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Summer – what summer?

Italian intern Teresa Lazzaro discovers the delights of British weather while taking soil samples in our TILMAN-ORG reduced tillage trial at Duchy Home Farm. See our website for details of this and other new projects.
(Photo: O Crowley)



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Organic Research Centre
Bulletin
No. 109 – Summer 2012



News in brief

Valuing ecosystems

The role and value of ecosystem services has become headline news for agri-environment and conservation policy and research. Yet understanding of the linkages between ecosystems, the services they provide and how they can be recognised and supported is incomplete. ORC researchers recently participated in an important SAC/SEPA conference on the subject: *Valuing Ecosystems: Policy, Economic and Management Interactions*. Thomas Döring presented a number of posters featuring ORC's crops and agroforestry research, while Catherine Gerrard spoke on assessing the provision of public goods by farming and Laura Hathaway-Jenkins' ORC-supported PhD work on effects of organic management on soil water infiltration was also featured.

Seed exchange networks

Diversity of cultivated plants is a fundamental factor for current and future food security, and one of the most important factors shaping crop diversity is seed exchange. Seed exchange networks are likely to become even more important for the conservation of crop diversity in the coming decades. However, these networks are currently poorly understood. ORC's Thomas Döring has been part of an international team of authors reviewing the emerging topics around seed networks. In an article published online last month in the journal *Agronomy for Sustainable Development*, they say there is a need to describe and preserve cultivated and wild germplasm and to conserve these resources through use and circulation in a sustainable way. Understanding how to maintain, monitor and propagate seed exchange structures, especially in the face of major problems such as climate change, is an important way to achieve this.

Pautasso M, Aistara G, Barnaud A, Caillon S, Clouvel P, Coomes OT, Delêtre M, Demeulenaere E, De Santis P, Döring T, et al. (2012) Seed exchange networks for agrobiodiversity conservation: a review. *Agronomy for Sustainable Development*. doi:10.1007/s13593-012-0089-6.

"The inspiring and renowned" Bob Crowder at Wakelyns Open Day on 28th June 2012

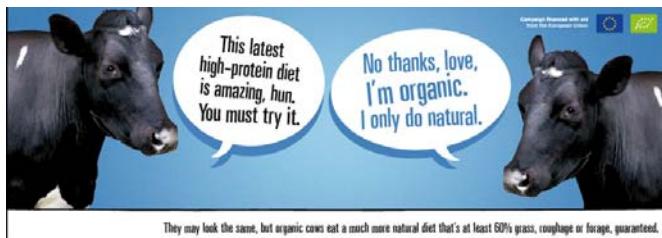
The founder and director of the Biological Husbandry Unit of New Zealand's Lincoln College joined ORC director Nic Lampkin and Soil Association chief executive Helen Browning as speakers at this year's open day at Wakelyns on 28th June. Helen opened the proceedings, reflecting on the need to promote organic principles with a more nuanced and evidence-based approach, while Nic focused on examples of agro-ecological research that form part of or inspire ORC's research. Bob Crowder, whose work, knowledge and enthusiasm have inspired many farmers, researchers and students, rounded off the day, which included a tour of the agroforestry systems and the cereal and vegetable trials. Local craftspeople were on hand to demonstrate their agroforestry-based products.

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

Organic - Naturally different campaign launched

Journalists and industry representatives joined a lively debate about the many myths surrounding organic food at the launch in May 2012 of the second year of the EU-funded UK organic promotion campaign. The launch featured a debate chaired by TV presenter John Craven, with dinner cooked by Kerstin Rodgers, who launched one of the first supper clubs in the UK. Getting stuck into issues of price and perceptions of organics were guests including Mercury award winner and rapper Speech Debelle, co-founder of Green & Blacks Craig Sams and award-winning chef Richard Bertinet.

The new campaign consists of a combination of advertising, PR and digital marketing and will run until October 2013. The aim is to increase consumer knowledge around the benefits of organic food and why it is worth paying a little bit extra. The adverts running across a number of London underground and mainline railway station sites have already proved popular, attracting more than 9,000 Facebook likes in the first few weeks. They feature different foods "talking" to each other about enhancing treatments they have had or have chosen not to have, in the latter case, because they are organic, and explaining why they prefer to go "natural". Organic businesses and organisations have collectively pledged £300,000 per year to support the 3-year campaign, matching the EU contribution to create a total budget of £1.8 million. More information on the campaign at: www.organicukfood.com.



© Campaign Launched with aid from the European Union

OF&G National Organic Cereals Day 5th July 2012

Organic Farmers and Growers' annual National Organic Cereals event, this year at Launceston Farm, Blandford, Dorset, brought together producers, millers, buyers, seed companies, researchers and more from across the sector to share expertise, experience and market data. This year the event focused on fertility and finance in the organic system with talks and demonstrations as well as the usual question and answer sessions, including:

- Varieties yield trial courtesy of Pearce Seeds
- Spring barley trial courtesy of Robin Appel Ltd
- Nitrogen stabilising treatments with The Farm Consultancy Group
- Presentations from experienced specialists including ORC's Nic Lampkin on topics including organic agronomy, profit margins, CAP reform and more
- A wide variety of trade stands/machinery on display
- A guided farm walk, with focus on trial crops
- Refreshments throughout the day and an organic breakfast and lunch for all
- Moisture meter clinic with Organic Arable



About us

ISSN 1367-6970

Bulletin editor

Lawrence Woodward OBE

The Organic Research Centre is the UK's leading, independent research organisation committed to developing sustainable land management and food production systems based on IFOAM organic/ agro-ecological principles; disseminating knowledge to current & future farmers/ land managers and other related businesses; compiling evidence on systems performance and informing public debate through communication with policy makers and opinion leaders, and through them the wider public, in order to ensure the health and well-being of soil, plant, animal, people and the environment.

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Editorial: Which tool in whose box?

During the last few weeks, when the *Take the Flour Back* protest against the GM wheat trial at Rothamsted was in the spotlight, it seemed as if the research establishment, GM researchers, the media and all of the fabled "great and good" of UK agriculture were outdoing each other to proclaim that GM is the answer to all the problems we face in feeding the world's growing population.

Mr Poul Christensen, farmer and Chairman of Natural England, is one of the latest. He says we need "all the technology we can get to feed the growing population", as if science and technology is the answer to that problem. It is depressing how often those who promote GM technology fail to mention that other issues such as access to water and land, economic structures and markets, gender and cultural issues are much bigger factors than technology.

At least he avoided the fatuous cliché about "needing all the tools in the box". It is notable that those people who use this dire phrase inevitably talk only about one tool – GM – and promote it to the exclusion of everything else.

I was briefly heartened by the UK's Chief Scientist, Sir John Beddington, who said at a recent conference that "GM is not a solution to the world's hungry, but it has the potential in certain circumstances to solve problems that can't be done in any other way". Taken at face value, this means that other "tools" should be taken out of "the box" and used; and moreover, they should be tried first.

Then, just as I'm thinking about giving up cynicism, bang: the government announces a £41 million grant to Rothamsted for its GM research as part of a £250 million package for "agricultural biosciences" – why don't they just say GM and save words?

So whose tool is in whose box? The imbalance in the funding and focus given to GM technology has now reached such extreme proportions that other scientific approaches, including organic/agro-ecological approaches, are being ignored.

Rothamsted's GM trial is a good example of this. Ostensibly about testing a GM "ecological chemistry" approach to dealing with aphids in wheat, the decision to fund the research, the scientific review of the problem and the structure of the trial completely ignored both previous successful non-GM R&D on the problem (on which Rothamsted had previously spent taxpayers' money) and, critically, farmers' experience.

If Sir John Beddington's words had any credence would there not have been a thorough assessment of why organic farms do not suffer as much from aphid problems nor the associated Barley Yellow Dwarf Virus before the GM wheat trial was funded? Knowing about the agro-ecological interactions that are found on organic farms is surely of importance if "all the tools in the box" are going to be used.

If Beddington's words are to be taken seriously, surely someone would have considered the Sustainable Link 2005 report of the Defra funded research on agro-ecological control of aphids on conventional farms? This 3 year study showed conclusively that biodiversity in field margins, the presence of hedgerows and the provision of on-farm habitat can ensure that populations of aphid predators survive the winter in sufficient numbers to keep aphid infestations below economic thresholds in most years.

Even if, after due evaluation, it was thought necessary to go ahead with a GM trial, then wouldn't any mature, considered and rational approach conclude that such a trial should include a consideration of these agro-ecological factors in its protocol?

But no, it seems that the organic and agro-ecological tools are to be left "in the box" as GM is deployed like a real-life version – although more chronic than sonic – of Dr Who's ubiquitous screwdriver.

Yet there is some hope that good sense about science will eventually prevail. A recent editorial in the leading scientific journal *Nature*, whilst commenting on the publication of the tomato genome, makes the point that it is not always necessary to go down the GM path and that "the skills of traditional plant breeders will have to come back into fashion in the world of science... because they have a feel for the whole organism".

Just like organic research and agro-ecology.

Lawrence Woodward



Reducing copper use in organic apple production

A new EU-funded project, Innovative strategies for copper-free low input and organic farming systems (CO-FREE), has started at ORC. The project aims 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. We are focussing on apple silvo-arable agroforestry as an approach to reducing scab and other diseases. **Polly McAdam**, a student intern from the College of Atlantic, and ORC researcher **Jo Smith** explore here the various non-spray options for controlling the main target, apple scab.



Highly diverse apple production within the mixed timber and fruit tree silvo-arable system at Wakelyns Agroforestry

Apple scab, a fungal disease caused by the fungus *Venturia inaequalis*, manifests as dark spots on the leaves and fruit of apple trees. If severe, this can lead to defoliation and a decrease in photosynthesis and yield. However, even one mark on a dessert apple is enough to render it unmarketable, making scab an extremely destructive disease¹.

Venturia overwinters in fallen leaves and fruit and begins primary infection in the spring with the release of wind-dispersed ascospores (sexual) and a secondary infection occurs in mid-summer with the release of water-dispersed conidia (asexual). This disease is dependent on wet weather. The release of the ascospores is triggered by moisture and the conidia need water on the leaves in order to spread and re-infect.

Some apple cultivars are resistant to scab through breeding with the *Vf* gene which is derived from the ornamental crab apple *Malus floribunda*. However, a resistant strain of scab emerged in Germany in the 1980s, highlighting the need for a more diverse breeding programme².

Reliance on copper

Conventional apple producers have many chemical weapons to combat apple scab, but organic growers are mainly restricted to spraying copper. Copper has been known to have fungicidal properties since 1807. In addition to suppressing scab, it also controls apple canker and fruit rot.

However, copper fungicides have a detrimental effect on earthworm populations and mycorrhizal interactions, and are highly toxic to aquatic organisms. Strategies such as high-density plantings and tunnel sprayers can reduce the amount of copper that is sprayed. Nonetheless the EU is planning to ban its use in organic farming from 2016. Researchers are therefore working on finding replacements for copper from both plant and microbial sources.

Phenols and resistance

Resistant cultivars are characterised by a higher phenolic content. Phenolic compounds are used for structural support and induced protein synthesis, which may provide a physical defence against spore penetration. Increasing the phenolic content in trees is difficult. For instance, damage from deer or infection leads to an increase, but only for a short period of time. One study has shown that trees grown on low-nutrient soils contain up to twice the phenolic content, a finding that has limited applicability³.

Mechanical methods

Mechanical suppression of scab focuses on increasing the rate of decomposition of infected leaves and fruit. This can be accomplished by increasing soil decomposer activity by shredding the leaves, mulching, or incorporating the infected leaves into the soil. These options can be very effective, for instance, shredding leaves has been shown to



give a 90% reduction in the risk of scab. However, the difficulty of collecting all of the leaves for shredding often reduces this to a 50-65% decrease in infection⁴.

Agroforestry systems

Integrating top fruit production into an agroforestry system, where woody species are mixed with crop production, may help the control of plant pathogens such as scab through a number of mechanisms:

- a greater distance between tree rows and between individual apple trees within the rows, with crops in the adjoining alleys, is likely to reduce the spread of pathogens;
- lower densities of trees compared to orchard densities favour increased air circulation, thereby lessening the severity of scab by reducing leaf wetness duration¹;
- regular cultivation within the crop alleys incorporates leaf litter into the soil, thus enhancing decomposition and reducing the risk of re-inoculation from overwintered scabbed leaves.

Although the potential of agroforestry based agricultural systems has been demonstrated in principle⁵, information on its application in the context of European low-input production systems is lacking. The introduction of this approach into high-yielding apple production systems faces substantial obstacles in the form of well-established fruit production traditions and doubts about agronomic performance. However, apple production systems need to become less dependent on external inputs.

ORC will evaluate the potential and the limits of agroforestry in achieving this using Wakelyns and Whitehall Farm as case studies. Research will focus on four elements:

- (i) yield and quality of apple and arable crops (including profit margins),
- (ii) impact on management activities,
- (iii) emergence of primary and secondary pests and diseases, and
- (iv) impact on ecosystem services and functionality.

Our intention within CO-FREE is to make a significant contribution to bringing the potential of agroforestry to a practical reality.

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CO-FREE

This 4.5 year project, funded by the European FP7 Programme, is led by the Julius Kuhn Institute in Germany and has 11 research partners and ten SME participants across ten EU countries. Copper-free production systems will be achieved by:

- Providing alternative compounds (of microbial and plant origins)
- Developing “smart” application tools
- Integrating these tools into traditional and novel copper-free crop production systems
- Evaluating copper-free apple, grapevine, potato and tomato production systems in a multi-criteria assessment of agronomic, ecological, economic performance
- Developing strategies to for “smart” breeding goals of crop ideotypes
- Fostering consumer and retailer acceptance of novel disease-resistant cultivars

By involving farmers, advisors, plant protection industry, policy makers, researchers and retailers, CO-FREE will ensure a rapid development, dissemination and adoption of the copper replacement strategies.

For more information on CO-FREE visit the ORC website or contact ORC Agroecology Researcher Jo Smith.



www.co-free.eu

Help requested for Reading University student agroforestry project

Charlotte Meyer from Reading University is conducting some research into farmers' and landowners' attitudes towards, and perceptions of, agroforestry for her Masters dissertation. She is looking for participants who would be willing to fill in a brief questionnaire either online or by post (whichever is most convenient). Participants may be farmers who don't currently practice agroforestry as well as those who do. Please contact her by e-mail: c.e.meyer@student.reading.ac.uk if you are interested or would like more information. There will be a prize draw for all participants who complete the questionnaire and the study will be fully scrutinised by the research ethics committee at Reading University before being released.

A date for your diary:
2013 ORC
Organic Producers' Conference
22-23rd January 2013
Aston University, Birmingham



Organic seeds for organic growers

In 2011, an Organic Growers' Alliance survey found that growers were dissatisfied with the quality and range of seed available to them. With this background and in the wider interests of decentralising control over seed resources, a new network has been born: Organic Seeds for Organic Growers. The network was launched with a workshop on Open Pollinated Seeds, held this April at Tolhurst Organics. ORC researcher **Louisa Winkler** was there.



Peter Brinch, who led the workshop, is the founder of the Open Pollinated Seeds Initiative and a strong advocate of open-pollinated seed breeding on the grounds of biodiversity, locally adapted cultivars and sovereignty over genetic resources. He highlighted the disconnect which has emerged in the developed world between crop production and reproduction, pointing out that generally, each of these stages is carried out separately by specialist actors in the supply chain.

The F1 hybrids commonly used by growers discourage on-farm seed saving due to segregation in the F2 generation and the accompanying deterioration in quality. Hybrids can, however, be returned to an open-pollinated state through the process of dehybridisation: hybrid lines are intercrossed or self-pollinated in the F1 generation and the diversified offspring are grown out to select for further lines. Some experts maintain that the process can produce high-yielding cultivars within a few generations, and several organisations such as Sativa in Switzerland are now carrying out dehybridisation programmes in the interests of seed sovereignty.

Among the open-pollinated varieties available, only a minority meet organic quality requirements. However, Peter believes that open-pollinated breeding can generate cultivars of a quality as high as, if not higher than, hybridised cultivars. There are, though, a number of technical issues to consider:

- Isolation of the breeding population is crucial, either with a physical barrier or through distance. Some plants have commonly-occurring wild relatives with which they will intercross. Growers producing carrot seed, for example, must ensure that wild carrot (*Queen Anne's Lace, Daucus carota* subsp. *carota* L.) does not grow within 1km of seed production beds.
- Out-crossing species always requires a minimum population size to avoid inbreeding depression and a

genetic bottleneck. This minimum size, however, varies considerably between species. Carrots require 25-30 individuals for healthy offspring, sweet corn over 200, and onions and leeks around 3,000.

- Breeders may employ a positive or a negative selection method. In positive selection, the breeder identifies a small subset of the parent generation (respecting the minimum size requirement to avoid inbreeding depression) as the best performers and allows only these individuals to intercross and set seed. A practical example of a positive selection programme would be to grow 3,000 onion plants in the first generation, select 5-10% of them, save the seed and grow another 3,000 in the second generation, continuing for as many generations as required to develop a consistently high-performing line. In negative selection, a subset of the breeding population is identified as the worst performers and rogued out, allowing the remaining plants to intercross and set seed.
- Positive selection narrows down the gene-pool more quickly than negative selection and produces more homogenous populations. This generates Elite Seed or Breeder Seed, and is the approach which should be used to produce a breeding line. The (non-hybrid) seed sold to most growers is Standard Seed, produced by negative selection and therefore not completely true to type but adequate as a crop.
- A single plot of soil should not be used for seed production more than once every three to four years.

Any commercially available cultivar may be used in on-farm breeding to produce seed for on-farm crops. While these crops can be sold, the seed cannot. Plant breeders have rights over their registered varieties for 25 years.

Seed is not a major cost category for most organic farmers and growers, and even experienced seed-savers find that they are barely able to justify the resource requirements of on-farm selection and seed-saving.

There are, however, opportunities to generate income by selling saved seed, and Peter Brinch discussed how these opportunities are expanding. He estimates that carrot seed can generate £6-7 per square meter, and cabbages £30-40. Some companies (Tamar Organics and Chase Organics, for example) are reportedly interested in selling locally-produced organic seed, and represent a market for aspiring seed-producers.

Further information

Horneburg, B., *Organic Plant Breeding: Achievements, Opportunities and Challenges*. Keynote Lecture, Organic World Congress, Korea 2011

Website of the Open Pollinated Seeds Initiative:
<http://www.open-pollinated-seeds.org.uk>



E. coli – from farm to fork

In 2003, *E. coli* overtook MRSA (*Methicillin-resistant Staphylococcus aureus*) to become the leading cause of blood poisoning which kills an estimated 37,000 people a year in the UK. *E. coli* now account for more infections than any other disease-causing bacteria. A new report from the Soil Association, *E.coli Superbugs on Farms and Food; the Use and Misuse of Antibiotics in UK Agriculture* written by Caoilín Nunan and Richard Young, finds that the use of antibiotics in intensive livestock farming is contributing to one of the greatest challenges faced by modern medicine. **Rebecca Nelder and Lawrence Woodward** summarise some of its findings.

The possibility of a link between antibiotic use on intensive livestock farms and the spread of antibiotic resistance through the food chain has long been suspected but some scientists, and in particular the intensive livestock industries, have been keen to play it down.

Although there are confounding factors, such as the undoubted problems associated with the medical use of antibiotics, recent evidence has emerged which highlights the linkage.

E. coli resistance in animals and man

In the last year, a substantial amount of research published by government scientists has demonstrated high levels of highly resistant extended-spectrum beta-lactamase (ESBL) *E. coli* in British farm animals. Studies have found significant evidence of bacteria with ESBL resistance genes being transmitted between farm animals and humans.

Other countries are reporting similar results. Research published in 2011, based on data from 11 European countries, found that the rates of resistance *E. coli* implicated in human blood-poisoning were strongly correlated with the rates of resistance of farm-animal *E. coli*. The authors concluded that “a large proportion of resistant *E. coli* isolates causing blood-stream infections in people are likely to be derived from food animal sources” – in particular poultry, but also pigs and cattle.

Studies have also shown that Danish pig farmers and Dutch poultry farmers are much more likely than the general population to carry ESBL *E. coli* in their intestines. Furthermore, the farmers frequently carried the same type of ESBL resistance as their animals, but in different *E. coli* strains, which is evidence that genes are transferring rapidly between bacteria.

A Danish government scientist reviewing Canadian data linking antibiotic use in animals with resistance in humans said that “Taken in context with all the other knowledge we have, anyone still opposing a link between antibiotic use in food and animal production and its direct impact on human health does so for other reasons besides science”¹.

Antibiotic use in the farming industry

Antibiotic resistance can be transmitted from farm animals to humans in three main ways:

- through the food chain (this is the most common way)
- through the environment when untreated manures are spread on the land
- by direct contact with farm animals.

Resistant *E. coli* from farm-animals can colonise the intestines, then cause infection at a later date. *E. coli* from

farm animals can also transfer resistance genes to human *E. coli* inside the intestines.

In 2009, Sir Liam Donaldson, the Chief Medical Officer, was so concerned about the irresponsible use of antibiotics in farming that he called for an outright ban on the use of fluoroquinolones and modern cephalosporins in animal production². Government scientists from the Veterinary Laboratories Agency (VLA) and the Health Protection Agency (HPA) have also expressed their concern.

Yet a year later it was reported that antibiotic use per animal in pigs and poultry (which together account for about 96% of farm antibiotic use) was at its highest ever level. 228t were used in pigs, 149t in poultry, 12t in cattle, 1t in fish and less than 0.5t in sheep.

The recent ESBL report by the government’s advisory committees Defra Antimicrobial Resistance Coordination group (DARC) and Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection (ARHAI), considered what the consequences would be of increased restrictions on antibiotic use on British farms. They concluded that it would lead to increased costs, either because there would be greater mortality or because “livestock have to be kept more extensively or in better buildings to minimise risks of becoming infected, such as avoiding pneumonia by building better designed, well-ventilated buildings”³ and advised against further restrictions.

Here is an implicit recognition, that routine antibiotic use enables farmers to keep animals in highly intensive and unhealthy conditions and an overt rejection of doing anything about it because of commercial considerations.

Organic regulations lead to lower resistance

The use of all antibiotics in organic farming is restricted under national and EU legislation to the treatment of ill animals when effective alternatives are not available. Using antibiotics in pig and poultry feed and water for routine prophylaxis, as frequently occurs in conventional farming, is not permitted.

For pig and poultry farms, levels of antibiotic use and antibiotic resistance in *E. coli* are much lower on organic compared to conventional farms. VLA research, published in 2006, found that per kilogramme of meat produced, conventional pig farms used up to 330 times more antibiotics than the highest-consuming organic pig farm. Figure 1 compares the antibiotic use on the 25 farms⁴.

Research funded by the Scottish Executive, published in 2000, found much lower levels of resistance in organic pigs than in conventional pigs. On intensive farms, it was found that resistance in *E. coli* was “widespread”, even when the pigs received minimal antibiotics in their feed.

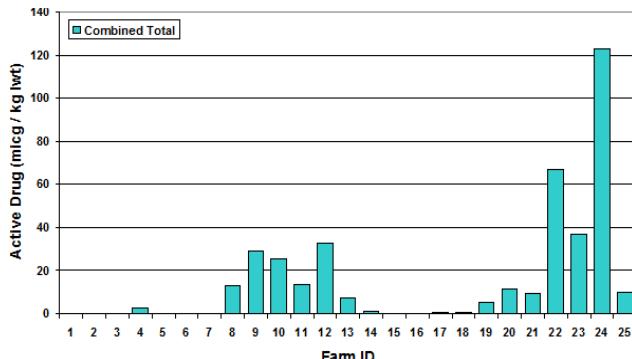


Figure 1: Use of antibiotics (microgrammes of active ingredient per kg of meat produced) on organic poultry (Farm ID 1 to 7) and pig (14-18) farms compared with non-organic poultry (8-13) and pig (19-25) farms⁴

Resistance to tetracycline was particularly high, at “up to 100% in pigs prior to slaughter”. In contrast, they found that on small organic pig farms there were much lower levels (0-10%) of resistant *E. coli*⁵.

UK is “off the pace”

This report is hugely significant and worthy of close reading. It has caused controversy in the farming press, livestock and veterinary sectors not least because it drew attention to some uncomfortable facts. Amongst them, the observation that there is extensive evidence that vets have been prescribing antibiotics off label for routine prophylaxis⁶; and that lobbying from the pharmaceutical industry and the farming press have been important in ensuring that alone in the EU, the UK continues to allow the direct advertising of antibiotics to farmers following a decision last year by Minister Jim Paice.

Conventional farmers are stuck on an antibiotic treadmill which is clearly having an adverse health impact on their animals, themselves and the wider public. They need to be helped off this treadmill, not hindered by vested interests and a shackled Defra.

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Dark matter in ecological space

Exploring data gathered in the ORC-led Legume LINK project, ORC researcher **Thomas Döring** finds interesting relationships between soil organic matter levels and increased plant diversity in leys.

One of the key soil properties that determine soil fertility is the content of soil organic matter (SOM) – the stuff that makes soils dark. Among many other functions, SOM is essential for structural strength of the soil, protection against soil erosion and water retention.

Depleting soils of organic matter, e.g. through imbalanced rotations or excessive tillage, is detrimental to their functional wellbeing. Once lost, SOM is not something that can be re-built quickly. It can take several years to replenish by just a few percentage points. So, it is important to have strategies for coping with low organic matter levels on a farm, whilst replenishing and building them.

ORC-led research has shown that, under conditions of low SOM levels, productivity can be boosted by increasing the diversity of plant species that are grown in a rotational ley. Recent data analysis reveals that on the soils poorest in organic matter, increasing plant diversity resulted in the greatest yield benefit. To put it another way, *not* using highly diverse species mixes led to the biggest drop in productivity when SOM levels were low.

Frequently, leys on organic farms are composed of relatively few species, with red and white clover generally chosen as the legume component. However, in the Legume LINK project, 34 farmers across the UK grew a diverse mixture of ten legume species and four grass species – called the All Species Mix (ASM), alongside a farmer-chosen ley mix.

The new results (Figure 2) show that the advantage of the diverse ASM over the control significantly depends on soil organic matter levels: the lower the SOM, the higher was the biomass of the diverse species mixture compared to the simpler mixes. Although at present we can't deduce what caused this relationship, it emphasises the importance of managing organic matter well and monitoring it regularly.

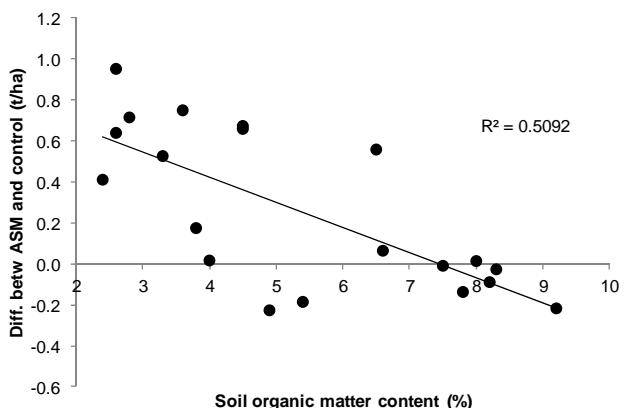


Figure 2: Relative biomass difference between the All Species Mix (ASM) and the control ley cf. soil organic matter content (SOM, %); the lower the SOM, the higher was the biomass of the diverse species mixture compared to the simpler mixes

The research was carried out as part of the Legume LINK project LK09106, which is supported by Defra's Sustainable Arable LINK programme.



Baking quality of genetically diverse wheat populations

Over the last few decades evidence has been accumulating that increasing genetic diversity in the crop offers several advantages over the use of monocultures. Extremely high genetic diversity is created in ORC's composite cross populations of winter wheat, where several varieties are crossed with each other and the entire offspring is used in the seed mix. This diversity has agronomic benefits, but is there a trade-off in the shape of reduced baking quality? Thomas Döring and Helen Pearce review the results.

The agronomic benefits of in-crop diversity are becoming well known: for example, the advantages of variety mixtures over monocultures are reported to include lower plant disease levels (Finckh and Wolfe 2006), increased buffering capacity (e.g. against unexpected weather) and improved efficiency of resource use (e.g. regarding water and nutrients in the soil).

In ORC's ongoing research programme, we have been investigating the agronomic and quality parameters of winter wheat where extremely high genetic diversity is created in composite cross populations or CCPs (Döring et al. 2011). One question is how higher diversity affects specific parameters of baking quality.

To evaluate this, we compared test results from two populations. One, called QCCP, was created by crossing 12 parents with high baking quality. The other, a very diverse population called YQCCP, was derived from 20 parent varieties, including high yielding varieties and those used to create QCCP.

Based on the genetic background of the two populations, we would expect that genes responsible for high baking quality would be diluted in the more diverse YQCCP compared with the QCCP. Our hypothesis was therefore that baking quality would be lower in the YQCCP than in the QCCP. To test this, we measured baking quality in the two populations.

We determined grain protein content, the Hagberg falling number (HFN) and the height of test loaves baked from grain samples of the two populations. In additional assessments, the baking volume of the loaves was determined in a subsample. Height and volume were well correlated.

Grain samples of the two populations were obtained from several organic and non-organic farms across England. Tests were replicated over three years. The grain samples were milled to flour and baked at one of two bakeries, each with their own milling and baking method. One was a roller mill using the standard Chorleywood process; while the other bakery stone ground the wheat and used a traditional sourdough baking method.

The YQCCP showed a significantly ($p<0.05$) lower protein content (13.0%) than the QCCP (13.2%). However, site and year effects were much more pronounced than the differences between the two populations. Also, HFN (average 192 seconds) and loaf height were not significantly different between the two populations.

These results indicate that the increased diversity and yield potential of the YQCCP was not traded off with a loss in baking quality and are further encouragement for the use of high genetic diversity in cropping.



Andrew Whitley with loaves of bread in the baking trial

The study also shows that protein as a single factor was not well correlated with loaf height. Although there is not sufficient data to challenge the assumption that protein content is well linked with baking quality, our results lead us to question the universal validity of this parameter as a quality predictor.

More broadly, it needs to be asked if the way in which baking quality is assessed is appropriate; i.e. should greater emphasis be placed on factors such as nutritional quality rather than loaf height? And, particularly for the organic sector, is the Chorleywood process the best method to use for test bakes of organic flour, or should a more artisanal approach be used?

Acknowledgements and references

We thank Andrew Whitley (Bread Matters) and Kelvin Ellam (W & H Marriage & Sons Ltd) for conducting the baking tests. We are grateful for research grants from Defra through the Sustainable Arable LINK programme (LK0999).

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Finckh, M.R., and M.S. Wolfe. 2006. Diversification strategies. In: Cooke, B.M., D.G. Jones, and B. Kaye (eds.), *The Epidemiology of Plant Diseases*, 2nd ed. pp. 269–307. Berlin: Springer.

Use and efficiency of EU public policy measures for organic farming

The development of the organic sector in Europe varies between countries, ranging from Austria, the Czech Republic, Estonia and Sweden where more than 10% of land area is now farmed organically to Bulgaria and Ireland with less than 2%. These differences are partly due to significant variations in the policy environment in EU member states. **Susanne Padel** from ORC, **Jürgen Sanders** from the German von Thünen Institute and **Matthias Stolze** from the Swiss Research Institute of Organic Agriculture (FIBL) report on the results of a study they conducted for the European Commission.

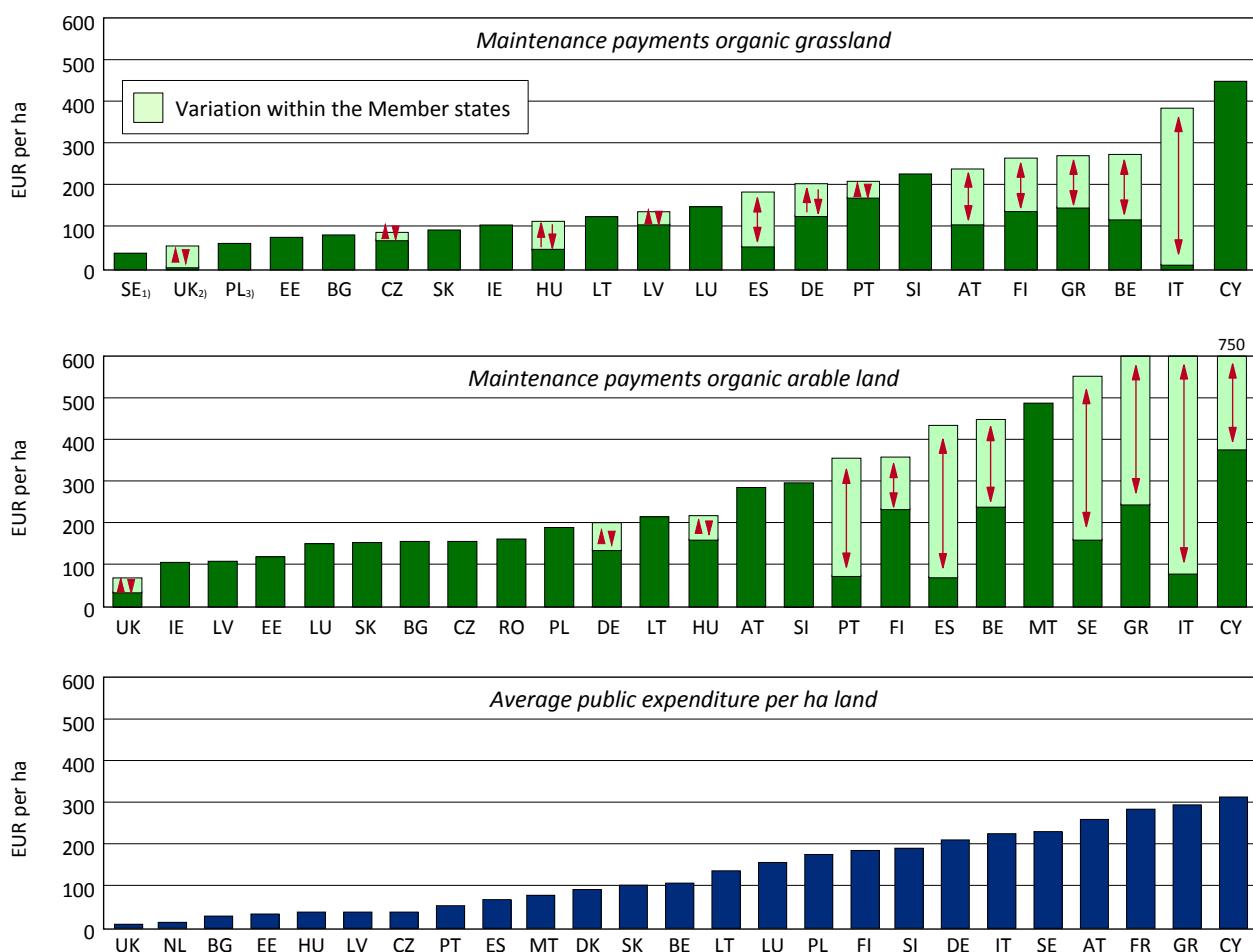
The study had two main aims: firstly, providing a comprehensive overview of public support measures for organic farming in all 27 Member States and, secondly, to explore the relationship between policy measures, policy strategies and the development of the organic farming sector (both in terms of production and market development) in six case study countries (Austria, Czech Republic, Denmark, Germany, Italy and the United Kingdom).

Significant variation in policy support across EU

It is clear from the results of the study that wide variations in support rates and policies exist between member states and that these have the potential to influence significantly the competitive position of producers within the European organic market. Organic area payments (as part of agri-environment programmes) are the most important support measure for organic farming. They are used in all EU

countries apart from France, where organic farmers are supported under CAP Pillar 1 (Article 68), and the Netherlands, where the focus is on market support.

As can be seen from the Figure below, there are wide variations in organic support payments under agri-environmental measures, both between and within countries (the latter either due to regional differences or due to different payment rates for variants of the same crop type, such as temporary, permanent and rough grazing in the case of grassland). Average public expenditure per hectare of certified organic area (across all payment types and land categories) varied between 7€/ha in the UK and 314 €/ha in Cyprus for the period 2008 to 2009. (It should be noted that the UK data are incomplete- they are based on values submitted to and published by the European Commission, which exclude England, as the data were not available from this source at the time of going to press.)



AT = Austria, BE = Belgium, BG = Bulgaria, CY = Cyprus, CZ = Czech Republic, DE = Germany, DK = Denmark, EE= Estonia, ES = Spain, FI = Finland, GR = Greece, HU = Hungary, IE = Ireland, IT = Italy, LT = Lithuania, LU = Luxembourg, LV = Latvia, PL = Poland, PT = Portugal, RO = Romania, SE = Sweden, SI = Slovenia, SK = Slovakia, UK = United Kingdom

Exchange rate (average 2011): 1) EUR 1 = SEK 9.0359 2) EUR 1 = GBP 0.8668 3) EUR 1 = PLZ 4.1551

Source: Own illustration, based on data from national contributors.



Additionally, considerable variation exists in the types of land supported, other scheme requirements and eligibility conditions as countries/regions struggle to sustain current levels of Rural Development Programme (RDP) support in the face of a lack of resources in times of austerity.

Some RDPs address organic farming under farm investment schemes, marketing and processing aids or the participation in food quality schemes. For example, under the measure *Modernisation of agricultural holdings* (Measure 121), organic farmers in Flanders (Belgium), Madeira (Portugal) and North Rhine-Westphalia (Germany) are given higher grant aid for investing in agricultural holdings to improve the overall performance of the farm; in Austria this is limited to organic livestock farmers investing in farm buildings.

Under the measure *Adding value to agricultural and forestry products* (Measure 123), projects related to organic food production, processing or marketing receive higher support rates in Bavaria (Germany) and Slovenia. In Estonia, a sub-scheme specifically targets organic farming and conventional dairy farmers.

As an alternative to providing higher grants, Cyprus, the Czech Republic, Latvia and Slovakia place organic farming projects in a higher priority selection category. Several countries/regions use *Participation of farmers in food quality schemes* (Measure 132) to cover parts of the certification and inspection cost incurred by farmers (Austria, Belgium, Cyprus, Estonia, Greece, Malta, the Netherlands, Poland, Portugal, Slovenia, most regions of Italy and Spain, as well as Scotland and Wales).

Policies need more strategic thinking

It is clear that the development of the organic sector is influenced by external factors and by the effective combination of a range of support policies. The study confirms that public support is a major driver for development, with area support payments and organic action plans identified as the two strong measures in several countries. 19 member states have some form of Organic Action Plans, but they have considerable variation in what they cover and how well they are embedded in the wider agricultural and rural development policy framework.

The growth of organic farming can be boosted by developing an overall coherent development strategy combining different instruments. For example, a significant expansion of organic fruit production in the German region Altes Land in Lower Saxony is the result of a successful interplay of area support, organic research, support for advisory services, and facilitation.

Another example is Denmark, which has a clearly stated strategy, *Organic Vision*, that sees organic farming as a key measure to promote the sustainability of agriculture, to improve food quality and consequently, the competitiveness of agriculture. Links between organic farming and wider policy goals have been successfully established and the whole framework of the RDP has been used, considering both demand-side and supply-side measures. Policy strategies also exist in Austria and the Czech Republic.

In other cases, policy makers appear to struggle in balancing the environmental and market aspects of organic

farming and the extent to which organic stakeholders have been consulted in policy development also varies. Of the case study regions both England and Lower Saxony in Germany appear to have no on-going strategic vision.

The study recommends that the Commission should further encourage strategic thinking about the potential of organic farming at Member State level by integrating common policy development principles for the organic sector (see Box) into the Rural Development Framework for 2014 to 2020.

Acknowledgements

The study was conducted by the Johann Heinrich von Thünen-Institut (DE) together with the Research Institute of Organic Agriculture (FiBL, CH) and the Organic Research Centre (UK) on behalf of the DG Agriculture of the European Commission. The conclusions, recommendations and opinions presented in this report reflect the opinion of the consultants and do not necessarily reflect the opinion of the Commission.

The full report can be downloaded from http://ec.europa.eu/agriculture/external-studies/organic-farming-support_en.htm

Organic policy principles

The report recommends that Member States, in implementing future organic policies, could improve results by:

1. Specifying a strategic vision for the development of organic farming
2. Recognising the dual role of organic farming in delivering environmental benefits and products for the market place
3. Contributing to fair competition between producers in different Member States
4. Acknowledging that premium prices and the market benefits of certification reflect the entrepreneurial activities of farmers
5. Ensuring continuity of organic land management schemes
6. Acknowledging the role of innovation, knowledge exchange and advisory programmes
7. Exploiting synergies between policy measures
8. Engaging stakeholders from various organic sector businesses and the general public.

CAP Reform update

The CAP reform debate continues to rumble on with slow progress being made on resolving key issues. One major topic for discussion has been the direct payment greening proposals, which introduced the idea that part of the payments to producers should require crop diversification, protection of permanent grassland and ecological focus areas, and that organic producers would qualify automatically. While the inclusion of organic farming appears to still be accepted, some Member States are arguing for a wider 'green by definition' category, to include agri-environment scheme participants and other 'green' certification schemes not defined by legislation in the way that organic farming is. There is also a debate about a menu-driven approach to ecological focus areas. For further details, see the CAP reform page on our website.



More changes in ORC's Council of Management

After more than 30 years, Christopher Bielenberg has retired as Chair of ORC's trustee body, the Council of Management, a role he has held since ORC was founded. He has been succeeded by Mike Turnbull. In recognition of their contribution, Christopher and Prof. Dr. Hardy Vogtmann, who retired as a trustee last year, have been appointed as Patrons of Progressive Farming Trust Ltd., the charity that runs ORC. Trustees and staff provide an appreciation of Christopher's contribution and an introduction to his successor.

Christopher Bielenberg retires as ORC Chair



Christopher's retirement in May marks the end of an era which began in 1979 when he was asked by ORC Founder David Astor to join a party consisting of David, his daughter Alice, son Richard and Lawrence Woodward, visiting the then relatively new, but already ground-breaking, Swiss Research Institute of Organic Agriculture (FiBL) and its director, Prof Dr. Hardy Vogtmann.

Alice and Lawrence had met Hardy by chance at the Kassel home of a family friend, Adam Onken, an expert in intermediate technology, who they were visiting to discuss how the ideas of Fritz Schumacher might be pursued in the UK. The ebullient Vogtmann was already an internationally renowned expert in organic farming and on hearing their as yet unformulated thoughts about doing something to promote organic research in the UK, enthusiastically proposed that they visit Switzerland to see what was happening at FiBL.

Christopher's parents, Peter and Christabel had strong connections to David dating back to the German wartime opposition to the Nazi regime (as also did Adam Onken's family) and Christopher willingly took a few days off from a hectic business schedule. But, as he admitted later, he had no idea why he had been invited, little idea about organic farming and absolutely no notion that he was about to be propelled into a project that was to engage him for over 30 years.

What became Elm Farm Research Centre was hatched during that visit. Everyone was energised by Hardy, deeply impressed by what was going on at FiBL and David Astor resolved to put up the initial funding to start something like it in the UK.

Hardy and Lawrence quickly formed a partnership which covered the technical and organisational aspects of the project, but David was concerned that the financial stewardship and business matters were in the hands of someone with the knowledge and expertise to look after the initial £1million plus endowment and the other funds that he hoped would follow.

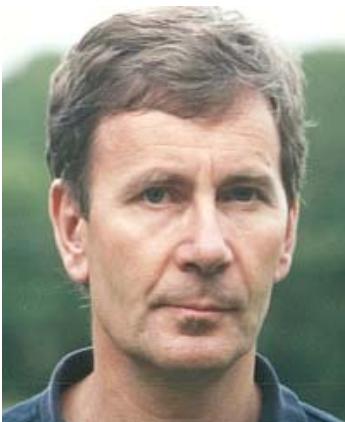
Christopher had a business background and skills and so David asked him to take on the role of leading and chairing the about to be formed Council of Management of EFRC. Alice Astor recalls that "it meant a lot to my father

that Christopher was willing to take on the responsibility. At that time he was extremely busy with a young family and a successful and growing business., but he kindly took on the role of chair and has done more than my father could have hoped or expected in staying in the role for the past 30 years."

Hardy Vogtmann points out that the success of EFRC/ORC over those years has been a team effort with Christopher playing his ever present and reliable role perfectly: "Christopher has been an excellent team captain, knowing when to let things flow and when to step in. He also set the policy of financial prudence that has served us well".

In time Christopher's knowledge and engagement with organic issues deepened. He regularly attended ORC meetings and conferences and, according to Lawrence Woodward, loved to visit the research sites and farms to see what was happening on the ground: "He has made friends in the organic sector and has done his best to help where he can with time, energy, advice and money. He has been crucial to the wellbeing of this institution and, if ORC has been important to the development of the UK organic sector, then so has Christopher Bielenberg."

Mike Turnbull takes over the reins



Mike Turnbull has taken on the role of Chair as a newcomer to ORC and its Council of Management. Mike spent his working life in the public and not-for-profit sectors. He worked initially in the Department of the Environment (on transport policy, housing, urban regeneration and international environmental protection). He

then held two Director posts at the Housing Corporation, was Executive Director of the National Association of Head Teachers, and subsequently held freelance management roles in public agencies before retiring in 2010.

Mike is also Chair of the International Tree Foundation (ITF), a charity that has promoted and funded sustainable community forestry projects in the UK and overseas, particularly in Africa, for almost 90 years and has been responsible for the establishment of hundreds of millions of trees. Prior to this, he was for eight years the Chairman of Tree Aid, which works with vulnerable communities in Africa's drylands to alleviate poverty and help cope with the impacts of environmental change, through community forestry and income generation projects.



Mike Turnbull – a personal view

David Wilson, farm manager at Duchy Home Farm and an ORC Trustee, has known Mike Turnbull for more than 33 years. Here he provides a personal view of our new Chair.

I first met Mike through his wife Sasha's family, who have been family friends since childhood. Our children are of similar ages and we would often go on family holidays together. For me, Mike possesses a combination of very English characteristics, namely he is understated, impeccably mannered and has a delightful sense of humour as well as being clever. He is also the sort of person with whom you could "enjoy a pint" in other words, he is good company and can talk about a wide range of subjects on which he is well informed.

One of Mike's enviable traits is his capacity to absorb large amounts of written information – ably demonstrated on wet Scottish holidays with children rampaging all around he would calmly read a pile of newspapers from cover to cover and then converse widely on the topics of the day.

It is only recently that I have begun to appreciate the level of work he carried out in his previous jobs in the civil service as well as with the National Association of Head-teachers.

Mike has always been keen to learn and has an intellect that keeps him hungry for information. His "dark horse side" relates to his hobby of furniture/cabinet making which he greatly enjoys and he has made some beautiful pieces – a nice mix of the intellectual and the practical.

Although not involved directly with farming, both he and his wife Sasha have long been consumers of organic food and supporters of the organic movement.

Participatory research

ORC is to be the lead research partner in the Soil Association-led Duchy Originals Future Farming programme, funded by the Prince of Wales's Charitable Foundation from income received from Waitrose for the use of the Duchy Originals brand.

The programme will involve producers across the country in developing innovative techniques aimed at improving yields and nutritional performance in organic and low-input agriculture. At its heart will be a network of on-farm events, led by farmers and growers, where they can share their know-how, work with scientists to design field experiments, and pinpoint practical challenges. These will shape the priorities for a new research fund, which will target key barriers to sustainable farming and food systems. The programme will focus on ecological farming, especially approaches that reduce farmers' reliance on expensive inputs. It will be particularly relevant to producers who farm to organic standards, yet open to all.

ORC will support the programme with data analysis and research dissemination activities, as well as a programme of events in 2012 to identify research priorities and the development of a UK network for organic/agro-ecological research, bringing producers and researchers together to get research happening, building on producer innovation.

Some of the work will be undertaken through ORC's Participatory Research and Demonstration Network, which already supports active producer engagement in research through a number of funded research projects, and is working to develop further projects in association with Organic Arable, OGA, OMSCo and others.

The Transatlantic Partnership – Tapping out

The crisis facing our planet and food systems are global, but very often the effects and solutions are distinct and local. As Bruce Pearce explains, The Trans-Atlantic Partnership (TAP), which ends this year, is a unique international collaboration which aimed to build a coherent coalition of young leaders able to work on both levels and become advocates for sustainability on both sides of the Atlantic.

The TAP project, funded by the Partridge Foundation, is a collaboration between the College of the Atlantic (CoA), Maine, USA, the University of Kassel (UoK), Witzenhausen, Germany and the Organic Research Centre (ORC). The goals of the project were for the partners to work together to:

- initiate a trans-Atlantic network of education and research institutions dedicated to creating a new generation of leadership for sustainable food systems,
- strengthen undergraduate education in human ecology at College of the Atlantic,
- strengthen the research, education and training capabilities of ORC-Elm Farm, and
- strengthen the professional Masters programmes offered by the University of Kassel.

We have largely met these goals with a number of clear successes.



*College of Atlantic and University of Kassel students at the first (2009) *Our Daily Bread* course at ORC*



Chair in Sustainable Food Systems

Dr Molly Anderson was appointed the inaugural holder of the Partridge Chair in Food and Sustainable Agriculture Systems at the College of the Atlantic, enabling CoA to focus on the study of sustainable agriculture practices and to engage students in exploring the multitude of social, cultural, political, ecological and economic implications of the ways our food systems do or do not work.

Student courses

As part of the programme, a number of courses were organised involving both student exchanges between countries and e-learning approaches.

Our Daily Bread: Following Grains Through the Food System. This international course was hosted by ORC and UoK for CoA students from the US, Mexico and Ecuador as well as other students from UoK and the UK in 2009 and 2010. The courses provided the opportunity for those who participated to experience different food systems – as exemplified by bread – in the US, UK and Germany.

Different elements of the courses were taught by lecturers, researchers, farmers, bakers and business people, but also included field trips to farms, bakeries and research institutes and hands-on practical sessions. The courses not only improved the knowledge of the students and staff but also enabled the sharing of cross cultural experiences, helping us to understand our differences (and similarities) and to foster a greater understanding and cohesion amongst what were quite different types of people.

History of Agriculture – Apples: ORC also worked closely with CoA to design and plan this field course to the UK in the winter of 2011. A dozen students and faculty toured sites of importance to the history of apple production and export throughout south and midlands of England.

E-learning on Sustainable Food Systems: This course was led and hosted on-line by UoK in the autumn and winter of 2011. The course consisted of three modules: Sustainable Nutrition and Consumption (UoK), Systems Thinking in Organic Farming (ORC) and Redefining Food Systems Efficiency (CoA). These modules offered students the possibility to study in an international context with the chance to draw on the experience and different specialisations of the three TAP partners as well as the opportunity for interdisciplinary knowledge generation. They provided students with the option to study independently and to their own schedules with institutions that for most would not be possible without the internet. 25 students from US, UK and Germany undertook the course with many gaining credits towards their degrees.

Student exchanges/internships

TAP also offered the opportunity for students to spend time at the three partners' sites for more detailed study and project work. Students from CoA were offered scholarships to study at UoK on their International Masters programme. Students from UoK also spent a semester at CoA as part of their undergraduate degrees. ORC, though not a college or university, also offered education activities with internships in policy, education, research and self-designed residencies for students from both CoA and UoK

(including Polly McAdam who contributed to the article on apples in this issue). Two students from UoK will visit Wakelyns Agroforestry in summer 2012 to work on ORC's field trials there.

Faculty exchanges

To facilitate communication and sharing of knowledge, faculty exchanges were undertaken between the three TAP partners. The partner's staff and trustees attended conferences, visited facilities and sites and assisted in teaching at each others' sites. ORC provided farm advice to CoA and also held research planning meetings. In June 2012, ORC researcher Jo Smith visited CoA to help design an apple agroforestry system for their farms. CoA attended ORC conferences and visited the sites at Elm Farm and Wakelyns. They also participated in teaching on a summer course at UoK. UoK visited CoA to advise on research and development of their farms and to ORC to discuss and develop e-learning and research ideas.

Conferences

Two conferences were held at CoA as part of TAP. The first was in October 2009 and was called "Food for Thought, Time for Action" with the aim to launch TAP and to connect experts and the best thinkers in sustainable food systems. Keynote speakers were Raj Patel, author of "Stuffed and Starved: The Hidden Battle for the World Food System" and Marion Nestle, author of "What to Eat" and "Food Politics: How the Food Industry Influences Nutrition and Health."

The second conference was in April 2012 and had the theme "The Food Connections: Reconnecting Hands, Mouth & Mind Through Food Systems Education" it attracted 140 participants (students, researchers, farmers, policy makers and NGOs) from the USA, Canada and Europe. Eric Holt-Giménez from Food First, Oakland started the conference off talking about his work on how food systems are changing toward food justice and sovereignty. Other speakers included John Piotti (Executive Director) of the Maine Farmland Trust who talked about the trusts work to help preserve farmland and farming in Maine and Gary Nabhan, University of Arizona who gave a talk on Redesigning Local Food systems for Land Health, Human Health and Community Economic Health. ORC's Nic Lampkin and Bruce Pearce contributed on agricultural policy and the delivery of public goods.

RIO +20

Following a successful visit by CoA students to the international climate change conference in Durban in 2011, the opportunity to participate in the Rio+20 debates in Brazil in June 2012, despite their disappointing outcome, was grasped enthusiastically by students from CoA and UoK and by ORC's Laurence Smith, whose attendance was supported with funds from the TAP programme.

Where next?

While this stage of the TAP project is coming to an end, the three partners are keen to build on the valuable relationships formed and experiences gained, with funding being sought for future collaborative initiatives.



Organic yields – too low to feed the world?

With the food security debate dominated by the notion that the only solution is increased production through ‘sustainable intensification’, the relevance of lower-yielding organic farming is being questioned. Yields may well be lower, as two recent studies show, but Nic Lampkin argues the issues are complex.

Lies, damned lies and statistics

It's an easy calculation to make. UK organic wheat yields are typically little more than half those of conventional systems^{3,4}. Due to the need for fertility building, organic farmers can't grow wheat every year. If wheat can only be grown half as frequently, then four times as much land is needed to produce the same total quantity of wheat. It is argued that organic farming is unproductive, irrelevant to food security and even environmentally damaging.

As usual, these arguments only tell part of the story. What happens to all the food we already produce? Why produce large quantities of feed wheat for ruminant livestock in feedlot or other intensive systems if ruminants can be fed from the fertility-building legume crops? Should we be consuming the levels of livestock products found in over-nourished Western diets? Could we be reducing waste and consumption before producing more? Despite some of these issues being addressed by the UK Food Foresight exercise², government policy assumes that global consumption trends will continue, the solution is to increase production, and that organic systems cannot deliver.

Organic yield evidence

While the arguments about the relevance of organic farming to food security are complex, the issue of yields in organic farming is important. Two recent meta-analysis studies have reviewed the evidence. Ponti *et al.*⁵ analysed data from 362 studies concluding that organic crop yields are on average 80% of conventional yields, but finding significant regional and crop type variations, with organic yields ranging from 20% to 177% of conventional. Seufert *et al.*⁸ found average organic crop yields to be 75% of conventional, with only 5% differences for rainfed legumes and perennials. This study in particular generated a strong media and public reaction, resulting in a supplementary statement by the lead author⁹. Both studies make reference to an earlier much debated review by Badgley *et al.*¹, who concluded that organic yields were 30% higher than conventional, particularly in a developing country context and therefore relevant to food security.

Ponti *et al.* identified, as other studies have done, that the organic-conventional yield gap increases as conventional yields increase, but this relationship was rather weak. They hypothesised that when conventional yields are high and relatively close to the potential or water-limited level, nutrient stress must, as per definition of the potential or water-limited yield levels, be low and pests and diseases well controlled, which are conditions more difficult to attain in organic agriculture. Seufert *et al.* suggested that with good management practices, particular crop types and growing conditions, organic systems can nearly match conventional yields. What is clear from all these studies is that yield differences found for specific crops in specific regions cannot be generalised globally.

See back page for references

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Nitrogen dependency

It is worth reflecting on the extent to which yield differences can be explained by the relative nitrogen dependency of conventional systems. This would explain why wheat yields in the UK, where conventional N inputs are high, show large differences. In the US, where conventional wheat is produced less intensively, studies show more similar yields. Similarly, within the UK, yield differences for crops such as oats and field beans, where less N is used conventionally, are also lower. Legumes in general, in part because of the improved utilisation of biologically-fixed nitrogen, show organic yields closer to conventional.

The Ponti *et al.* study did not specifically consider nitrogen use intensity *per se* as an explanation. Seufert *et al.* did, but from the perspective that organic performance improved where N availability was higher, identifying N as a major yield-limiting factor in many organic systems. The better performance of legumes and perennials could be due to better N utilisation, rather than higher N levels.

The N issue could also explain why in many developing countries, resource poor farmers unable to afford purchased N fertilisers have demonstrated potential to increase yields using organic/agro-ecological approaches^{1,6,7}. But many of these studies are not of certified organic systems (certification is not relevant in self-sufficiency contexts) and in some cases involved non-permitted inputs and were therefore excluded from the Ponti *et al.* review. They also argued that in many cases the conventional yields were far below best practice and did not give a fair representation of the potential performance (an argument that can also be used for some of the organic data).

Seufert *et al.*, in marked contrast to the earlier studies, found organic yields to be 43% *lower* than conventional in developing countries. However, the majority of these studies had atypical conventional yields more than 50% higher than local yield averages. They were not able to identify a single study meeting the selection criteria for their meta-analysis comparing organic and subsistence agriculture and highlighted the need for further research.

It is also relevant to examine the total system output of products to meet human needs. If crops are used as intermediate inputs for animals, then the total system output is correspondingly reduced. This is an issue we are currently working on at ORC and will feature in a future article.

Conclusion

In a context where yield responses to nitrogen fertiliser may be limited by cost, oil-dependency and availability of other nutrients such as phosphorus as well as water, the assumption of continued increases in productivity of conventional systems is unsafe. Organic farming does have a relevant role to play, at the very least as an insurance policy should the sustainable intensification route prove inappropriate in the face of rapidly diminishing resources.



Events and announcements

Forthcoming events

10 July 2012: Multi-cropping at Wakelyns

Natural England event to examine multi-cropping options

20 September 2012: Agroforestry for advisors

IOTA event at Whitehall Farm, Peterborough, Cambs.

24 September 2012: IFOAM EU Organic Days

Cyprus venue for European organic research/policy events

22-23 January 2013: ORC's 7th Organic Conference

Aston University, Birmingham. Book the date now!

Further details: see Events at www.organicresearchcentre.com.

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