates and represents the whole organic sector in England, including all the main organic charities, trade organisations and Defra-approved certifying bodies. Member organisations include: Abacus Agriculture Ltd.; Biodynamic Association; Garden Organic; National Farmers Union Organic Forum; Organic Arable; Organic Farmers and Growers CIC; Organic Food Federation; Organic Growers Alliance; Organic Milk Suppliers Co-operative; Organic Research Centre; Organic Trade Board; Soil Association and SA Certification Ltd., Triodos Bank; UK Organic Certifiers Group. It works closely with the Scottish Organic Forum and the Organic Group of Wales.

Can you help us?

The challenge of responding to the Brexit debate, preparing briefing papers, consultation responses and supporting evidence, is significant. We need a full-time policy officer, to work with our senior research and policy staff to deliver the goods. We need to raise £50kpa for 2017 and 2018. Can you make an immediate donation, regular payments or pledges for future support. Contact us if you would like to know more.

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Join ORC's Farmer and Business Supporters' Group

ORC is at the forefront of UK research on organic and other agroecological approaches to sustainable and healthy food production, including knowledge exchange and policy advocacy on behalf of organic farmers and businesses.

While much of this work is supported through project funds from the EU, governments and foundations, we rely heavily on donations from individual supporters to provide vital underpinning for our activities.

Regular monthly or annual donations help us to plan ahead with greater confidence about our ability to undertake new initiatives on behalf of organic farmers and food businesses.

Will you join the growing band of farmers and businesses willing to support us like this?

We're not just asking for your support – we're offering something in return to say thank you!

FAB supporters have:

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- Opportunities to participate in bids and funded projects;
- Networking opportunities and events;
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- Access to the research team and a quarterly update on progress and staff news, with links to on-line resources, for each of the main areas of ORC activity;
- Links to and (optional) membership of relevant on-line discussion forums;
- Discounted access to ORC conferences and events, including our next annual conference, 1-2 February 2017 in Birmingham;
- Free subscriptions to ORC's quarterly printed bulletin, monthly e-bulletins and the Organic Farm Management Handbook every two years or so.

Please give us your support and sign up today!

To join the ORC FABS group, please pledge a regular annual donation (or monthly equivalent) of at least:

£100 (Supporter) £250 (Bronze)
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£5000 (Platinum/Organic Ambassador)

We are keen to recognise the different levels of support, but all supporters will receive the same benefits.

To register, please contact Gillian Woodward at ORC.

01488 658298 ext. 554

gillian.w@organicresearchcentre.com

Coordinating organic plant breeding activities for diversity (COBRA)

*Plant breeding plays a crucial role in creating organic crop production systems that can better cope with increasing stresses, including climate change. Producers need crop varieties with good resistance against pests and diseases, especially seed-borne diseases; the ability to react to environmental, especially climatic variability; and high competitiveness against weeds. This summer saw the completion of COBRA, the ORC-led trans-European organic breeding project. Project leader **Bruce Pearce** reflects on the project's achievements in this area.*

Ensuring seed quality and health

Breeding for resistance

In wheat, considerable progress was made in unravelling the range of bunt resistance genes and of virulence genes in the pathogen, together with how often these genes occur and where. Molecular techniques revealed the presence of major gene resistances to dwarf and common bunt. Partners in different countries were able to show, however, that only two of these genes provided resistance to dwarf and common bunt at all locations. Experiments on a series of composite cross populations (CCPs) showed there was no evidence of adaptation of the populations to the disease, which may indicate a more rapid response of the pathogen to changes in the host, rather than the reverse.

More than 1,000 landraces and cultivars of barley were tested at a range of European centres for resistance to seed-borne diseases, including net blotch, leaf stripe and loose smut. Many resistant lines were found, including some with previously unknown resistance to leaf stripe. Tests were also made for nutrient use efficiency, demonstrating a positive relationship between N and P use efficiency. In tests in Estonia and Latvia, a number of potentially useful breeding lines were identified, including some with resistance to loose smut. Tests with inbred lines of barley, which carry markers for loose smut resistance, unfortunately showed that some were susceptible to smut, indicating that current markers for resistance are not wholly reliable.

Seed testing

Good progress was made in determining the vitality of single barley seeds through application of a new method for measuring oxygen variation. The related software application produced values that help to indicate samples with potential high germination. In addition for wheat and triticale, multispectral imaging and Single Kernel Near-Infrared Spectroscopy (SKNIR) proved valuable for distinguishing uninfected and infected parts of the surface of a seed and to distinguish between different varieties.

Disseminating information from COBRA at NOCC

COBRA supported and developed organic plant breeding and seed production with a focus on increasing the use and potential of plant material with High genetic Diversity (Hi-D) in cereals (wheat and barley) and grain legumes (pea and faba bean). Its strength was its focus on coordinating, linking and expanding ongoing organic breeding activities across Europe, drawing together experts from previously fragmented areas.

COBRA worked to improve methods ensuring seed quality and health; determine the potential to increase resilience, adaptability, and overall performance in organic systems by using crop diversity at various levels; improve breeding efficiency and to develop novel breeding methods to enhance and maintain crop diversity; identify and remove structural barriers to organic plant breeding and seed production; and improve networking and dissemination in organic plant breeding.

COBRA's achievements are:

- Successful coordination of many teams allowed huge screening activities for disease and climate change resistance/resilience to be undertaken
- Successful demonstration of the superior resilience of diverse composite cross populations (CCP) under a large number of environmental conditions
- Improved understanding of resilience of CCP performance
- New CCPs of winter and spring wheat resistant to bunt
- Barley molecular markers to help select genotypes suitable for climate change
- Improved approaches in identifying individual seed actual and potential resistance to seed borne diseases
- Progress made with organic trials of grain legumes
- Development of seed policy. Advances in work on legislation through cooperation with other projects and policy makers.
- Good dissemination via many field days, congresses, even beyond the end of COBRA, etc.

COBRA had 41 partners (both industry and research) from 18 countries and a total budget of more than €4M of which €2.9M was funded by ERA-net CORE Organic II by national funds to each partner. CORE Organic II is a collaboration between 21 countries on initiating transnational research projects in the area of organic food and farming. CORE Organic II has initiated 14 research projects.

Seed treatments

Clove oil, tea-tree oil and thyme oil were tested in the field for their ability to control the *Ascochyta* blight fungal complex in peas. Seed treatment was found to be damaging but foliar sprays appeared to be as effective as copper sulphate sprays, suggesting that they could be an alternative to copper applications. Extracts of clove and thyme oil applied to pea, field bean and lupin in the lab were found to be effective against other important seed-borne pathogens, which was not the case for oils from tea-tree and common juniper. The activities that were found now need to be trialled in the field to see if they are effective in a more realistic situation.

Increasing resilience, adaptability and performance

Coping with climate change

More than 12 partners across Europe were involved in field trials with a wheat CCP that cycled around the countries. The CCPs performed exceptionally well with respect to an emerging epidemic of yellow rust at all test sites. The data showed the benefits of genetic diversity when coping with unexpected stress such as yellow rust and severe drought. They showed evolutionary changes occurred for morphological traits (the form of the plant) such as stem length, ear length and degree of ear awnedness, but not for grain yield, disease incidence or molecular markers. This suggests that selection for morphological changes can occur within only two to three years, while agronomic traits such as grain yield and disease resistance are not affected in this time frame. The CCPs' baking quality often suggested lower potential performance than pure stands, however, in practice, baking volume usually did not differ from the high baking quality of conventional varieties. The results showed the plasticity of the CCPs and their ability to adapt and change within short time periods of only two to three years under selection.

Coping with weeds and intercropping

It has been thought that one of the factors associated with the resilient performance of wheat populations was effective competition with weeds, relative to the parents or other monoculture varieties. However, the project studies showed that although root and seedling development in the populations appeared to improve over generations, at least under organic conditions, such development was associated more with nutrient use efficiency (NUE) and competition for light than with direct weed competition since no allelopathic interactions were detected. Early root and seedling vigour was more strongly shown in a 'quality population' than in the 'yield populations', further indicating the importance of NUE in relation to the expression of high quality. Despite the lack of overall allelopathic interactions, it was possible to find individual individuals in the populations with strong allelopathic activity, indicating a potential for selection for this characteristic in future breeding programmes.

Other trials on inter-cropping grain legumes with cereals indicated that, both for winter and spring types, inter-cropping provided more stable yields although it was difficult to predict the proportions of the components, which was environmentally sensitive. Mixtures of grain legumes also looked promising in terms of weed suppression.

Participatory plant breeding (PPB)

Though farmers and breeders selected for similar characters in breeding material, it was found that farmer-selected lines were higher yielding than those selected by breeders, suggesting that experienced farmers should be more involved in the breeding process. Within wheat, a large participatory breeding programme was carried out and new approaches for the management of on-farm experiments further developed, with improved experimental designs and ways of analysing and managing these data. Importantly, several new bulk populations of quality wheat, adapted to central European conditions, were created based on commercial varieties adapted to Germany and surrounding countries. The parents comprised nine winter and seven spring wheat genotypes carrying resistance to common and dwarf bunt. This creates a sound base for further research and practical application of PPB and dynamic management of populations.

Removing structural barriers

COBRA recognised the need to lower the socio-economic and legal hurdles to organic seed production and plant breeding. The booklet *Breeding for diversity – political implications and new pathways for the future* looked at financing models and case studies.

COBRA also produced an inventory of alternative breeding initiatives within the EU that resulted in an increased focus on specific potentials and barriers for different organic breeding initiatives.

COBRA continued the work on establishing changes to EU seed laws and regulations to produce a framework that is more fitting to the needs of organic farming and its producers. Partners were active in meeting with both national and international policy makers in this area, which resulted in the Commission Decision on the 'Call for participation for a temporary experiment providing for certain derogations for the marketing of populations of the plant species wheat, barley, oats and maize' enabling us to market the ORC Wakelyns Population of winter wheat.

Conclusions

The work on improved methods to ensure seed health, use of crop diversity in breeding and methods to enhance and maintain crop diversity have improved our knowledge considerably. The work on barriers has gained useful insights for both the industry and policy makers. The improvement in networking and dissemination in organic plant breeding will be a lasting legacy of COBRA. In part, just bringing the consortium together achieved this but the institutional and individual contacts made within the project will allow increased formal and informal cooperation in the years to come.

The COBRA website (www.cobra-div.eu) is still available as is the CORE Organic II website at www.coreorganic2.org/COBRA.

The publications from COBRA can be found on Organic Eprints: http://orgprints.org/view/projects/cobra.html

Can we replace copper in organic fruit and vegetable production systems?

The authorisation for the use of copper in organic farming in the UK expires at the end of this year. Activities in the organic sector to reduce copper use have aimed to optimise management systems through the use of forecasting, the development of alternative plant protection products, plant cultivation measures, and an increased use of resistant or robust varieties. Since 2012, ORC has been involved in a European-wide project called CO-FREE, that aimed to reduce copper use in organic apple, grape, potato and tomato production systems using a range of approaches. Project coordinators ***Annegret Schmitt*** *and* ***Lucius Tamm*** *outline the main outputs of the research, which finished in June 2016, while ORC researcher* ***Jo Smith*** *summarises the work she has been involved with, focusing on the potential of agroforestry as an approach to reducing the need for copper in organic apple production in the UK.*

Copper is one of the oldest agents used in plant protection. The main targets for copper compounds are diseases such as late blight of potato and tomato (*Phytopthora infestans*), downy mildews of grapevine, hops and other crops (*Peronospora*), and apple scab (*Venturia inaequalis)*. Copper compounds are the only effective fungicides permitted in organic agriculture for the control of these economically important plant diseases; the EC Council Regulation No 834/2007 permits up to 6kg of copper per ha per year as a fungicide only in the form of copper hydroxide, copper oxychloride, copper sulphate, copper oxide or copper octanoate.

However, copper is a heavy metal and does not degrade in the soil; thus concentrations in many agricultural soils, particularly in permanent crops such as orchards and vineyards, are higher than background levels. Copper at high rates has been shown to have negative effects on earthworms, mesofauna and soil microbial activity as well as being very toxic to aquatic organisms. Therefore, some member states, including Denmark, Norway and the Netherlands, have banned the use of copper for plant protection in organic systems, and elsewhere, organic grower associations or certification bodies have restricted the use of copper below the 6kg limit imposed by the Commission. Copper is registered for use in Europe until 2018, but the situation post-2018 is unclear and a complete ban may be a possibility. Organic production in the face of such a ban is likely to suffer severe losses, unless alternative approaches can be developed.

CO-FREE: Innovative strategies for copper-free farming systems

The CO-FREE project aimed to develop innovative methods, tools and concepts for the replacement of copper in European organic and low-input fruit, grapevine, potato, and tomato production systems by providing alternative compounds and 'smart' application tools, and by integrating these tools into traditional and novel copper-free crop production systems. CO-FREE aimed to identify strategies to develop 'smart' breeding goals by the development of crop ideotypes and foster consumer acceptance of novel disease-resistant cultivars by consumers and retailers. The innovations and production systems were evaluated in a multi-criteria assessment with respect to agronomic, ecological and economic performance. In the course of the project, farmers, advisors, the plant protection industry, policy makers and researchers as well as stakeholders of the European organic and low input sector (food supply chain, retailers, and producer associations) were closely involved to ensure rapid development, dissemination and adoption of the copper replacement/reduction strategies as soon as they became available. The project comprised 20 partners (research institutions, field trial stations and small and medium enterprises) located in 10 European countries.

In CO-FREE a total of 17 microbial- or plant-based alternative compounds were investigated for which modes of action, formulations, and application strategies were explored in the lab and field. During the lifetime of the project, one active substance was approved under EC Regulation 1107/2009, two registration dossiers have been submitted and three are in preparation. Furthermore, for three additional alternative compounds, efficacy was demonstrated under field conditions but additional R&D is necessary. All CO-FREE candidates exhibited unproblematic ecotoxicological profiles in detailed studies on non-target organisms (beneficial arthropods, aquatic and soil indicator organisms). Costs for registration, however, are high and require a substantial initial investment by SMEs. This means that, together with the facts that (i) copper has a broad spectrum of activity, (ii) it is unlikely that one compound will have the potential to completely replace copper in all crops, (iii) the alternative compounds in the best cases had similar efficacy as copper and (iv) new compounds have to be safeguarded to remain effective over time, it is likely that different candidate compounds are necessary to further reduce/replace copper. Thus, a range of products will be required for practice, to which CO-FREE has contributed strongly with a number of candidate compounds providing the foundation for the development of new products for the market.

Practical Decision Support Systems (DSS) are one of the key approaches to copper reduction and yield security. Within CO-FREE, DSS for grape (downy mildew and black rot) and potato (late blight) have been optimised or developed from scratch. The beta versions of the DSS are ready for implementation into farming practice.

Robust/resistant varieties are a major contribution to copper replacement and their availability is constantly increasing. However, introduction into markets remains a challenge. In CO-FREE, strategies were developed to improve market introduction of new varieties, with a focus on potato. The variety approach is valuable in potato and tomato, for example, but feasibility also depends on crop and region, and especially in the case of grapevine, is severely limited by consumer expectations and the legal framework.

Advanced self-regulating cultivation techniques (agroforestry and Very Low Input Systems (VLIPS)) have been explored in grapevine and/or apple, both of which showed potential for promotion of biodiversity and reduction of copper use. However, these experimental production systems are not yet ready for implementation at scale. The potential of resilient systems in the context of reducing copper is not (yet) explored at length nor fully exploited. Substantial R&D investments are needed to develop these experimental systems into feasible mainstream options. In many cases, this will need at least 20 years. In CO-FREE, a partial proof of concept was provided in selected model systems and current limits were identified.

In conclusion, depending on the crop, a range of measures were developed and are ready to be implemented and used, while others need some more time. For several of the alternative compounds investigated in CO-FREE, the earliest registration is likely to be completed from 2022. Also, new varieties need time to be adopted by farmers, retailers and consumers, and communication and commitment along the whole value chain is essential. Results indicated that strategies including the use of alternative compounds as one component together with DSS and further measures will be the way forward to further reduce/replace copper. However, the replacement and reduction of copper is currently slowed down beyond the technical potential by, for example, the legal frameworks, associated costs or lack of markets.

More information at www.co-free.eu

Silvoarable agroforestry: an alternative approach to apple production?

Integrating top fruit production into an agroforestry system, where woody species are integrated with arable crop production, may have a beneficial effect on the control of plant pathogens such as apple scab (*Venturia inaequalis*) due to a number of mechanisms:

- A greater distance between tree rows in agroforestry systems, with crops in the adjoining alleys, is likely to reduce the spread of pathogens. This has been recorded for crop pathogens in agroforestry systems but the evidence for tree pathogens is inconsistent.[1] Lower densities of trees compared with orchards favour increased air circulation, which has been shown to reduce the severity of scab by reducing leaf wetness duration.[2]
- Regular cultivations within the crop alleys will incorporate leaf litter into the soil, thus enhancing decomposition and reducing the risk of re-inoculation from overwintered scabbed leaves the following spring.

However, the introduction of such systems into European high-yielding traditional apple production systems will meet substantial obstacles as the approach affects not only agronomic performance but also well-established fruit production traditions. As part of the CO-FREE project, we evaluated an apple-arable agroforestry approach as a sustainable strategy for reducing copper inputs in organic and low input systems using two contrasting case studies: Wakelyns Agroforestry in Suffolk, and Whitehall Farm, Cambridgeshire. We focused on three elements that are likely to be impacted by an agroforestry systems approach to apple production:

1. Yield and quality of apples;
2. Emergence of primary and secondary pests and diseases;
3. Impact on management activities.

Agroforestry case studies

The two case study systems contrasted in scale and diversity: at Wakelyns Agroforestry, a diverse mix of 21 varieties of apple trees on MM111 rootstock are interspersed with seven timber species, in north/south rows with 12m-wide crop alleys between adjacent rows (Fig. 1). Cereals, potatoes, field vegetables and fertility-building leys are grown in rotation within the alleys.

Figure 1: Mixed apple and timber tree system at Wakelyns Agroforestry, Suffolk

Figure 2: Organic apple silvoarable system at Whitehall Farm, Cambridgeshire

The apple trees cover just 2.5% of the land area in the 2ha system. At Whitehall Farm, Stephen and Lynn Briggs established a large-scale silvoarable system in October 2009, planting 4,500 apple trees, consisting of 13 varieties, in rows running NE/SW 27m apart, with 3m spacing of trees within rows (Fig. 2). The understorey was sown before tree planting with a 3m band of nectar flower mixtures and legumes. The 24m remaining between rows is cropped on an organic rotation including cereals, vegetables and legume fertility-building leys. Late-maturing apple varieties have been chosen to allow harvesting of the alley crops first. A local organic orchard (Willock Farm) was used as a comparison.

Yields

Yields at Wakelyns in 2012 and 2013 were comparable with standard figures when scaled up from 2.5% land area under apple production to 100% apples, and even at just 2.5% cover, appeared to out-perform the organic orchard used for comparison (Fig. 3). With so few apple trees, this would probably not be acceptable for large scale apple producers who rely on economies of scale. However, this approach could work well in a diverse, potentially small-scale system such as a market garden, where apples could contribute to direct marketing channels such as vegetable box schemes or farm shops. Having such a wide range of varieties within the system means that harvesting would occur over a longer period. This requires careful planning and may be a challenge for selling to wholesalers if only small amounts are ready at any one time. New approaches to marketing could address this problem, for example, creating mixed bags of varieties, categorising by taste, e.g. 'sweet' apple bag, or 'sharp' apple bag; or by making more of a feature of the varieties if going into vegetable box schemes e.g. 'apple of the week'.

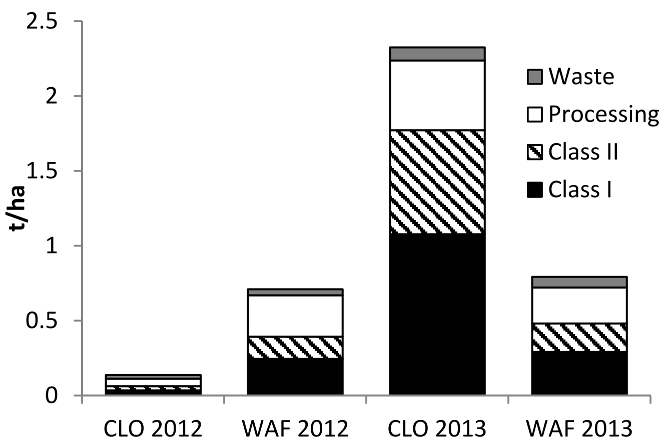

Figure 3: Apple yields (t/ha) from the agroforestry (WAF) and orchard (CLO) sites in 2012 and 2013. NB: Apple trees account for 2.5% of land area in the agroforestry system.

In the more commercial system at Whitehall Farm, tree rows account for 10% land area with 85 trees/ha. Scaling up to 100% apples, yields in 2014 ranged from 0.25t/ha to 5.95t/ha, depending on variety, and in 2015 from 1.36t/ha to 15.18t/ha, which compares with standard yields for 5-year-old orchard of 3t/ha and an organic orchard in peak production (6-11 years) of 14t/ha.[3] Considering that the apple trees at Whitehall were planted only in 2009 and so the system is still establishing and developing, the apple yields look promising, with some varieties performing much better than others.

Apple scab and secondary pests and diseases

Neither case study systems spray to control for scab or other diseases or pests, and scab was detected in both systems during the years of study. At Wakelyns, scab levels were several times lower than in the nearby organic orchard in both 2012 and 2013 (Fig. 4). Although no firm general conclusion can be drawn from this case study, there may be indications of a potential positive impact on reducing scab levels within the agroforestry. This could be due to the very low densities and high diversity of apple tree varieties. Also, while some varieties may fail to set fruit or have high

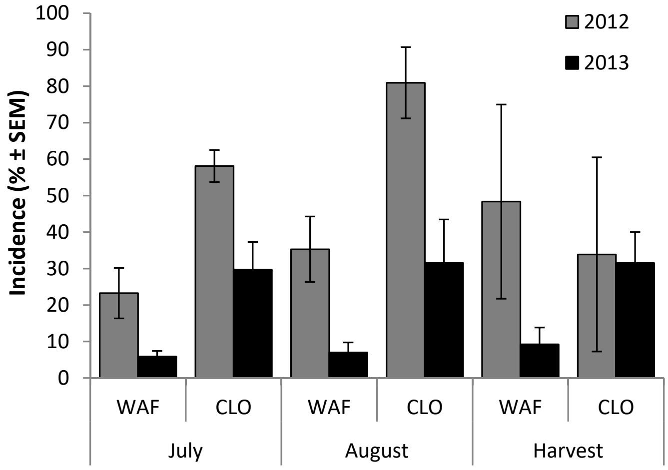

Figure 4: Mean scab incidence per plot in the agroforestry (WAF) and orchard (CLO) in 2012 and 2013

levels of scab, the high diversity of apple varieties within the agroforestry means that other varieties will compensate and so buffer against extreme losses of yields. However, further research will be required to confirm this theory.

Scab was recorded in the apples at Whitehall Farm at quite high levels, particularly in 2014, and in one variety (Falstaff) in 2015, although the resistant variety Red Windsor maintained its resistance (Fig. 5). However, the apple varieties studied seemed to perform poorly, while other varieties in the system yielded well and had fewer pests and diseases, which demonstrates the value of planting a wide range of varieties. The varieties were planted in blocks, which is likely to have facilitated the spread of pests and diseases, despite the crop alleys in between tree rows. It may therefore be better to mix varieties within the rows and fields, although this then becomes a challenge to manage and harvest efficiently.

In both case study systems, the impacts of secondary pests and diseases varied between the agroforestry systems and the orchards. This supports previous research on agroforestry systems that while some pests are reduced in agroforestry systems, other pest groups may be observed in higher numbers, and shifts in relative importance of pest groups may present novel management problems and influence crop choice.[4]

Impact on management activities

To identify the main management benefits and challenges of integrating apple and arable production systems, semi-structured interviews were conducted with key stakeholders from four innovative silvoarable apple systems, located in East Anglia, the East Midlands and the South West of England. Although farmers reported a number of management issues and unforeseen challenges in the design, establishment and on-going operation of their systems, they also spoke of substantial benefits in terms of product diversification, increased biodiversity, reduced soil erosion, and the provision of shelter, with most believing that their systems had been successful in meeting their objectives, suggesting such benefits may well outweigh any management inconveniences. Nevertheless, a number of approaches to mitigating the management impacts of integrating apple and cereal production were identified. These included appropriate system design, de-synchronisation of management activities,

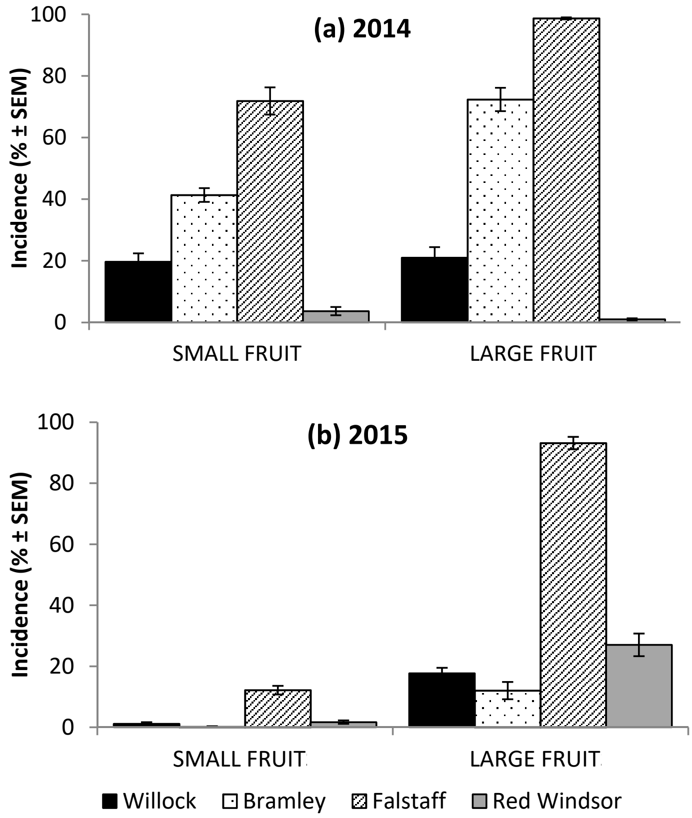

Figure 5. Mean scab incidence per plot at Whitehall Farm and Willock Farm orchard in July and September 2014 (a) and 2015 (b)

effective management of tree-crop competition and weeds, and the ability of farmers and contractors to adapt management practices.

Evidence of farmer-led adoption suggests farmers perceive silvoarable apple systems to be viable, implying scope for wider uptake within England. However the interviews also identified a number of substantial knowledge gaps. This calls for not only further documentation of existing systems but further trials on their establishment, operation and commercial performance. As recognized by all five of the farmers interviewed, in addition to continued research, favourable policy changes and conversion grants will be required for wider adoption of agroforestry-based apple production within the UK.

Acknowledgements

With great thanks to Prof. Martin and Anne Wolfe, Wakelyns Agroforestry, and Stephen and Lynn Briggs, Whitehall Farm, for their enthusiasm, support and cooperation in this research. Thanks also to Jim Cooper for access to his organic orchard and his help with harvesting and assessments. We are grateful to the farmers who participated in the interviews and value their input. This research was carried out within the CO-FREE project (grant agreement number 289497; duration 54 months), which is funded by the European Commission in FP7.

Potatoes post-copper

What is the future of organic potato production without copper? Come to our workshop at the Organic Producers' Conference on Thursday 2nd February.

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European Copper Conference

***Tony Little** reports back from the European Conference on Copper in Plant Protection in Berlin at the end of November.*

In the UK there are currently no copper products registered for use on potatoes against blight. At the EU level proposals are in, and likely to go through, to extend the use of: hydroxides until the end of 2020; oxyclorides until 2017; and sulphates & oxonates until end of 2019. All with a limit of 4kg/ha/year.

Viticulture & Hops: As the biggest users of copper by some margin, they are under huge pressure to reduce usage but their options are limited: the withdrawal of potassium phosphonate has removed another tool from the box; and developing new resistant varieties is technically challenging and introducing them to a market, certainly for wine, which is all about the variety, is risky. That said the overall trend of usage is downward, due to improved timing of applications and better canopy management. Growers say they can make progress but they need flexibility to cope with the bad years (like 2016) and workable alternatives. They are calling for a 'smoothing mechanism' where annual limits are replaced by an 'allowance' of 15kg/ha over 5 years and 6Kg in any one year.

Top fruit: Reported usage, mainly against scab, has been pretty low over the last few years (under 1.5kg/ha/yr), at least in Germany. While the case was made for retaining copper, there is much greater optimism, compared to Hops and Viticulture, with resistant varieties coming forward.

Potatoes: Usage in terms of treated areas and dosage is actually fairly low (less than 25% of the German crop treated at less than 2kg/ha over the last few years). With a number of resistant varieties available (including of course, from Sarpo) and more in the pipeline from the Netherlands, life without copper is seen as a realistic prospect. All eyes are on the UK in this coming year!

Vegetables: Although individual growers may disagree, in the bigger picture vegetables are not seen as a problem. Copper is used on a handful of crops at low rates.

Biologically-based alternatives

Much of the conference was given over to alternatives, with a wide range of products at various stages of development. The bases for these are many and various, including: beneficial bacteria; milk derivatives; larch extract; yeast extracts; vinasse; and saponins. Probably the most promising – certainly the closest to the market – is a fatty acid based product from Neudorf. It's working its way through the regulatory system and, assuming it gets through, will be on the market within the next couple of years.

ORC Wakelyns Population wheat – half baked or foodie nirvana?

As part of the Diversifood project – which aims to enhance the diversity of cultivated plants across Europe – ORC is producing a case study which looks at the potential opportunities to market bread made from the ORC Wakelyns Population wheat. In November, ***Oliver Rubinstein*** *ran a tasting and focus group at E5 Bakehouse in Hackney to try and get a better insight into what potential consumers thought of this bread and what their reasons might be for buying it.*

The ORC Wakelyns Population wheat has been more than 15 years in the making and involved the crossing of 20 parent varieties of wheat, making it an ideal example of an initiative promoting diversity amongst cultivated crops. Our research (Wheat Breeding LINK - LK0999) has shown that flour from diverse populations can perform well in bread-making, but our thinking is that this might provide an interesting new opportunity for artisan or home bakers to make use of locally distinctive flour with a fascinating back-story.

Whilst the ORC Wakelyns Population is an exciting concept, as they say 'the proof is in the pudding' - or bread in this instance - so if this is going to be a viable option for farmers, we need be sure that it makes suitable quality bread and more importantly, that consumers are going to buy it. With that in mind, I recruited 13 self-confessed bread connoisseurs, to pick their brains on this matter.

Despite my initial concerns that this was going to be a half-baked affair, after an email sent out by E5 Bakehouse and some targeted social media activity by ORC, we were overwhelmed with people who wanted to take part in the focus group. Ben's elite team of bakers had produced similar looking loaves using ORC Wakelyns, Gilchester's, Paragon and E5 special blend flours and the idea was to put the ORC bread through its paces in front of some seasoned bread consumers.

The session kicked off with a simple blind tasting and I was quietly confident that the ORC bread would come out tops. When asked to choose the most appealing loaf, based solely on appearance, the ORC bread won; however when the participants were asked to rank each loaf based on taste, it was Paragon – the standard milling wheat variety used across the UK – that won! After overcoming my initial disappointment, a critical look at the scores indicated that there was nothing in it between the other loaves and all this really suggests is that people prefer the taste of more conventional flour.

The aim of the project though, is not to conduct a detailed taste comparison of ORC Wakelyns flour, just to examine consumers' perceptions and motivations. What these findings suggest to me is that there is no reason to think that quality, palatable bread from ORC Wakelyns flour cannot be produced. If people were spitting the bread out in disgust, one could assume that perhaps the ORC flour is not well suited to baking, but this was not the case. 'Taste' is enormously subjective and unless this process was conducted in a controlled environment under rigorous conditions, there is little point trying to come to significant conclusions about the taste of the ORC bread. This was also the first time that Ben's team at E5 had used the flour, so it would be expected that the 'quality' of the loaf would also improve with practice.

After the tasting we then moved on to the main focus group discussion and I asked the group about their reasons for buying artisan bread and the things that were important to them. Unsurprisingly, the reasons focused on better quality, lack of chemical residues, traceability and the wish to support a local business. Interestingly all the group were keen to know more about the origins of the flour and many were surprised to know that the majority of milling wheat in the UK is imported. There was also a general feeling that they weren't sure where to go to find out more about organic cereal production in the UK. Consumers' differing perceptions of what 'organic' farming involves were also apparent, with several people mentioning 'different levels of organic certification' and unclear about what organic cereal growers could or couldn't do. There was a good understanding of issues around glyphosate contamination in flour, but otherwise limited knowledge about the other challenges facing farmers.

Overall this was a fascinating opportunity, and a great chance to interact with potential consumers of the ORC bread. In particular it was heartening to see how keen people were to learn more about the origins of the wheat used for their bread and how easily they grasped the concept of the ORC Wakelyns Population wheat. Although this was a very niche group – loyal artisan bread consumers mostly – these are the people who would be buying the ORC bread in the first instance, so based on their reaction I would confidently say that there is potential here to develop a market for the ORC Wakelyns Population wheat.

Thanks to Ben Mackinnon and his team at E5 Bakehouse in Hackney for baking the loaves and hosting us.

If you are interested in growing the ORC Wakelyns Population contact Bruce Pearce: bruce.p@organicresearchcentre.com

Staff and project news at ORC

Beth Cullen

Beth left ORC in July to take up a new position as a Research Fellow at the University of Westminster. Beth had worked really hard to get Agricology up and running, and also on the OK-NET Arable project. We miss her and wish her well.

Katie Bliss

Katie, a farmer's daughter from Cambridgeshire, joined us in September as Beth's replacement, working on the Agricology and OK-NET arable projects. She is co-manager of the family farm in East Anglia, where she is working towards a more agroecological approach in collaboration with neighbouring farmers to diversify the rotation, including livestock and grass leys. Katie has a degree in Geography and an MSc in Agroecology from Wageningen University.

Rachel Lewis

We also welcome Rachel to the team, working as Communications Assistant on the Agricology project. Rachel has an Ecology degree from Aberystwyth University. After graduating she did an internship with the National Trust on the south coast of Devon, working as a practical ranger. In June 2016 she began a conservation traineeship with BBOWT based at Chimney Meadows, a farm reserve managed as a farm with the main focus being hay crops from the meadows to encourage a diverse sward of wild flowers. Rachel is based at Daylesford Organic Farm, with frequent trips to Elm Farm.

AgriBio project

ORC, represented by Laurence Smith, has a small role in this project led by INRA in France, which aims to assess the feeding capacity that organic farming is likely to play in scenarios of large organic upscaling (eg, up to 20% or 50% of global agricultural area). The project will be organised around two main questions:

1. The analysis of inter-annual and spatial crop yield in organic vs conventional agriculture;
2. The capacity of organic farming to scale-up under N and P supply constraint.

The project will model different scenarios of organic upscaling at the global scale.

comment@organicresearchcentre.com

Transitions to agroecological systems

ORC has been contracted by the Land Use Policy Group (LUPG) to carry out a second study, building on the report by Nic Lampkin and others on the *Role of Agroecology in Sustainable Intensification*. The aim is to provide more insights into the transition process to agroecological systems on farms. The LUPG wishes to learn more about the experience of those farmers who have undertaken significant shifts in their methods of production. Transition towards a more agroecological approach may range from increased resource efficiency through input substitution to whole system redesign. We will investigate whether this corresponds to the farmers' experience and how they perceive transition, by doing interviews with those who have done it.

CERERE – Cereal Renaissance in Rural Europe

Incorporating partners from the UK, Ireland, France Italy, Denmark, Hungary, Finland and Spain, CERERE aims to 'embed diversity in organic and low-input food systems. Diversity is already a key part of organic and low-input farming systems but CERERE aims to speed up and strengthen innovation in these systems. This will further boost the economic, social and environmental sustainability of these farming systems. Likewise, the project also aims to better develop links between researchers, producers and others involved in the organic and low-input sector to help disseminate best practice and other useful information. This will help to make the organic and low-input cereal sector more competitive and improve its perception as a viable alternative to conventional production systems.

In order to do this, the project aims to gather and synthesise a wide range of information about best practice in organic and low-input farming systems, with a focus on maintaining and improving diversity. This will then be communicated to the relevant people through events at a national and regional level. The jam-packed calendar proposed includes a *Let's Cultivate Diversity* event for around 200 participants, held in Belgium and Denmark. Similar to OF&G's *National Organic Combinable Crops* (NOCC) event in the UK, these events will feature a range of field trials and demonstrations to help those attending share their knowledge about farming and processing low-input cereals. Alongside this, there will also be 'Class Vertes' (green classes) in every participating country, which will focus on fostering and improving dialogue between farmers, scientists and policymakers. In the UK, the ORC is fortunate to be working with Andrew Trump from Organic Arable to organise these events.

In addition, the project also intends to produce videos, guidance documents, web resources etc., to help share best practice in organic and low-input cereal production. This is where the bulk of the ORC's contribution will come – in the form of compiling and synthesising UK case studies that are of relevance to this project. Our hardened team of case study and research dissemination experts at the ORC should be in their element here.

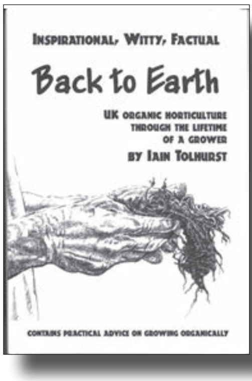
The emphasis on information sharing and developing useful information resources also makes for an interesting project.

Oliver Rubinstein

Book reviews

Back to Earth. UK Organic Horticulture through the Lifetime of a Grower **by Iain Tolhurst**

£24.99 plus postage from: www.tolhurstorganic.co.uk/back-to-earth/



Back to Earth is the title of Iain Tolhurst's new book, which to me is a surprising title because I hadn't realised he'd ever left it. Although you can never really tell with a guy who seems to conjure up out of nowhere enough time to do stuff like building boats and writing articles while working more than full time on growing vegetables and other ancillary activities.

I was thinking how to sum up the book when these words flashed in front of me; "Has wit, verve and swagger to spare". Unfortunately, they're not my words. I saw them from a train on a poster advertising a film, but they are so apt I thought I'd use them and hope the Observer's film critic isn't averse to recycling.

The film is called *The Preacher,* which isn't apt because there is nothing preachy about the book or about Tolly for that matter. He does have a touch of 'guru' about him though and the book is full of hard won wisdom and insight, but it's held together by the down to earth muck and sweat of practicality that's a long way from preachiness.

Everyone who knows him – and more than a few who don't – know this about Tolly; he has a huge amount of knowledge of organic growing and he has always been willing to share it. That was and is the hallmark of the OGA – both the first version (Organic Growers Association) and the second one (Organic Growers Alliance) – self help, helping each other and sharing experiences and information.

It's one of the few surviving traits of the organic movement – although I'm not sure that enough people tap into it – but it is here in this collection of articles going back over decades but which are as vibrant and pertinent as they were when they were first written. They also tell the story of how one grower learnt his trade and shared that learning with others. It's also the story of a number of growers who weren't born with easy access to land and money, who didn't have farming and growing backgrounds or training but who wanted to go 'back to the land' and build a life and livelihood out of growing – mainly growing vegetables – organically. Which they did and they succeeded and in doing so they gave substance to the organic movement.

The book starts with 'how to grow' type articles – guidance in enough detail to be followed by budding and existing organic growers and gardeners. As Tolly masters those things, the articles move on and cover things such as 'systems approaches', soil tests, standards issues and how organic practices need to change to be more sustainable. The ups and downs of growing are here in the articles, the failures as well as the successes; technical insights and personal insights; and flashes of inspiration which make this book far more than a 'how to technical guide' or an almanac for organic growing; it is also a kind of journal of the nitty-gritty side of the organic movement.

Tolly and his generation of organic growers and farmers do what they do, and do it properly because it's right for them and it's right for their land and holdings; and they have found a way to do it that is right for their livelihoods. This is a symbiotic relationship not a dependent one. If Tolly was told that to have organic certification he would have to use some animal manure, would he abandon his stockless approach? Not at all; if his soil told him he needed to use some animal manure, would he? No question.

The nitty-gritty side of the organic movement – where principles guide practice and markets are vehicles for principled practice – is what is represented in this book. Oh and it does have "wit, verve and swagger to spare."

Lawrence Woodward

Organic Revolutionary: A memoir of the movement for real food, planetary healing and human liberation
By Grace Gershuny.

Joes Brook Press.
ISBN 978-0-9972327-2-1.
www.organic-revolutionary.com


Grace Gershuny reading from her book at Elm Farm in July

Grace Gershuny works in the US as an author, educator and organic consultant. She has been involved with the organic movement at the grassroots levels including developing an early organic certification programme for the Northeast Organic Farming Association (NOFA). In the 1990s, when organic farming became more noticed by the regulators, she served on the staff of USDA's National Organic Program, where she helped write the organic regulations, bringing in her considerable experience.

The book is a personal account of the journey of organic farming from a grassroots movement to a regulated and global industry. She relates the difficulty encountered in finding the right words to express in the standards concepts that many of us believe are the founding principles of organic agriculture. I liked in particular her reflections on the 'material or practice' conundrum, whether organic farming should be understood as way of farming that uses only "organic(ally) approved non-synthetic materials" or as one of "best agronomical practises". The other conundrum that I found very relevant is her reflection that the aim to make organic 'pure' can have many unintended consequences, including damaging the farmer's willingness to go organic. Her personal journey is characterised by gaining deeper insights but also of losing some friends in the organic movement through her involvement with the USDA and her growing frustration about "absurd arguments over what constituted a real threat to organic integrity." Much of the book centres on the American organic movement but it contains a lot that is highly relevant to the ongoing debates in the UK to better understand how we can improve organic standards, moving forward, without destroying what it is we want to protect.

Susanne Padel

Supermarkets asked to *Feed me the Truth* about GM in the food chain

Dressing up as a chicken and climbing into a supermarket trolley might not seem the most obvious way to promote sustainable agriculture but for the GM Freeze team it's all in a day's work. Director ***Liz O'Neill*** *explains why.*

GM Freeze is the UK's umbrella campaign for a moratorium on the use of genetic modification (GM) in food and farming. Organic Research Centre is a long-standing member, alongside the Soil Association, Garden Organic, Friends of the Earth, Scientists for Global Responsibility, organic and conventional farmers, grassroots campaign groups and concerned individuals.

GM Freeze is working to help create a world in which everyone's food is produced responsibly, fairly and sustainably. That involves responding to the political, technological and business developments that threaten to bring GM to our fields. It also means raising the profile of imported GM crops, used largely as animal feed in the supply chain for conventional meat, eggs, dairy products and farmed fish. And that's where the *Feed me the Truth* campaign (www.feedmethetruth.org), which launched at the end of October 2016, fits in.

GM crops are not grown commercially in the UK but conventional farms across the UK are already awash with imported GM feed. Most of it is glyphosate tolerant soya which is causing what even the US National Academy of Sciences admitted are "major agricultural problems". [1]

GM products and ingredients must be labelled and consumer rejection means they are a relatively rare sight on the supermarket shelves. The UK's main supermarkets also excluded GM feed from the production of most of their own-brand meat, eggs and dairy products until 2013.

In the past three years, though, GM animal feed has quietly become the norm. So quietly, in fact, that when GM Freeze carried out an assessment of the UK's top ten supermarket chains even the campaign team were shocked by how badly the companies have slipped.

Launching the *Feed me the Truth* campaign, GM Freeze ranked supermarkets against a five-star standard on their policy commitment to supporting and developing non-GM supply lines; on the information they provide to consumers; and on the availability of non-GM-fed products in their stores. A shocking nine out of ten performed so poorly they received a zero rating, with no non-GM-fed products available outside their organic ranges and no plans to improve. Only Waitrose bucked the trend, scoring two of a possible five stars.

Ten days after the campaign launch, Waitrose consolidated their lead by announcing that the pigs producing their non-organic pork products would now be enjoying non-GM European-grown soya. The new source doesn't currently meet their full feed requirements so Waitrose pork products are not entirely non-GM-fed but the move is a strong step in the right direction and proof that change is possible.

However, even Waitrose scores badly on customer information and that appears to reflect a conscious decision by retailers to keep consumers in the dark.

Photo: GM Freeze

In February 2016 David Hughes, Professor of Food Marketing at Imperial College London, shocked a farming conference by declaring on behalf of the food industry: "We find it convenient not to make a big noise about [GM animal feed]".

When GM Freeze's secret shoppers tried to find out which products they could buy without supporting the cultivation of GM crops, they met with confusion and outright ignorance from supermarket staff. Some received incorrect information, while others were given irrelevant information about GM ingredients. Even the campaign team are finding it difficult to get a straight answer from some of the supermarkets. That's why they are asking people to tweet a photo of themselves wearing a blindfold and asking their favourite supermarket to #FeedmetheTruth – to highlight the fact they are currently being kept in the dark about GM animal feed.

Will it work? It's too early to say how much impact the campaign will have but supermarkets are consumer led. If they believe that their customers care enough about GM feed to shop elsewhere then they will start to take notice. The GM-free supply chain is dogged by poor segregation and the dominance of GM soya and maize in key growing regions. That is currently presented as 'our' problem, but if the supermarkets believe their profits depend on providing non-GM-fed, their attitude will change. They can't source non-GM overnight but they can start by being more open with their customers. They can also change their specifications and use their influence to ensure supply.

And the giant chickens? Okay, yes, that was a just a stunt to grab attention and encourage grassroots campaigners to play with the blindfold idea in their own way. The message that we want GM out of the food chain is serious and urgent, but that doesn't mean we can't be creative in the way we deliver it.

Find out more and take part at www.FeedmetheTruth.org

Reference

1. http://www.gmwatch.org/news/latest-news/16958-comments-on-national-academy-of-sciences-report-on-gm-crops

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Other events

4-5 January 2017: The Oxford Real Farming Conference 2017. Gathering of the UK's sustainable and organic food and farming movements.

19 January 2017: Tree to heat. Making use of on-farm woody resources. Wakelyns Agroforestry, Suffolk. Come and see a live demonstration - coppicing of short rotation coppice agroforestry rows and boundary hedges and pollarding of trees in an agroforestry system, machinery in action, a chance to meet the contractors and talk to them about practicalities.

15 - 18 February 2017: BIOFACH - World´s Leading Trade Fair for Organic Food. Nuremberg, Germany.

22 June 2017: Agroforestry 2017. Improving productivity for farmers and foresters. Cranfield University.

6 July 2017: National Organic Combinable Crops (NOCC) 2017. OF&G's flagship event will be held in Hampshire. ORC will be there, and we have been planning the crop itinerary to include some ancient wheats (from the Diversifood project) in the autumn cropping such as einkorn and emmer. We will also be involved in spring crop planning and will lead a station on the farm walk engaging farmers over their 'impressions' and scoring of the crop species/varieties.

9-11 Nov 2017: 19th IFOAM Organic World Congress. New Delhi, India

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