40 years of ORC

Pioneering research in #40rganic farming

AUTHORS
Current ORC Researchers

ACKNOWLEDGEMENTS
Past ORC Researchers & Collaborators

YEARS
1980-2021

CONCEPT GRAPHICS EDITING
ORC Knowledge Exchange Team

ORGANIC RESEARCH CENTRE
40th anniversary

During the past year we have taken time to celebrate past achievements and the contributions of those who have helped make ORC the organisation it is. I hope that it is an organisation that our founder, David Astor, would have been proud of. The charity was founded in a time of political, economic and environmental uncertainty; themes which still resonate now and which continue to make our work vitally important.

Originally established as the Elm Farm Research Centre, over the last forty years the ORC has delivered pioneering research that has helped transform the organic sector in the UK and beyond. During this time, it has collaborated with some of the world's leading scientists on applied research into issues as diverse as agroforestry, wheat populations & genetics and public goods assessments. In addition, ORC has worked with farmers converting to organic production and helped them to access value-added markets, supporting the formation of organisations such as OMSCo and Organic Arable. It has also created innovative information hubs such as Agricology to share research widely across the industry and has influenced policy, helping ensure that Defra supported organic production within environmental stewardship schemes.

This book is testament to all that has been achieved during this time. It has been carefully curated to highlight and reshare our leading research and achievements. To see so much valuable work in one place is humbling but it makes me incredibly proud to work for such a fantastic organisation.

Over the last year I have had the chance to debate, discuss, and explore many of the challenges facing British agriculture, and I'm struck by the sheer scale of change facing so many British farmers. With great change comes great opportunity and I truly feel that our work researching and sharing our knowledge of no input organic farming systems can add significant value to the whole farming community. ORC are well placed to help catalyse the change to encourage more farmers to deliver a more environmentally sustainable agricultural system. These are exciting times and we are very much looking forward to a bright, action-packed future.

Lucy MacLennan
ORC Chief Executive

Our story

1980

The Progressive Farming Trust was established as an educational charity, with a focus on development and promotion of organic agriculture. Moved to Elm Farm, a 237 acre farm near Newbury in Berkshire. The Elm Farm Research Centre (EFRC) was founded

1983

Launched first soil analysis system specifically designed for organic farmers

1984

HRH the Prince Charles visits Elm Farm. Following this, EFRC advised Duchy Home Farm on their conversion to organic

1985

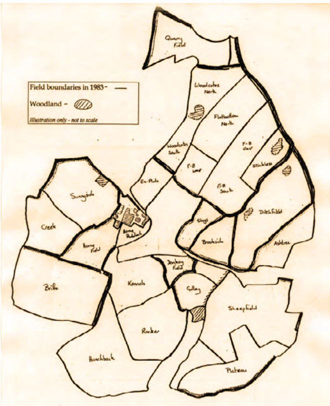
ORGANIC ADVISORY SERVICE
ELM FARM RESEARCH CENTRE

Worked with Soil Association standards committee to keep BSE cohort animals out of certified organic herds in UK. Launched Organic Advisory Service (first service in UK): conversion planning process developed for organic farmers

1986

First stockless arable research trial established – ran for 11 years

Elm Farm map 1983



1990

Played a major role in the organic movement's opposition to genetic engineering. One of the first international organic bodies, and the first in the UK to oppose GM

1992

First EFRC Bulletin sent out

1993

Introduced the idea of on-farm composting of household waste to the UK

1994

Established and managed the Organic Milk Suppliers Co-operative

1995

First Organic Farm Management Handbook with University of Wales, Aberystwyth

1996

Launch of the government-funded Organic Conversion Information Service (closed in 2011)

1998

Professor Martin Wolfe appointed as Research Director (from 2009: Principal Scientific Adviser). Started to work with Wakelyns Agroforestry as a trial site

2001

Lawrence Woodward, EFRC's Director and co-founder, given OBE in recognition of his services to organic farming. EFRC initiated the first opposition to the slaughter only policy during the Foot and Mouth Disease

2002

Pioneering work on evolutionary plant breeding with wheat populations begins

2005

IOTA
Institute of Organic Training and Advice

The Institute of Organic Training and Advice (IOTA), a professional body for UK and Irish trainers, advisers and other extension workers involved in organic food and farming was developed with support and funding from ADAS, Organic Research Centre - Elm Farm, Organic Centre Wales and Soil Association

2006

THE ORGANIC RESEARCH CENTRE
ELM FARM

Elm Farm Research Centre became The Organic Research Centre – Elm Farm. First ORC Organic Producer Conference

2009

Nic Lampkin succeeds as Director of ORC. Conversion of farm buildings to offices and conference centre at Elm Farm completed

2010

Launch of intern programme as part of the College of the Atlantic transatlantic programme

2012

INNOVATIVE FARMERS
PART OF THE DUCHY FUTURE FARMING PROGRAMME

Duchy Future Farming Programme (later Innovative Farmers) launched, in conjunction with Soil Association and Waitrose Duchy Originals

2014

From our trials we were able to convince EU officials that the benefits of the population approach should be evaluated through test marketing at the European level. As a result EU law was changed to allow a trial period for marketing 'varieties' (populations) that do not fit the normal rules and regulations

2015

AGRICOLOGY

Agricology launched to provide advice and guidance to farmers. Launch of ORC Wakelyns Population of wheat suited to organic and low-input farming systems

2016

Nic Lampkin and Mark Measures (IOTA) awarded by the Royal Agricultural Societies

2017

Publication of 'Towards farmer principles of health'

2018

ORC host UK Organic Congress with LWA, OGA, OF&G, OTB and Organic Arable

2020

Relocated to Cirencester (sale of Elm Farm). Celebrated our 40th birthday. Lucy MacLennan appointed CEO

ORC

Index

ORC Factsheet no. 1 - January 2021

AGROFORESTRY

Agroforestry at Elm Farm and Wakelyns

Highlights from 20+ years of on-farm research

AUTHOR
Sally Westaway

CONTACT
Will Simonson

ORC ACKNOWLEDGEMENTS
Jo Smith, Martin Wolfe

YEAR
1994-2020

FUNDING - PROJECT
Ashden Trust
- TWECOM
DEFRA
- SustainFarm
EU FP7
- AGFORWARD
- Co-Free
- SOLID
Woodland Trust

Abstract

Agroforestry encompasses the establishment of new trees in productive fields, the integration of existing boundary hedges and trees into the farming system and the incorporation of farming into forestry. It is a land use approach that can maintain or enhance the productivity of a farming system while supporting ecosystem services including soil and water protection, biodiversity and carbon sequestration. The emphasis is on managing rather than reducing complexity, and as such, it is knowledge intensive, with farmers needing to work with their environment to create a dynamic, ecologically based management system that offers more resilience in the face of future climate uncertainty.

At Wakelyns Agroforestry in Suffolk the four different agroforestry systems, based on a maximum use of biodiversity, have been the site of many years of research trials and demonstrations. Over a 10-year period a range of agroforestry approaches have also been introduced to Elm Farm, formerly a commercial and research farm in West Berkshire.

Over the years these two farms have been key sites for the Organic Research Centre to carry out trials and build up evidence on the contribution of agroforestry to the delivery of a number of important ecosystem services such as food and fuel production, maintenance of soil health and biodiversity enhancement.

Figure 1 Silvoarable systems: wheat harvest inbetween two hazel tree rows at Wakelyns

Introduction

Elm Farm: The former home of the Organic Research Centre and an organic livestock farm in West Berkshire. Over the past 10 years, as part of a farm-scale agroforestry plan to increase the overall productivity of the farm whilst also providing environmental benefit, 3,800 new trees (apple, willow, alder, hazel and oak and other native UK tree species) were planted, the planting also included an innovative and fully replicated silvopastoral alley cropping trial. New management approaches for existing trees and hedgerows were also introduced to investigate ways of incorporating them into the productive farm system.

Wakelyns: This 22.5 ha experimental and innovative agroforestry farm in Suffolk was established by the late plant pathologist Prof. Martin Wolfe to put into action his theories of agrobiodiversity being the answer to achieving sustainable and resilient agriculture. Wakelyns Agroforestry integrates trees for timber (ash, wild cherry, italian alder, small-leaved lime, sycamore, oak and hornbeam), energy (hazel, hybrid willow and poplar) and fruit (apple, plum, pear, cherry, quince, peach and apricot) production into an organic crop rotation in four mature silvoarable systems. The first trees were planted in 1994 and planting continues today.

Our key findings and outputs

Key recent technical guides and publications outline the wealth of research and knowledge gathered by the Organic Research Centre and partners over the years from these two sites.

Wakelyns Agroforestry: Resilience through diversity[1]. Short summary booklet detailing the story of Wakelyns Agroforestry and key concepts and research, including the innovative approach to diversity at all levels from genes to landscape as the bedrock of sustainable agricultural systems; evidence collected to demonstrate the concept of decentralising and localising food and energy production; and research trials examining the productivity of the different systems and the interactions (positive and negative) between tree and crop components.

Wakelyns Agroforestry: 25 years of agroforestry[2]. Long report detailing some of the key theories investigated and evidence produced by Martin Wolfe and fellow researchers from the Organic Research Centre at Wakelyns over two decades. The report is arranged into five sections: Farm description, Decentralised food and energy production, Tree-crop interactions and total productivity, Functional diversity, Sustainability.

Figure 2 Silvopastoral systems: sheep grazing alongside a tree row at Elm Farm

Elm Farm: integrating productive trees and hedges into a lowland livestock farm[3]. This review document consolidates in detail the research results and experiences of Elm Farm's 10-year agroforestry journey. The review is arranged into four sections: New tree and hedge planting, Managing hedges for bioenergy, Silvopasture trial, Tree fodder.

Elm Farm: Planning and developing agroforestry at a farm scale[4]. This research briefing summarises the lessons learned in the planning, establishment and management of the range of agroforestry approaches introduced to Elm Farm over a 10-year period.

Technical Guide: Productive Hedges: Guidance on bringing Britain's hedges back into the farm business[5]. As a valuable resource within our rural landscapes, hedges need to be managed in a way which is sustainable, both economically and ecologically, and allows them to continue being healthy and vigorous so they persist for generations to come. The coppicing of hedges for woodfuel or other products has the potential to not only reduce the cost of managing hedges but to provide local communities with a renewable, low cost energy source whilst supporting wildlife and improving the health of hedges. This practical guide based on case studies from Elm Farm and elsewhere outlines some options for farmers wishing to take a second look at their hedgerows.

Hedgerow harvesting machinery trials report[6]. This is the full report from the hedgerow harvesting trials that were carried out at Elm Farm and Wakelyns. Based on the trial results the report assesses feasibility, efficiency, costs and viability of mechanising the process of coppicing hedges and processing the resultant hedgerow material as a local and sustainable source of woodfuel.

Technical Note: Agroforestry for livestock systems[7]. Based on research at Elm Farm and Wakelyns, this technical note highlights some of the potential benefits and impacts of utilising an agroforestry system for low-input and organic dairy systems. The research evaluated an established willow agroforestry system in terms of productivity, microclimate modification and carbon storage and investigated the establishment phase of a new agroforestry system, providing economic and environmental data on establishing and managing a new system.

CONCLUSION

These just some of the key highlights from a selection of the many technical guides, scientific publications and factsheets that have been produced over the years at these two important agroforestry farms. Many of the supporting publications referenced in the long reports can be found on the Organic Research Centre website or on Agricology.

Figure 3 Coppicing hazel at Elm Farm

REFERENCES

1. Smith and Westaway (2020) tinyurl.com/y5uhu7bw
2. Smith and Westaway (2020) tinyurl.com/y64ugjts
3. Smith and Westaway (2020) tinyurl.com/y2wcrvo4
4. Smith and Westaway (2019) tinyurl.com/ya2dtjum
5. Westaway and Smith (2019) doi.org/10.5281/zenodo.2641808
6. Chambers *et al.* (2015) tinyurl.com/yy8t3d86
7. Smith *et al.* (2016) tinyurl.com/y4tkw834
8. AGFORWARD project website: agforward.eu

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

CROP DIVERSITY & AGRONOMY

Farm-based organic variety trials

A collective experiment with an organic farmers network

AUTHOR
Ambrogio Costanzo

CONTACT
Ambrogio Costanzo

ORC ACKNOWLEDGEMENTS
Dominic Amos, Charlotte Bickler

YEAR
2017-Present

FUNDING - PROJECT
EU Horizon 2020
- LIVESEED

LIVESEED

Abstract

Varietal choice is the major crop specific management decision organic farmers can make to manage crop performance. However, with official varietal evaluation mostly carried out in conventionally managed environments, there has been widespread difficulty in identifying varieties suitable for organic and low-input systems. This has been especially difficult in wheat, which is the most important arable crop in England, yet with a very small and shrinking organic acreage.

In 2017/18 we started a collective experiment in which wheat varieties were tested by organic farmers at a commercial field scale. In the first two years, besides providing useful information on the tested varieties, this work has paved the way to better understand winter wheat production and thereby build decision support frameworks and feedback to breeders on useful traits.

Collective experiments can be a powerful tool for co-learning between researchers, farmers and supply chain stakeholders. By working together, the industry, and any farmer engaged in a journey towards a more sustainable production with reduced use of chemicals, can be empowered to independently generate the evidence needed for on-farm decision making.

Figure 1 Different weed suppressive ability by a modern (left) and a historic (right) wheat variety grown in the same field Credit: Mark Lea

Introduction

Crop performance in organic farming is in part limited by use of inappropriate varieties. As a matter of fact, varietal evaluation is critical to match the most appropriate variety to a farm's conditions and needs, yet it requires complex and resource-intensive organisation. Organic farming adds further difficulties to the task for three reasons. First, different varieties perform differently whether they are grown in a conventional or in an organic farm[1]. Second, with minimal or no use of external inputs (herbicides, mineral fertilisers, pesticides), organic farms tend to differ from one another more than conventional farms do[2]. Third, observations from experimental plots can be less reliable in organic than in conventional farming to predict how a crop performs at a field-scale[3]. With the whole of agriculture aiming to reduce the use of external inputs, understanding varietal performance in organic farming can be of high strategic importance well beyond the organic sector.

What we did and what we have learned

ORC started testing winter wheat varieties at a field-scale in 2017/18, with a network of seven farmers from Dorset to Lincolnshire, which grew to 13 farms in 2018/19 and tested 12 varieties. These included commercial varieties, as well as the historic cv. Maris Widgeon and the Yield-Quality Composite Cross Population (YQCCP) aka "ORC Wakelyns Population". Also see: Factsheet no. 3 "(R)evolutionary wheat populations".

At least three varieties were drilled as strips in each farm's main wheat field, according to an experimental design which allows robust statistical comparisons. Crop cover, height, ear density, severity of foliar diseases, weed abundance and community composition were measured during the growing season. Farmers measured the yield of their strips and provided a grain sample for quality analysis, after which they used the harvest for sale or for on-farm feed use.

Varieties tended to cluster in two groups: one with a high yield potential (4-5 t/ha) but low protein content, and one with high protein potential (10-11.5 %) and slightly lower yields (3-4 t/ha) (**Figure 2**). The historic variety Maris Widgeon and the ORC Wakelyns Population, which are not officially classified in end-use categories, positioned themselves in the high-protein group, suggesting their suitability for the milling market.

Two weed management strategies emerged across the participating farms: one based on spring-tine harrowing on wheat sown in 10-15 cm distant rows; and one, more intensive, relying on power hoeing on wheat sown in 20-25 cm distant rows. The second showed less abundant, but less diverse, weed communities than the first. This evidence, coupled with observed varietal effects on weed abundance, can inform integrated weed management strategies.

Lastly, integrating such a real-farm crop performance dataset with climatic data over several years, will provide precious information to improve resilience to climatic unpredictability. For example, data from the 2017/18 growing season, which had a dry and hot spring and summer, can be a snapshot of the more drought-prone climate that is forecasted for the second half of the century[4].

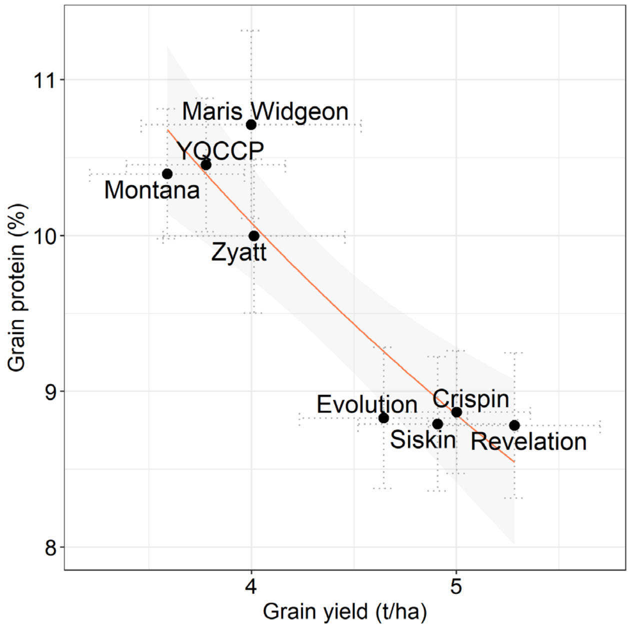


Figure 2 Grain yield and protein content measured across a network of farms in 2017/18 for eight selected winter wheat varieties, averaged over farm and year

Conclusion

As of the 2020/21 growing season, the collective experiment is continuing and expanding, with more varieties tested and more farmers involved, including non-organic farms. We aim to build a comprehensive dataset of wheat performance that will inform farmers, breeders and scientists on the interactions between genetics (the varieties), environment (climate, soil) and management. Moreover, the work on varieties can be a starting point to shed light on bigger, highly strategic questions such as crop adaptation and resilience to climate change, dynamics and assembly of weed communities and their effects on cropping system performance and sustainability.

So far, this work is a successful proof of concept of how farmers, in collaboration with research, can generate the evidence they need to support their decision making. In fact, with some attention to experimental design, participatory research can generate robust data whilst being easily accessible to farmers and ultimately empowering them to improve their adaptive capacity and consequently foster the transition towards more sustainable food systems.

Figure 3 Measuring ear density in a wheat crop

References

1. Murphy *et al.* (2007) doi.org/10.1016/j.fcr.2007.03.011
2. Wolfe *et al.* (2008) doi.org/10.1007/s10681-008-9690-9
3. Kravchenko *et al.* (2017) doi.org/10.1073/pnas.1612311114
4. MetOffice (2019) UK Climate Projections: tinyurl.com/yxw3mvev
5. LIVESEED project website: liveseed.eu

ORGANIC RESEARCH CENTRE
40th anniversary

40th ORC

Crop Diversity & Agronomy

(R)evolutionary wheat populations

Adaptable, stable, or both?

AUTHOR
Thomas Döring

CONTACT
Ambrogio Costanzo

ORC ACKNOWLEDGEMENTS
Charlotte Bickler, Nick Fradgley, Sally Howlett, Hannah Jones, Bruce Pearce, Martin Wolfe

YEAR
2001-Present

FUNDING - PROJECT
CORE Organic II
- COBRA
DEFRA
- AR914
- Wheat Breeding LINK
EU FP7
- SOLIBAM
EU Horizon 2020
- LIVESEED

COBRA Coordinating Organic Plant Breeding Activities for Diversity
Solibam
LIVESEED

Abstract

Wheat cropping forms an important component of organic rotations and it is therefore critical to identify varieties that are well adapted to organic growing conditions. However, organic conditions among farms are notoriously varied, and climate change adds further to this variability. A potential solution to these challenges is to grow crops with a high genetic diversity, composed of many different types of plants, as opposed to commonly used varieties in which every plant is virtually the same. Thanks to their diversity, these crops, called 'populations', can buffer against the environmental variability through compensatory processes as well as adapt to differentiated conditions by natural selection over time. In 2001 started testing and developing this concept with a set of initially three winter wheat populations. These were made from crossing various varieties; the crossing resulted in three genetically diverse composite cross populations (CCPs), designed for high baking quality (Q), high yield (Y), or as an all-rounder (YQ). Initial field trials demonstrated a small yield advantage of the CCPs over the mean of the parent varieties, and a gain in yield stability. Several farmers, bakers, and breeders were involved in the research, and their enthusiasm for this approach led to a substantial expansion of the experimental CCPs grown in the UK. In response to this development and similar pressures on the continent, a derogation of European seed legislation was allowed for a temporary experiment on the marketing of seed of heterogeneous cereals. This experiment has led to the recognition of organic heterogeneous material within the new European Organic Regulation 2018/848.

Figure 1 Two plants from the same population at Wakelyns Agroforestry. Credit: T. Döring

Introduction

Most cereal crops nowadays tend to be uniform stands where each plant is genetically similar if not the same. Uniformity is in fact a legal requirement for the seed of major cereal species, such as wheat, to be commercialised. Current EU seed legislation requires registered varieties to comply with tests of Distinctiveness, Uniformity and Stability (DUS) over time and space.

Wheat is a typical example of a crop that yields remarkably lower in organic compared to non-organic farms, and this is in part linked to inappropriate varieties. Also see: Factsheet no. 2 "Farm-based organic variety trials". Yet organic systems are as diverse as nature itself, so what may be the right variety for one organic farm, may be unsuitable on the neighbouring farm. Furthermore, the natural environment is becoming increasingly unpredictable due to climate change. With increasing frequency of extreme weather events, adaptation to just one environment seems increasingly inappropriate. So, what can be done?

The concept of evolutionary breeding

A potential solution could be to grow plant populations composed of a huge diversity of plants, i.e., the opposite of a uniform variety and allow them change over time via a method known as 'evolutionary breeding'[1]. Seed from one generation is saved, bulked together rather than as individual lines, and sown in the next generation. It is expected that the frequency of well-adapted genotypes in the population increases over time through the process of natural selection. This may lead to better adaption of the population to the specific conditions faced by farmers at a given site.

Simultaneously, the genetic diversity with the population can buffer it against environmental fluctuations, as one individual may compensate the failure of another. The concept of evolutionary plant breeding was already developed in the first half of the 20th century[2] but was largely ignored by mainstream breeding. In 2001, Martin Wolfe and team joined up with breeders from the John Innes Centre to create a first set of population from a set of 20 parent varieties. These composite cross populations (CCPs) became widely known as the QCCP for high baking quality, the YCCP for high yield and the YQCCP for both purposes. At the time, trading such heterogeneous material was illegal under European legislation due to the necessity of complying with DUS rules.

Figure 2 Resilience: a lush YQCCP crop surrounds a failed crop of a commercial variety, in a field sown in suboptimal conditions

Extensive testing

From autumn 2004, ORC led the testing of the populations, along with some mixtures, against their respective sets of parents at two organic and two conventional sites[3]. CCPs out yielded the mean of the parents by 2.4 % and their stability was higher than that of the individual monocultures[3]. Subsequently, the CCPs were tested on several organic farms against different commercial varieties across the UK (Wheat Breeding LINK project, 2008-2013), mixed with pure line varieties and grown in different European countries (SOLIBAM project, 2010-2014) and even cycled across Europe to test their large-scale adaptability (COBRA project, 2013-2016).

Further work explored the mechanisms of evolution, comparing the CCPs to their original seed in several UK locations. After being grown as CCPs for several generations, no genetic signs of adaptation to any of the four different growing sites could be detected. However, across all locations, evidence of evolution was found as dwarfing genes had been lost from the population, probably due to stronger competition of tall plants within the population[4]. The extent of adaptation within the populations versus the role of plasticity is still an open question.

Across the various projects, several farmers, bakers, and breeders and researchers got involved in the work and became interested in the CCP concept. However, according to EU seed legislation, only seed of genetically homogeneous varieties can be legally marketed. Evidence of the potential benefits of CCPs from our research has led the EU to allow, with the directive 150/2014/EU, marketing on an experimental basis of CCPs of wheat, barley, oats and maize. Hence, the YQCCP could finally be marketed as "ORC Wakelyns Population".

The new Organic Regulation EU/848/2018, which will come into force in 2022, has introduced the concept of 'Organic Heterogeneous Material', which will make production and marketing of organic seed of populations fully legal for every crop species[5].

CONCLUSION

The legal recognition of genetically diverse seeds in organic agriculture means that organic farmers will be able to access seeds that they can adapt to their growing conditions, limiting the need for external inputs. This is a success story highlighting how scientific research can trigger changes in the international landscape, from legislation to farmers' fields.

Figure 3 Seed to bread: YQCCP wholegrain sourdough loaves produced by the Small Food Bakery Nottingham, UK

REFERENCES

1. Döring *et al.* (2011) doi.org/10.3390/su3101944
2. Suneson (1956) doi.org/10.2134/agronj1956.00021962004800040012x
3. Döring *et al.* (2015) doi.org/10.1016/j.fcr.2015.08.009
4. Knapp *et al.* (2020) doi.org/10.3389/fpls.2019.01757
5. Costanzo and Bickler (2019) tinyurl.com/y4y9oy2r

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Factsheet no. 4 - January 2021

BUSINESS & MARKETS

Organic seed use in the EU

A survey of organic farmers from across Europe

AUTHOR
Stefano Orsini

CONTACT
Stefano Orsini

ORC ACKNOWLEDGEMENTS
Ambrogio Costanzo, Susanne Padel

YEAR
2017-2021

FUNDING - PROJECT
EU Horizon 2020
- LIVESEED

LIVESEED

Abstract

Organic farming endeavours to be a closed-loop system, as such the new European Organic Regulation 2018/848 aims to make the organic sector more independent from conventional agriculture. There is a planned phasing out of derogations for the use of untreated conventional seed by 2036, i.e., seed that has been produced within conventional farming systems but has not received any chemical seed treatments. The phasing out is in line with the principles of organic agriculture, in particular with the idea that only organic inputs should be used. However, at present, the use of organic seed is limited. How realistic is this target and what factors drive seed choice across Europe at present?

The Organic Research Centre, as a partner in the EU Horizon 2020 LIVESEED project, led a survey of 763 organic farmers in Europe, to identify the factors currently affecting the use of organic seed. The results of the survey reveal big challenges to the achievement of the goal of 100 % organic seed use in organic farming. Significant differences in organic seed use were found across different groups of farms: between farms operating in 'alternative' and 'mainstream' food supply chains, between smaller and larger farms, between established and more recently converted organic farms, and finally between farms located in different geographical regions.

In addition, farmers claimed a lack of availability of organic seed for a wide range of varieties they need to use to match the different agri-environmental conditions throughout Europe. This is a critical issue which needs to be addressed to allow all European farmers to pursue the inter- and intra-species diversity required in organic farming.

Introduction

The new European Organic Regulation 2018/848[1] that will enter into force in 2022 has announced the phasing out of derogations for the use of untreated non-organic seed in the EU organic agriculture by 2036. In fact, the current Regulation 834/2007 still allows the use of untreated non-organic seed through derogations where no organic seed is available. So far, however, the use of organic seed is limited.

The Organic Research Centre, as a partner in the EU Horizon 2020 project LIVESEED 'Boosting organic seed and plant breeding across Europe', has led a survey to understand the factors that are currently affecting the use - or not - of organic seed by farmers.

ORC Factsheet no. 4 - January 2021 Business & Markets

Main results

The survey was conducted in 2018-2019 with a network sample of 763 organic farmers in 17 European countries, which yielded the following results[2].

- Organic seed use is not consistent across European regions: farmers in Central Europe, the region where most organic seed production takes place, use more organic seed than farmers in the other geographical regions, in particular Eastern and Southern Europe.
- As far as production orientation is concerned, organic seed use is highest in the vegetable sector, followed by arable, the forage and, last, the fruit sector. As shown in **Figure 1**, differences in organic seed use are statistically significant between the vegetable and forage (livestock) sectors, and between the fruit sector and the arable and vegetable sectors.
- Organic seed is mainly used by farms operating in short and specialised supply chains. In fact, farmers that sell their production directly to consumers, farmers markets, organic shops, use more organic seed than farmers in the mainstream food chains selling to supermarkets.
- The share of organic seed used on farm decreases as farms get larger and more recently converted.
- The main critical issue reported by the surveyed farmers was the availability of organic seed for the varieties they need, followed by seed price, whereas seed quality was not reported to be a problem.

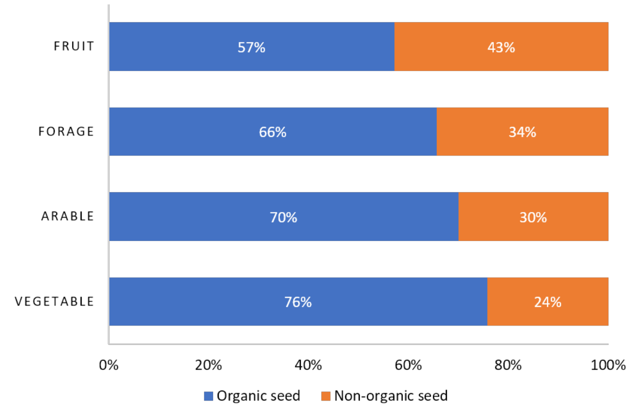


Figure 1 Mean share of organic seed use by production orientation across the surveyed EU farms. Bars with the same letter are not significantly different (Kruskal-Wallis test)

- Across five possible actions to boost the use of organic seed in Europe, the ones perceived as most important by most farmers were "*Improve availability of organic seed for locally adapted varieties*" and "*More effort to breeding programmes for organic farming*" (**Figure 2**).

Overall, organic farms use a relatively low proportion of organic seed unless they are part of short and specialised organic supply chains. As more farms in Europe convert to organic farming, barriers to organic seed use by the recently converted generation of organic farmers must be identified and overcome. This is especially true considering that in the Farm to Fork and Biodiversity strategies published by the European Commission, organic agriculture is put at the heart of a transition towards sustainable food systems, with a target to reach at least 25 % of agricultural land under organic farming on average in the EU by 2030[3,4].

CONCLUSION

Given the current situation, a 100 % organic seed use by 2036 as set out in the new Organic Regulation appears to be challenging unless the issue is more widely addressed.

Whilst the harmonisation of the implementing rules and the organic seed market in Europe remains a fundamental goal for the sector, the first condition for the sustainability of organic agriculture is to ensure availability of a wide range of varieties and species suitable to different agri-environmental conditions to allow all European farmers to pursue the intra- and inter-species diversity required in organic farming. Also see: Factsheet no. 2 "Farm-based organic variety trials" and Factsheet no. 3 "(R)evolutionary wheat populations". To improve the availability of organic seed, seed companies throughout Europe need to invest in organic seed multiplication. ORC is leading further work within the LIVESEED project to investigate if competitive business models exist and what they should look like so that supply can meet farmers' demand.

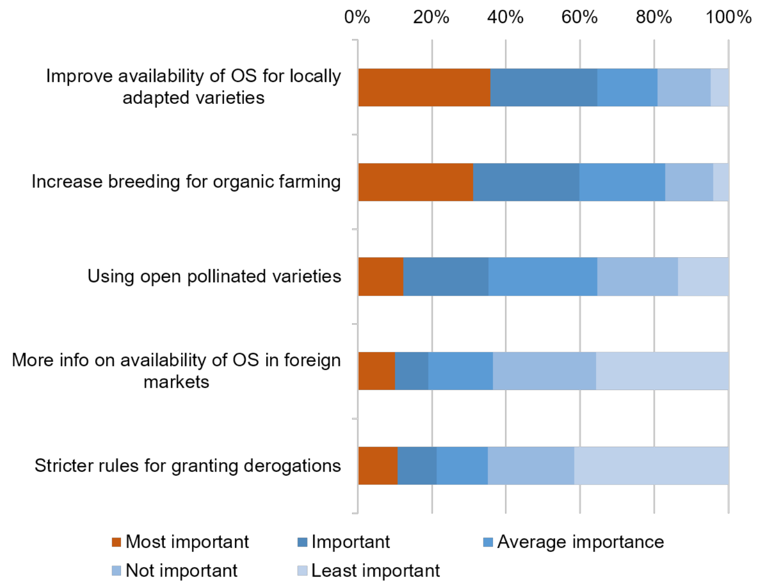


Figure 2 Actions to boost organic seed use: percentage of farmers classifying each action as most important

REFERENCES

1. Regulation (EU) 2018/848: eur-lex.europa.eu/eli/reg/2018/848/oj
2. Orsini *et al.* (2020) doi.org/10.3390/su12208540
3. European Commission (2020) Farm to Fork Strategy: tinyurl.com/y3ro3fcg
4. European Commission (2020) EU Biodiversity Strategy for 2030: tinyurl.com/yyae5hc9
5. LIVESEED project website: liveseed.eu

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

CROP DIVERSITY & AGRONOMY

Reduced tillage in organic farming

Lessons from the TILMAN-ORG project and beyond

AUTHOR
Dominic Amos

CONTACT
Dominic Amos

ORC ACKNOWLEDGEMENTS
Oliver Crowley, Thomas Döring, Mark Measures

YEAR
2011-2014; 2020-Present

FUNDING - PROJECT
CORE Organic II
- TILMAN-ORG
Innovative Farmers

TILMAN-ORG A European Network

INNOVATIVE FARMERS

ABSTRACT

Reduced tillage can lead to improvements in soil health and enhance ecosystem services including carbon sequestration, reducing soil erosion, improving soil fertility and biodiversity, whilst reducing CO_2 and N_2O emissions from soils and decreasing energy usage. However, some consider it incompatible with organic farming stemming from concerns around weed control, nutrient availability, and ley incorporation, as well as insufficient equipment and knowledge to make the system work. ORC took part in the "Reduced tillage and green manures for sustainable organic cropping systems – TILMAN-ORG" project where these issues were investigated.

The results of this project showed that organic farmers can consider reduced tillage through a pragmatic site-specific approach: they can strategically employ occasional shallow inversion tillage or even shallow non-inversion tillage to realise some of the benefits of reduced tillage without significant yield loss. Specifically, the field trials conducted by ORC showed shifts in the weed communities, improvements in crop establishment and only moderate effects on crop yield over three cropping cycles.

Further research and development needs that were identified related to synchronisation of nutrient supply and demand, machinery improvements and adaptation of farm-specific reduced tillage systems to keep weeds controlled in the long-term. ORC is currently exploring combining reduced tillage with green manures, to improve nitrogen provision and weed control as a promising option for UK arable cropping systems. Adopting living mulches, i.e., cover crops grown simultaneously with the main cash crop, can potentially enable further reductions in tillage, or even organic no-till systems.

Figure 1 Field preparation with the Ecodyn (left) and with ploughing (right) in the trial at Duchy Home Farm

INTRODUCTION

Organic farming can improve carbon sequestration thanks to its use of fertility building leys, diverse crop rotations and organic manures and compost[1]. However, these benefits risk to be offset by ploughing, that can undermine soil health via compaction and disruption of the microbiome of the soil and can generate excessive mineralisation of organic matter. Reducing tillage can be achieved in many ways, including shallower cultivation and less frequent soil disturbance. Adopting these approaches can reduce energy consumption and help offset greenhouse gas emissions through carbon sequestration[2], whilst improving soil fertility and enhancing microbial and earthworm communities[3].

However, alternatives to ploughing are especially problematic in organic farming[4,5]. The main risk is that, by reducing tillage and by excluding inversion tillage, it can be difficult to control weeds and ensure plant nutrition in the absence of herbicides and mineral fertilisers. In addition, destruction of the ley, an element so integral to an organic rotation for soil fertility, becomes a huge practical challenge without ploughing. Machinery is available to help address these challenges and new systems are being trialled to investigate whether UK organic farming and reduced, or even no-till, can coexist or whether system changes can be found to integrate the benefits of organic agriculture and reduced tillage approaches.

REDUCED TILLAGE EXPERIMENT

As part of the TILMAN-ORG European project, we investigated the use of the Ecodyn combination drill and cultivator, to assess its potential for UK organic farming. Field trials were run at Duchy Home Farm (Tetbury, Gloucestershire) between 2010 and 2013, comparing shallow non-inversion tillage based on the Ecodyn machine to a depth of 7.5 cm with a more typical inversion tillage using a mouldboard plough to a depth of 15 cm.

In all three years, crop establishment was significantly more successful in the reduced tillage system however weed cover was also higher (**Figure 2**). The advantage of the reduced tillage was particularly apparent during dry spring sowing conditions, where the lack of inversion is likely to have helped conserve soil moisture and retention of soil organic matter in the upper soil layers and may have conferred a greater water holding capacity. However, the Ecodyn machine performance was weakened under wet conditions, as the duckfeet shares became clogged with soil. Consequently, the adoption of reduced tillage implies a certain degree of technical challenge, often requiring modifications to make the machinery suitable for specific soil conditions.

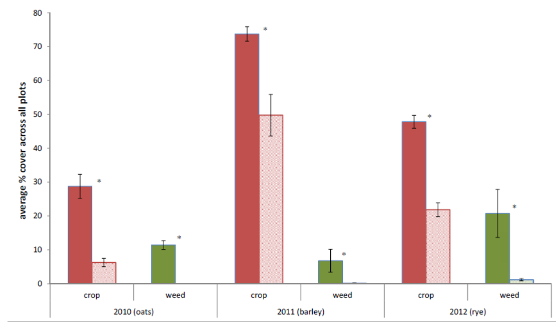


Figure 2 Mean crop and weed cover after establishment in the reduced tillage (solid fill bars) and in the ploughed (shaded fill) systems

Shifts in weed community composition were observed, with some weed species more prevalent in either the ploughed or the reduced tillage systems, but these are not necessarily linked to increased crop-weed competition from reduced tillage[6].
Average grain yields were similar between the two systems for spring crops (oats and barley) but were 50 % lower in the reduced tillage compared to the ploughed system for winter rye in 2012. Reduced tillage improved soil physical properties, earthworm abundance and community composition. In addition, fuel use was reduced by a third and tillage operations could be completed in a quarter of the time compared to the plough, meaning energy efficiency and profit margins were greater.

In our 40th Anniversary year ORC is helping farmers explore reduced tillage further via an Innovative Farmers field lab investigating a living mulch system where the cash crops in the rotation are intercropped with a (semi-)permanent forage legume. Once the perennial forage legume is established, the main crop can be established by either direct drilling or strip tillage thus eliminating or reducing the need for tillage. The system may require the development of in-crop mulch management devices such as an inter-row mower to reduce competition from the mulch, help control weeds and mobilise nitrogen for the cash crop. The mulch can also be mown and grazed at certain times to reduce its impact on the crop.

CONCLUSION

Unlike common perception, reducing soil disturbance in organic farming through non-inversion tillage is a very realistic option for maintaining crop yields whilst building soil carbon[7]. Combining reduced tillage with green manures is a promising option in the UK to guarantee nitrogen provision and control of weeds. Whilst shallow non-inversion is, at present, the most viable option for limiting the negative impacts of tillage in organic farming, current participatory research into living mulch systems combining zero-tillage and green manures is expected to provide interesting alternative options.

Figure 3 The Ecodyn combination drill and cultivator

REFERENCES

1. Berner *et al.* (2008) doi.org/10.2134/agronj2018.01.0028
2. Krauss *et al.* (2017) doi.org/10.1016/j.agee.2017.01.029
3. Holland (2004) doi.org/10.1016/j.agee.2003.12.018
4. Gattinger *et al.* (2012) doi.org/10.1073/pnas.1209429109
5. Kuntz *et al.* (2013) doi.org/10.1016/j.pedobi.2013.08.005
6. Armengot *et al.* (2016) doi.org/10.1016/j.agee.2016.02.021
7. Cooper *et al.* (2016) doi.org/10.1007/s13593-016-0354-1
8. TILMAN-ORG project website: tilman-org.net

ORGANIC RESEARCH CENTRE 40th anniversary

ORC 40th

CROP DIVERSITY & AGRONOMY

Matchmaking for legumes

Mixing the right species for multifunctional leys

AUTHOR
Thomas Döring

CONTACT
Dominic Amos

ORC ACKNOWLEDGEMENTS
Oliver Crowley, Sally Howlett, Mark Measures, Bruce Pearce, Helen Pearce, Martin Wolfe

YEAR
2008-2016

FUNDING - PROJECT
DEFRA
- LegLINK

EU FP7
- OSCAR

OSCAR Optimising Subsidiary Crop Application in Rotations

ABSTRACT

Forage legumes are indispensable components of organic rotations. White and red clover are the most widely used, however there are many different legume species available. Two ideas came together in a series of research projects at ORC: (i) to expand the range of species used by organic farmers, showing which species grow best under which conditions, and (ii) using multiple species in mixtures to combine the different properties and advantages that these species offer.

Field trials were set up at six sites across the UK, including English, Welsh and Scottish locations, to test different legume species with a range of traits. In addition, a mixture of nearly all of these species was grown on more than 30 organic farms alongside a farmer-chosen control ley.

Results showed that some not so well-known species, such as black medic (*Medicago lupulina*) have a strong multifunctional performance under various environmental conditions and may have been underrated by farmers and growers. Also, the optimal species composition of mixtures was dependent on the site.

The OSCAR project went on to show that several rarer legume species have good potential to be grown in organic rotations.

INTRODUCTION

Figure 1 A legume species mix undersown in barley

Building soil fertility is one of the central tenets of organic agriculture and improving soil fertility is almost unthinkable without legumes. Apart from their unique property to fix atmospheric nitrogen, they provide several further important services to the soil, e.g., by building up organic carbon, supporting a diverse soil fauna, and suppressing weeds and diseases. Their additional ability of providing ample resources of nectar to pollinators makes legumes true champions of multifunctionality. Starting in 2008, ORC brought together a large consortium of farmers, researchers and seed producers to ask which forage legume species are best suited to various organic growing conditions. The LegLINK project aimed to find multifunctional mixtures of multiple legume species to optimise the fertility building capacity of organic leys[1].

ORC Factsheet no. 6 - January 2021 CROP DIVERSITY & AGRONOMY

MANY SITES AND A MODEL

A set of twenty different legume species was pre-screened for their general suitability to organic conditions. Following this initial analysis, a subset of 12 of these legumes plus an additional set of four grasses (**Table 1**) were selected for trialling at six sites across the UK, namely Wakelyns Agroforestry in Suffolk, Barrington Park in Gloucestershire, Rothamsted in Hertfordshire, Duchy College Cornwall, IBERS Ceredigion and SRUC in Aberdeenshire.

At these locations, individual species were grown in monocultures to learn more about their various growth characteristics. A mixture compiled of 10 of the legumes and all of the grasses was tested alongside the monocultures. In addition, seed of this mixture or ASM (All Species Mix) as it was known, was sent to more than 30 farmers across the UK to be grown in a strip alongside their individual, farmer-chosen ley.

Table 1 The list of the species selected for on-farm trials

Species	Latin name
Alsike clover	*Trifolium hybridum*
Birdsfoot trefoil	*Lotus corniculatus*
Black medic	*Medicago lupulina*
Crimson clover	*Trifolium incarnatum*
Italian ryegrass	*Lolium multiflorum*
Large birdsfoot trefoil	*Lotus pedunculatus*
Lucerne	*Medicago sativa*
Meadow fescue	*Festuca pratensis*
Meadow pea	*Lathyrus pratensis*
Perennial ryegrass	*Lolium perenne*
Red clover	*Trifolium pratense*
Sainfoin	*Onobrychis viciifolia*
Timothy	*Phleum pratense*
White clover	*Trifolium repens*
White sweet clover	*Melilotus alba*
Winter vetch	*Vicia sativa*

Data was collected on the establishment, growth and biomass of the legumes; on a subset of sites, the occurrence of weeds and insects was studied (**Figure 2**), and in a final year we studied the performance of the cereal crop following the incorporation of the ley. Further, data collected in the field was used to calibrate a model that simulated the growth of all possible mixtures of the legume species – something that would have been impossible to test in the field, because of the astronomical number of mixtures.

Results from the LegLINK project showed clearly the large potential to diversify organic leys in the UK, e.g., by including lesser known species such as black medic, alsike clover or crimson clover in the ley[1], but also by expanding the geographical range of other species, e.g., lucerne grew surprisingly well up in Scotland. Work from the modelling then showed that the species composition of optimal multifunctional mixtures would be site-dependent[2], highlighting the need to develop mixtures adapted to specific conditions found on the farm. Somewhat surprisingly, the model also showed that even with multifunctionality as a target, some optimal mixtures contained only one species, i.e., were in fact monocultures of a high-performing all-rounder species.

ORC's experience with the diversity of forage legumes then led to its participation in OSCAR: a collaborative European research project to develop more sustainable systems of conservation agriculture and increase the diversity of cover crops and living mulches. This work considered legumes' role as so-called subsidiary crops, e.g., as cover crops between cash crops or undersown into main crops. Here, the research combined the screening of further diverse legume mixes and included the development of specialised machinery to enable reduced tillage[3]. Also see: Factsheet 5 "Reduced tillage in organic farming".

Conclusion

Many of the results produced by the LegLINK project were complex and not easy to translate into robust advice for the choice of the right legume species in an individual growing situation. However, the project and its participatory nature with large-scale farmer involvement meant that many farmers were able to become more engaged in their forage legume selection.

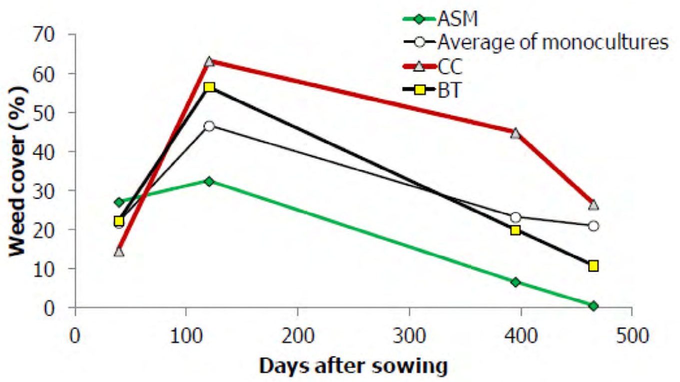


Figure 2 Weed cover for two selected legume species, the all species mix and the average of the monocultures. CC - Crimson Clover, BT - Birdsfoot Trefoil, ASM - All Species Mix

References

1. Döring *et al.* (2013) LegLINK project report: orgprints.org/24662
2. Storkey *et al.* (2015) doi.org/10.1890/14-1605.1
3. The OSCAR Toolbox: web5.wzw.tum.de/oscar

Organic and regional feedstuffs for pigs and poultry

Sustainable organic diets for monogastrics in Europe

AUTHOR
Lindsay Whistance

CONTACT
Lindsay Whistance

ORC ACKNOWLEDGEMENTS
Catherine Gerrard, Bruce Pearce, Jo Smith, Phil Sumption

YEAR
2011-2014; 2018-2021

FUNDING - PROJECT
CORE Organic II
- ICOPP
EU Horizon 2020
- OK-Net EcoFeed

Abstract

Providing organic pigs and poultry with a balanced diet that is fully organic and based on regionally-grown feedstuffs is a challenge and particularly so when sourcing quality proteins that satisfy amino acid requirements. Across Europe, there is a serious shortfall in the amount of organic feed grown and the amount required. In the UK, the self-sufficiency rate for crude protein is only 30 %. The shortfall in monogastric feed is further exacerbated by half of the available protein being fed to ruminants. ICOPP and OK-Net EcoFeed projects have both identified the need to seek alternatives to reduce the need to import feedstuffs. Trials in different European countries offer some viable solutions including an increased and novel use of forages such as nettles and bio-refining grass leys to extract high-quality protein. Utilising byproducts from the human food industry and different processing techniques including sprouting seeds and on-farm heat-treating of regionally-grown soya and field beans offer further promising solutions. Alongside the trials, to help create balanced diets using organic and regional feedstuffs, a ration planning tool is being developed to support farmers and advisors at an individual farm level as part of the OK-Net EcoFeed project. Good knowledge exchange is key to help ensure that identified solutions are utilised as widely as possible and, as an organic knowledge exchange network, OK-Net EcoFeed has created a library of tools developed from past research and extension work to which will be added the results of trials currently being tested. All of the tools will be placed on the open access Organic Farm Knowledge platform.

Introduction

A goal in organic farming is to offer animals a balanced diet that is fully organic and based on regionally-grown feedstuffs. However, achieving this for pigs and poultry is problematic and the two biggest challenges are closely linked. Sourcing quality protein that satisfies specific amino acid (AA) requirements, particularly lysine and methionine is difficult. Overfeeding lower-quality protein can correct AA levels but leads to nitrogen pollution whilst underfeeding protein risks health and welfare problems as well as poor production. The higher quality protein sources, for example soya beans, are typically imported from other continents, such as China, increasing both human/animal feed competition issues and pollution problems associated with excessive food miles. In recognition of the problems facing the organic, monogastric farming sector, and to allow time to find solutions, European legislation has permitted the use of five percent non-organic feedstuffs until 2021.

Some solutions

It is estimated that 330,000 tonnes per year of organic animal feed are required for organic livestock in the UK but farmers are only able to grow 141,000 tonnes. At about 30 %, the self-sufficiency rate for crude protein is low, and for the AA methionine it is even lower, at only 14 %. ICOPP calculated that 49 % of crude protein is fed to ruminants and note that reductions here would help solve shortages in monogastric feed. The low self-sufficiency rates indicate that innovative and alternative feed sources must be considered including cultivated insects and byproducts from the human feed and fishing industries. Additionally, forage in organic animal diets is mandatory but its full contribution to monogastric nutrition is not well understood. A trial in the UK found that locally-grown protein sources, particularly peas, together with a lucerne-silage-based feed ration, can replace soya beans for growing pigs. Silage can also help subordinate sows increase feed intake when concentrates are restricted. If properly processed, sainfoin seeds can be used as a substitute for soya bean expeller for weaned piglets. The contribution of insects and invertebrates foraged from the range was also investigated and earthworms (**Table 1**) were found to offer the most potential for laying hens whose lysine requirements could be met with access to one square metre of land.

Table 1 Earthworm yields of dry matter, crude protein, lysine and methionine content from different farming systems

	Yield g/m²			
	Dry Matter	Crude Protein	Lys	Met
Pasture	23.1	11.9	0.78	0.22
Woodland	18.9	9.7	0.63	0.18
Agroforestry	30.3	15.6	1.02	0.28

The OK-Net EcoFeed project is working with farmers and other industry stakeholders to develop an organic knowledge network on monogastric animal feed across Europe.

Existing knowledge has been gathered to identify and share current solutions and developed factsheets are available on the Organic Farm Knowledge platform. Other key texts have been translated to further improve access to existing knowledge. Additional factsheets and videos are being created from trials in each participating country, the topics of which include bio-refining grass/clover to extract protein; how to grow and feed nettles and camelina; how to sprout and feed grain and seeds; improving gut health to optimise utilisation of nutrients; stabilising brewer's yeast as silage; on-farm processing of locally-grown soya; growing rotational protein fodder for foraging pigs and creating flexible seasonal feed plans based on exclusively homegrown and regional feedstuffs.

Alongside the trials, a ration planning tool is being developed to support farmers and advisors at an individual farm level in the development of balanced diets using organic and regional feedstuffs. To further increase the sustainability of organic monogastric feeding practices, farmers identified a broader need to understand more about the nutritional content of all available and potential feedstuffs and more about the nutritional requirements of different breeds at different ages and production stages.

CONCLUSION

Supplying fully organic and regionally-produced diets to organic pigs and poultry across Europe is a challenge but the ICOPP and OK-Net EcoFeed projects show that collaborating with farmers and other industry stakeholders and using a toolbox-like approach to research can identify solutions. Practical trial outcomes indicate that using novel and innovative feedstuffs can help to reduce the reliance on traditional protein sources such as soya beans. Forage is mandatory for organic livestock diets but its full potential as a quality protein feed is not yet realised. Identifying and sharing both existing potential solutions and project trial outcomes can help to progress learning and reduce inefficient repeat learning. The open-access Organic Farm Knowledge platform has been developed to help improve knowledge exchange.

REFERENCES

1. Repository of knowledge for European organic farmers and other stakeholders: organic-farmknowledge.org
2. OK-Net EcoFeed project website: ok-net-ecofeed.eu
3. ICOPP publications and technical notes: tinyurl.com/y39um75o

ORGANIC RESEARCH CENTRE
40th anniversary

40th ORC

FOOD SYSTEMS

The Public Goods Tool

Assessing the sustainability of sheep and goat production in Europe

AUTHOR
Lisa Arguile

CONTACT
Lisa Arguile

ORC ACKNOWLEDGEMENTS
Catherine Gerrard, Roger Hitchings, Marion Johnson, Mark Measures, Samantha Mullender, Susanne Padel, Bruce Pearce, Laurence Smith

YEAR
2011-Present

FUNDING - PROJECT
DEFRA
- OCIS PG Tool
EU Horizon 2020
- iSAGE

iSAGE Innovation for Sustainable Sheep and Goat Production in Europe

ABSTRACT

The identification of sustainable agricultural practices is essential to ensure the sector remains profitable, whilst reducing its environmental footprint. In order to achieve this there is a need for tools to help farmers understand what influences their farm's sustainability and how those aspects influence the public goods they deliver. ORC's Public Goods Tool (PGT), is an assessment designed to do just that. Developed with farmers, the tool identifies strengths and weaknesses in current farming practices. Presenting the results in a holistic manner using a radar diagram, creates a platform for discussion and the easy identification of areas of high performance and those where improvements could be made. The PGT has been used in several research projects since its development in 2011. The most recent to conclude being iSAGE: "Innovation for Sheep And Goat production in Europe". iSAGE adapted the PGT to address sustainability across the diversity of pan European sheep and goat systems and identified trends that could feed into future policy recommendations. Key findings identified were strengths in animal health and welfare awareness, whilst weaknesses were situated within environmental activities, monitored through agricultural systems diversity and agri-environmental management. The tools ability to identify strengths and weakness within just a few hours on farm ensured its successful application within iSAGE.

INTRODUCTION

The Public Goods Tool (PGT) is an on-farm discussion tool that identifies strengths and weaknesses among agricultural practices, holistically addressing 11 themes of sustainability: *1. Soil management*; *2. Biodiversity* – later renamed *Agri-environmental management*; *3. Landscape and heritage*; *4. Water management*; *5. Manure management and nutrients*; *6. Energy and carbon*; *7. Food security*; *8. Agricultural systems diversity*; *9. Social capital*; *10. Farm business resilience*; *11. Animal health and welfare*[1]. Developed by a team of both researchers and advisors at ORC in 2011 through the Organic Conversion Information Services (OCIS) Public Goods Tool project, the original tool helped organic farmers identify which public goods their farming practices delivered. Each theme achieves a score between 1 and 5, that is dependent on the management practices implemented. Scores are determined based on a combination of what practices are conducted on the holding, i.e., the presence of buffer strips along watercourses, primary data, i.e., fuel usage and advisor opinion based on the farmers responses to a set of questions. A score of 5 highlights a strength in the business, whilst a score of 1 indicates a weakness and room for improvements to be made. Over the years the tool has been adapted and applied to a further 10 UK & EU research projects, which have looked at conventional, organic, dairy, arable, agroforestry and pasture-based systems, supporting the development of the indicators for assessing farm sustainability.

WHAT WE DID AND WHAT WE HAVE LEARNED

Sustainable agriculture is a common phrase quoted when discussing ways to reduce the environmental impact of farming systems. With livestock the largest land use sector on Earth[2], there is a need to identify sustainable livestock systems that will support farmers, the economy, and the environment for years to come. The iSAGE project addressed some of these issues with the aim to improve the future sustainability of the European sheep and goat sector. ORC had a lead role within iSAGE, involving researchers from across the Animal Husbandry, Food Systems, and Business & Markets themes at ORC.

Well managed sheep and goat systems provide economic support within rural communities, retain cultural practices, support social wellbeing, and deliver environmental benefits[3]. As efficient grazers sheep and goats can utilise land unprofitable for cattle or arable production, filling a niche within the farmed environment. However, in order to successfully deliver those benefits the system needs to be managed sustainably.

Changes to subsidies, disease outbreaks and extreme weather events have preceded declines of animal numbers and holdings in the industry. To help revitalise the sector iSAGE generated outputs to aid its future sustainability, one of which involved assessing the current sustainability of European sheep and goat farms, using an adapted PGT.

The adapted PGT modified in iSAGE has a greater focus on livestock systems and was aligned with the FAO's Sustainability Assessment of Food and Agriculture (SAFA) guidelines[4] by including a section on governance, the cornerstone to sustainability.

As a livestock project, focused on sheep and goat production, iSAGE was particularly interested in animal health, animal welfare and socio-economic performance. To accommodate these interests the structure of the PGT increased from 11 to 13 sustainability themes with the inclusion of governance and the separation of animal health and animal welfare (**Figure 1**). The indicators present within the PGT at the start of the project were reviewed by members of the iSAGE consortium, new ones were suggested and those not applicable removed to form the final list. This led to the creation of a tool that could account for the diversity of sheep and goat systems in Europe, from intensive milk production to extensive meat production.

Using the tool, we were able to identify the sustainability strengths and weaknesses on 206 sheep and goat farms from Finland, France, Greece, Italy, Spain, Turkey and the UK[5].

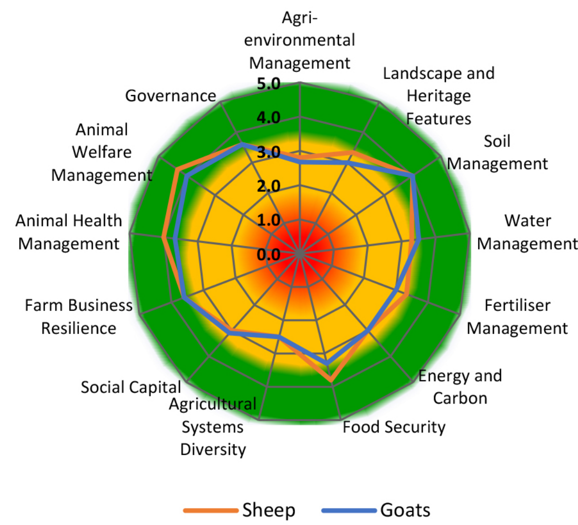


Figure 1 Median farm PGT scores from sheep and goat farms partcipating in iSAGE

Out of those studied, farms appeared to struggle in areas of agricultural systems diversity and agri-environmental management, with a median score lower than 3. A score of 3 can be taken as average performance. Some spurs appeared to be influenced by climate zone, with lower scores for water management achieved on farms in southern climates in comparison to Alpine, Atlantic or Northern regions. Animal health and animal welfare scored high on all farms, with median scores of 4.3 and 4.0, indicating an awareness of good practice within the industry, however actual implementation of these activities was not easily quantified within the PGT.

CONCLUSION

The PGT is one of many sustainability assessment methodologies (SA) available within the agricultural sector today. With over 100 SA to choose from selection depends on the context and framing of the question investigated, whether that be focusing on environmental or economic performance, or a specific farming system.
The PGT has been applied in several different research projects covering a range of farming systems, with iSAGE being number 5 of 11. This work highlights its cross-sector applicability. The PGT's other strengths lie in its role as a discussion tool, a useful means for assessing on farm sustainability whilst educating farmers and increasing the awareness of the link between public goods and sustainability.

REFERENCES

1. Gerrard *et al.* (2011) orgprints.org/18518
2. Herrero and Thornton (2013) doi.org/10.1073/pnas.1321844111
3. Zygoyiannis (2006) doi.org/10.1016/j.smallrumres.2005.07.043
4. Food and Agriculture Organisation (2014) SAFA guidelines: fao.org/3/a-i4113e.pdf
5. Paraskevopoulou *et al.* (2020) doi.org/10.3390/su12083099
6. iSAGE project website: isage.eu

ORGANIC RESEARCH CENTRE 40th anniversary

FOOD SYSTEMS

Health in organic farming systems

Intuition and other soft skills crucial for translating organic principles into practice

AUTHOR
Anja Vieweger

CONTACT
Will Simonson

ORC ACKNOWLEDGEMENTS
Thomas Döring, Lawrence Woodward

YEAR
2012-2020

FUNDING - PROJECT
Ekhaga Foundation
- Farm System Health in Practice
- Health Networks
- Health Concepts

EKHAGASTIFTELSEN

Abstract

Since 2012, ORC has been investigating health concepts within organic food and farming systems. As health is one of humankind's greatest goals, and a prime argument for buying organic food products, we explored crucial questions such as: 'How do we define health?'; 'How do we measure health?' and 'How do farmers increase health in their farming systems?'.

After our qualitative literature analysis found significant variation in health criteria within different scientific disciplines[1] (e.g., soil science prefers to describe health with terms such as *sustainability* or *function*; veterinary science on the other hand, uses the term less, and tends to describe health rather as *productivity* or *resistance*)[2]; we wanted to find out how farmers deal with this variation and how they themselves describe and measure health.

Taking the IFOAM principle of health[3] as basis for this work, we worked with farmer groups in Germany, Austria and the UK to jointly identify their own strategies and philosophies for running healthy farming systems and increasing the health of soils, plants, animals and humans. The groups initially developed their own 'principles of health' in each country, and later worked together to agree the most 'accurate' formulation to merge these 10 statements[4].

The "Farm System Health in Practice" project built on these findings, using participatory multi-actor approaches to collaborate with the established international network to develop a concept for farmer-to-farmer learning, defining the most appropriate conditions and methodologies for the transfer and multiplication of tacit farmer knowledge around health.

Introduction

The pressures on our food systems, including climate change, biodiversity loss, environmental contamination, and global health crises to name a few, call for a comprehensive and holistic approach to finding solutions, linking up individual disciplines and working together towards transformative change.

The international group of farmers collaborating on this project series agreed a list of 10 statements that describe how they achieve health on their organic farms. Although several of these 10 statements are already commonly known, widely accepted in the organic sector and in line with the IFOAM principles, some of the farmer statements are addressed much less often and describe more holistic and softer approaches. While the identified required 'soft skills' scarcely feature in the organic regulatory or advisory framework, these skills were highlighted by the farmers as being of particular importance for running a healthy farm, producing healthy food and collaborating in healthy value chains[1].

ORC Factsheet no. 9 - January 2021 Food Systems

A learning process

Now that the perspectives and philosophies of farmers were written down in their 10 statements of health, we wanted to find methods and suitable approaches to share this tacit knowledge with other farmers and together develop this continuous learning process further. A joint learning process seemed to be particularly challenging for the softer skills such as self-awareness, self-reflection, or intuition. However, all three national farmer groups stated that such skills are crucial for running healthy farms, and that they can be trained and practiced. They identified peer-to-peer exchange as being especially valuable.

The final project in the series brought the three farmer groups together again in each country, UK, Germany and Austria; and together they established three individual concepts for a farmer-to-farmer learning process to spread awareness about their own principles of health. Many aspects of the three learning concepts were quite similar:

1. The exchange with other farmers needed to happen on a farm, to exemplify and demonstrate the meaning behind the statements.
2. The core-group farmers needed to be involved/facilitate at least the initial exchange events in order to 'get the message across' and to explain the process they went through that brought them to these conclusions and statements.
3. The farmer co-learning groups needed to be of a particular size (optimal group size to ensure engagement and room for each member to build up trust, confidence and engagement), although this size was determined to be quite different in the three countries: UK groups were said to ideally count around 20 participants, 10-15 in Germany and a maximum of 10 in Austria, including the three host farmers.

But above all, the farmers unanimously agreed that this was a *long* learning process, that such courses or exchange events could not, and should not cover the entirety of this subject in just two or three events. The full potential of these 10 statements was seen in their ability to inspire other farmers to reflect and review health concepts on their own farms, and to find parallels or highlight areas where they needed to increase their efforts to foster better health.

There is no silver bullet that can be applied on each farm, each farm needs to be seen within its individual environment, economic and social circumstances. Through a plan of regular meetings within a specific 'working group for farm health', over several years, the farmers expected to enable a sound basis and common ground to learn and develop together, from each other and jointly drive their individual pathways, skills and growth towards healthier and sustainable food systems.

CONCLUSION

Implementing the organic principle of health on organic farms is a complex and multifaceted task which requires individual approaches on each farm. Transferring knowledge on how to promote health on organic farms can therefore not be based on a simple roll-out of recipe-like recommendations. Instead, it needs a dynamic process based on intensive social interaction with peers, personal engagement and self-reflection, and open-ended questions more than quantifiable health metrics. While this process may be slow, our results and experiences with the organic farmer workshops show that this approach is more appropriate for bringing about and handling the system shifts required for better health on organic farms.

REFERENCES

1. Organic Research Centre (2015) Towards farmer principles of Health: tinyurl.com/y2z3muru
2. Vieweger and Döring (2015) doi.org/10.1002/jsfa.6708
3. Döring *et al.* (2015) doi.org/10.1002/jsfa.6539
4. IFOAM (2005) The Principles of Organic Agriculture: tinyurl.com/z5zasjr

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

BUSINESS & MARKETS

The financial performance of organic farms in England and Wales

Outcomes from Farm Business Survey data

AUTHOR
Abel Villa

CONTACT
Abel Villa

ORC ACKNOWLEDGEMENTS
Catherine Gerrard, Nic Lampkin, Simon Moakes, Stefano Orsini, Susanne Padel

YEAR
2007-2015

FUNDING - PROJECT
DEFRA
- Organic farm incomes in England and Wales

ORGANIC RESEARCH CENTRE

Abstract

A detailed knowledge of farm finances is critical for on-farm and policy-level decision-making. This is one of the key considerations for farmers who would like to convert to organic farming and yet still need detailed information about the financial implications.

Between 2007 and 2015, ORC contributed to improving the knowledge base for organic conversion with a collection of reports about the financial performance of organic farms in England and Wales. These reports, based on the Farm Business Survey (FBS) data supplied by DEFRA, provide a comparison of financial figures of organic vs conventional farms.

Organic holdings were matched with clusters of comparable conventional holdings, to ensure meaningful comparisons between farms with a similar resource base such as similar land area, farm type and region. In this factsheet, some highlights from the last publication are presented together with some trends from the previous years.

Introduction

At the time of the publication of the final report in 2015, 548,000 ha of agricultural land in the UK was farmed organically. This area has declined over the years to 474,000 ha of land farmed organically in 2018[1]. Different factors may hinder the adoption of organic farming practices. A good knowledge of the financial implications of organic farming can help farmers make decisions to convert on a sound basis.

The financial performance of farms is a complex subject. In this factsheet we look only at some aspects; we refer the reader to the full reports which are publicly available for a detailed overview[2]. Furthermore, external factors such as trade agreements and farming subsidies have a significant role to play, meaning that business performance is dynamic and requires review in light of changing circumstances. Here, we present highlights related to farm business income (FBI) and the costs of organic and conventional holdings to explore how understanding the financial performance of organic farms can be approached.

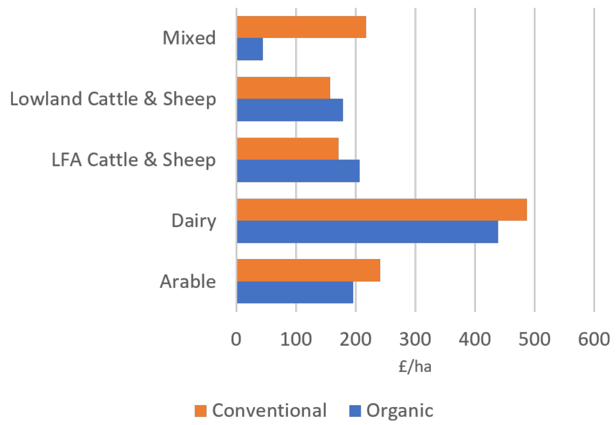


Figure 1 Farm business income, comparison between organic and conventional farm by production sector in 2013/14 (LFA: Less Favoured Areas)

ORC Factsheet no. 10 - January 2021 Business & Markets

Main results

Using data collected through the FBS in England and Wales (2013/14 data), organic holdings that met the pre-determined criteria were selected, namely farms that comprised of 70 % of their land area certified as organic. This included 190 organic holdings. Land area was controlled for by matching clusters of comparable conventional holdings. This led to data from 850 conventional farms being matched with 176 organic farms.

The analysis found that for most farm types, the performance of organic farms remains comparable to that of similar conventional farms. In terms of FBI (£/ha), organic farm incomes were higher for dairy and Less Favoured Area (LFA) and lowland cattle and sheep farm types, with organic arable cropping, horticulture and mixed farm types having lower FBI. The same pattern translated to total farm income.

Three figures are included to give an overview of the summarised data. **Figure 1** indicates that in 2013/14 the profitability (£/ha) of most organic farm types was in fact similar to that of comparable conventional farms. This was confirmed by no statistically significant t-test results in the data, except for some year-to-year changes within farm.

Figure 2 shows the input costs for organic and conventional farms by farm types. Total costs were lower or similar for most organic farm types. Crop input costs such as fertiliser and crop protection were lower, as were livestock costs for all types except mixed farms; other costs varied by farm type.

Overall, whilst some fixed costs, in particular those related to labour, are higher, variable costs are generally lower in organic than in conventional farms.

Figure 3 shows, with the example of winter wheat in 2013/14, how organic enterprise output were 236 £/ha lower than conventional, whilst the variable costs in organic production were 283 £/ha lower than those in conventional production. This highlights the importance of understanding how costs and outputs partition across different categories in organic and conventional farming. For example, lower variable costs shown in **Figure 3** are mainly linked to the higher use of inputs (mineral fertilisers, crop protection) in conventional farms.

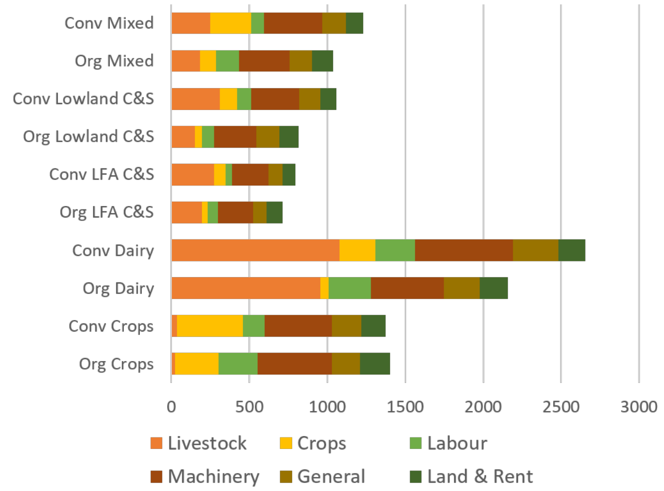


Figure 2 Breakdown of farm input costs in 2013/14 (Conv: Conventional, Org: Organic, C&S: Cattle and Sheep, LFA: Less Favoured Areas)

CONCLUSION

The comparison between organic and conventional farms in the 2015 report on the analysis in England and Wales showed no statistically significant differences in FBI per farm or per hectare, although some differences can be found by farm type and at enterprise level. Overall, looking at the trend in England and Wales since 2007 to 2014, the performance of organic farms was comparable with that of similar conventional farms. This analysis provides top-level data to inform practitioners and policy-makers when making decisions about organic farming.

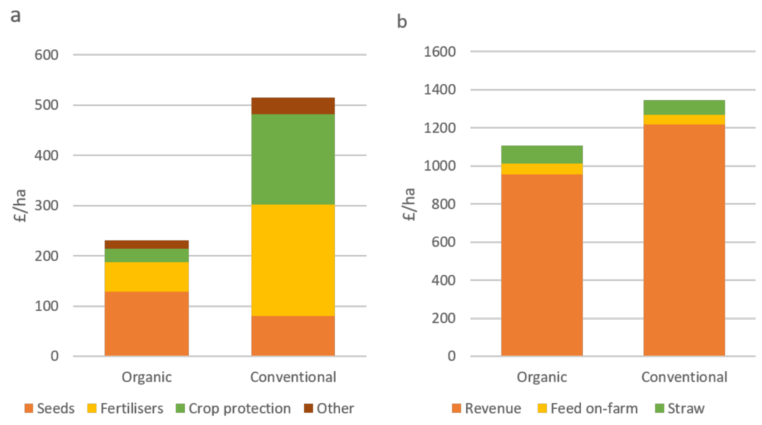


Figure 3 Variable costs (a) and enterprise output (b) breakdown: comparison between Conventional and Organic farms

It is important to consider the long-term financial performance of organic farming when considering the option to convert. Of course, every farm has its own set of circumstances that are relevant and need to be considered. It is worth noting that, since the publication of the last report of the series in 2015, the organic market in the UK has grown tremendously by more than 130 %, mainly driven by the increase in consumer demand[3]. This growing market potential is far from being fully exploited by the internal organic production.

REFERENCES

1. Moakes *et al.* (2015) orgprints.org/29475/
2. DEFRA (2019) Organic farming statistics 2018: tinyurl.com/y3tjt9jo
3. Soil Association (2020) Organic Market Report 2020: tinyurl.com/y5n9s8j8

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 1 - Feb 2021

40th ORC

CROP DIVERSITY & AGRONOMY

Diversifying wheat in organic farming

Opportunities to include underutilised wheat species in organic crop rotations

AUTHOR
Dominic Amos

CONTACT
Ambrogio Costanzo

ORC ACKNOWLEDGEMENTS
Charlotte Bickler, Nick Fradgley, Sally Howlett, Martin Wolfe

YEAR
2015-2019

FUNDING - PROJECT
EU Horizon 2020
- DIVERSIFOOD

DIVERSIFOOD

Many types of wheat, now forgotten, may prove well suited to organic and low-input agriculture today. We explored three 'forgotten' relatives of wheat: einkorn, emmer and rivet. Various accessions, including landraces, old and, where available, modern varieties of each species were grown and observed under organic conditions in the UK.

- Einkorn (*Triticum monococcum*) is the first type of wheat ever domesticated. Its hulled grains are known for their high nutritional value. A tiny plant in its early stages, it grows vigorously to produce a high number of tiny ears. Quasi-immune to diseases, can grow very tall and be subject to lodging. However, modern, short varieties, were not as competitive and productive as old, longer-strawed landraces.
- Emmer (*Triticum turgidum ssp. dicoccum*) is another ancient relative of wheat with hulled grains, recently rediscovered in Europe thanks to its nutritional value and flavour. A vigorous plant from the early stages of development, it showed the highest incidence of foliar diseases in our trials, although with important differences across accessions.
- Rivet (*Triticum turgidum ssp. turgidum*) is a close relative of durum wheat, but well adapted to cool climates, and was in fact widely used in the British Isles in the past. Quasi-immune to diseases, and very vigorous and competitive throughout the whole cycle, it is very tall, thus subject to lodging. However, it showed the highest productivity in our trials, mostly linked to its big ears and large grains.

Left to right: miracle rivet, emmer, einkorn, rivet, bread wheat

All three species thrived in environments where modern wheat varieties failed. Selected accessions were further tested in different rotational position and tillage systems. We found that these minor cereals can be sown as second cereal and/or under reduced tillage and grow shorter, i.e., less prone to lodging, without yield penalties.

Further reading

1. Costanzo *et al.* (2019) doi.org/10.3390/su11226304
2. DIVERSIFOOD database: tinyurl.com/yybbthvx
3. Friedrich *et al.* (2016) doi.org/10.1016/j.tplants.2016.05.005
4. ORC Bulletin 128, pp. 9-12: tinyurl.com/yy7jzbwc

Intercropping pulses and cereals

Experiences from research and practice

AUTHOR
Katie Bliss

CONTACT
Katie Bliss

ORC ACKNOWLEDGEMENTS
Dominic Amos, Charlotte Bickler, Thomas Döring, Nick Fradgley, Louisa Winkler, Martin Wolfe

YEAR
2017-2021

FUNDING - PROJECT
DEFRA
- OF0173

EU Horizon 2020
- DIVERSify

Innovative Farmers

Growing pulses in organic and low input systems can be challenging due to weed pressures and risk of lodging. Can intercropping pulses with a cereal help solve these problems?

- **Intercropping is a tool for integrated weed management.** Trials at Wakelyns in 2012 showed that weed abundance was negatively correlated to the sowing density of wheat intercropped with field beans. On-farm trials on an organic farm in Wiltshire demonstrated that weed biomass (mostly wild oat) was reduced by over 70% in wheat-bean intercrops compared to monocrop beans in 2017/18 (175 kg/ha beans and 125 kg/ha wheat) and in 2018/19 (200kg/ha beans and 100 kg/ha wheat). The interpretation is that wheat fills the niche of the weed whilst being less competitive against the pulse.

Harvesting lentil and oat. Credit: Andy Howard

- Cereals can **provide scaffolding** to prevent pulses from lodging and **enhance harvestability**. On farm trials in Shropshire in 2017/18 compared different relative densities (RD) of triticale (10, 20 and 30% of the monocrop sowing density) with 200 kg/ha carlin peas. Although in low lodging season, harvestability was notably better in the 30% RD triticale. Similar results were obtained with lentils and oats in Kent in 2019/20: oats drilled at 30 plants/m2 significantly reduced lodging and combine losses of lentils. The intercrop also halved the harvest costs, as monocrop lentils required two passes.
- Other benefits observed include greater **yield stability** – likely due to the lower weed burden, increased **land use efficiency** (Land Equivalent Ratio of one or greater) and improved **cereal grain quality** (protein content and Hagberg falling number).

Intercropping a cereal with the pulses can, thus, reduce weed pressure and enhance harvestability of the pulse. These benefits can be optimised acting on sowing rates and variety selection.

FURTHER READING

1. Fradgley *et al.* (2013) tinyurl.com/y2ymlqgc
2. Agricology Intercropping Virtual Field Day video: tinyurl.com/y599355x
3. Bliss (2019) tinyurl.com/y6egggwh
4. Bickler (2019) tinyurl.com/y44sz4bv

ORGANIC RESEARCH CENTRE
40th anniversary

40th ORC

CROP DIVERSITY & AGRONOMY

Using subsidiary crops to optimal effect

An online toolbox for cover crops and living mulches

AUTHOR
Charlotte Bickler

CONTACT
Dominic Amos

ORC ACKNOWLEDGEMENTS
Janie Caldbeck, Henry Creissen, Mary Crossland, Nick Fradgley, Robbie Girling, Sally Howlett, Bruce Pearce, Sally Westaway

YEAR
2012-2016

FUNDING - PROJECT
EU FP7
- OSCAR

OSCAR

Maintaining ground cover via techniques such as cover cropping and living mulches has several benefits including preventing soil erosion, conserving soil moisture, adding soil organic matter, reducing external inputs, and increasing soil biodiversity.

Following on from research on optimal use of species-rich legume-based leys in varied local environmental conditions, ORC was the UK partner in the OSCAR (Optimising Subsidiary Crop Applications in Rotations) research project. In multi-environment experimental trials across 12 different climates, it was found that the performance of subsidiary - cover crop and living mulch - crop species on soil quality improvement strongly related to climate; hence choice of species based on environmental conditions is essential. Although use of subsidiary crops reduced weed growth in most cases, satisfactory weed control remained a challenge which further emphasised the importance of good crop choice.

Researchers worked with farmers to assess cover crop species performance

Resultantly, a decision support tool was developed by ORC. It was based on a database of trial results from across the different climates included in the project and gave an overview of individual subsidiary crop species traits as well as the possibility to filter results in relation to site specific performance factors such as pH range or winter hardiness. This allowed farmers to explore the potential performance of different crop species according to geographic location and taking into account their on-farm growing conditions, e.g. soil type.

Presenting experimental data in a format that encourages uptake remains a key part of ORC's work. The OSCAR toolbox enabled farmers to identify suitable subsidiary crop species, varieties and appropriate species mixtures and access practical management advice. The online toolbox is now available via the Subsidiary Crop Database, which is part of the AgroDiversity Toolbox wiki site.

Further reading

1. IOTA Technical Leaflet no. 7 (2014): tinyurl.com/7ume96v3
2. Crossland *et al.* (2015) tinyurl.com/14m6b5vl
3. ORC Bulletin 120, pp. 20-22: tinyurl.com/5ckzuyw4
4. ORC Factsheet no. 6 (2021)

ORGANIC RESEARCH CENTRE
40th anniversary

40th ORC

Agroforestry

Productive hedges

Bringing hedges back into the farm business

AUTHOR
Will Simonson

CONTACT
Will Simonson

ORC ACKNOWLEDGEMENTS
Meg Chambers, Mary Crossland,
Jo Smith, Colin Tosh, Sally Westaway

YEAR
2013-2020

FUNDING - PROJECT
DEFRA and FACCE SURPLUS
- SustainFarm
INTERREG IVB NEW / Ashden Trust
- TWECOM
Woodland Trust

SUSTAINFARM

TWECOM
Growing local energy

There are half a million km of hedgerows in the UK, and they have been a valuable part of the patchwork agricultural landscape for centuries. Recent decades have seen them in major decline, however, as traditional management practices have given way to agricultural intensification. Can hedgerows see a resurgence once again, capitalising on their economic potential but also ecological importance, for example as sinks for atmospheric carbon and as habitat for biodiversity?

1. We have investigated the potential of hedges as a source of biofuel. At Wakelyns Agroforestry and Elm Farm, trials were undertaken to assess the costs and viability of mechanised hedgerow coppicing, comparing different equipment. Measurement of harvested woodchip quantity and calorific content provided evidence for the viability of decentralised energy production: the demand of a farmhouse boiler can be met by 320 m of hedgerow on a 15-year harvesting rotation (or a total of 4.8 km). Our results on coppiced hedgerow woodchip quality also underlines its saleability on the open market, when comparing revenue and costs on a £ m^{-1} hedge and a £ m^{-3} woodchip basis.
2. We have studied how hedgerows can be important for their wildlife and other ecological value. For example, surveys of hazel dormice at Elm Farm in 2014-2019 detected records of this protected species in most years, whilst also uncovering other small mammals such as pygmy shrew, wood mouse and yellow necked mouse, using the hedgerows for habitat or dispersal. The data informed hedgerow management planning, whilst also fostering positive links with local nature organisations and providing enjoyment of the farm environment for the 66 people that took part in the data collection.

Testing machinery for coppicing hedgerows at Wakelyns Agroforestry

These and other research results have informed best practice guides (see references) for managing hedgerows in an economically and ecologically sustainable way.

Further reading

1. Westaway and Smith (2019) tinyurl.com/84up3py6
2. Chambers *et al.* (2019) tinyurl.com/khdn99d6
3. Smith and Westaway (2020) tinyurl.com/27d3ust4

ORGANIC RESEARCH CENTRE
40th anniversary

ORC 40th

AGROFORESTRY

Tree-crop interactions

Maximising productivity and public goods with tree-crop alleys

AUTHOR
Colin Tosh

CONTACT
Colin Tosh, Will Simonson

ORC ACKNOWLEDGEMENTS
Ambrogio Costanzo, Jo Smith, Sally Westaway, Martin Wolfe

YEAR
2011-2016

FUNDING - PROJECT
EU FP7
- AGFORWARD
- Co-Free
- SOLID

ORC has a long history of research with Wakelyns Agroforestry farm in Suffolk. This farm operates an innovative system of arable crop alleys lined with marketable timber and fruit trees (**Figure 1**) and willow used for domestic fuel. Tree-crop alleys are becoming popular in the UK as they combine high overall productivity per area land with delivery of public goods (biodiversity, carbon storage).

1) Maximising the benefits of agroforestry with strategic tree and crop selection - Trials at Wakelyns have shown that crops growing close to trees take a yield hit of around 25% relative to those growing at the centre of the alleys due to competition with trees (see point 3 for compensating mechanisms). Yield losses can be minimised through careful selection of tree and crop species, however. Sycamore is an excellent combination with winter wheat, but for oats, cherry is better. Spring wheat does best next to alder and alder, which fixes nitrogen, is a good general choice for arable systems.

Figure 1 The Wakelyns Agroforestry alley cropping system

2) Weeds, pests, and disease - Reviews of global agroforestry indicate that agroforestry suppresses crop weeds and reduces pests and disease in perennial crops but less so in annuals. ORC research at Wakelyns has shown that marketable trees also benefit from agroforestry. Apple trees grown around crop alleys show consistently less scab damage than those grown in a monocrop orchard. Trees are less densely packed and the scab fungus transmits less efficiently.

3) Maximising productivity per area land - Those prepared to harvest both tree and crop will get most from agroforestry. ORC researchers at Wakelyns, using a statistic called Land Equivalent Ratio, have shown that growers would have to use significantly more land growing tree and crop in monoculture to obtain the same yield obtained using agroforestry. Agroforestry can be an extremely efficient use of land.

FURTHER READING

1. Pumariño *et al.* (2015) doi.org/10.1016/j.baae.2015.08.006
2. Smith and Westaway (2020) tinyurl.com/ya53lyjp

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 6 - Mar 2021

ANIMAL HUSBANDRY

Browse and tree fodder

Nutritional benefits for livestock

AUTHOR
Lindsay Whistance

CONTACT
Lindsay Whistance

ORC ACKNOWLEDGEMENTS
Jo Smith, Sally Westaway

YEAR
2014-2019

FUNDING - PROJECT
EU FP7
- AGFORWARD
EU Horizon 2020
- AFINET
Woodland Trust
- Minerals in tree leaves

Trees offer multiple benefits to livestock including shade and shelter. They provide feed and medicine and can be browsed or cut and preserved as tree fodder.

Agroforestry Networks across Europe foster exchange of knowledge and innovation between researchers and practitioners. In the AFINET project, factsheets were developed including 'Browse, preserved tree fodder and nutrition'. All livestock browse trees and benefit from the presence of condensed tannins (CTs). Up to 5% CTs of dry matter (DM) intake increases protein availability and can reduce parasite burdens by 50% in sheep. Salicylic acid, high in willow, is a pain killer, but also reduces swelling and has antibacterial properties.

A trial at Elm Farm in 2016, looked at the effects of air drying and storage on nutritional content. Harvested in June and fed to cattle in March, palatability remained high. Digestible organic matter of leaves was 85.7% for ash, 73.5% for goat willow and 77.7% for English elm, comparing favourably to fresh or preserved grass. Mineral analysis showed higher levels in stored leaves compared to fresh (June) samples. For example, fresh goat willow leaves contained 10.2 (g/kg DM) calcium and 4.2 (g/kg DM) phosphorus compared to 14.5 and 5.5 (g/kg DM) respectively when stored.

Cow browsing on ash

A further trial in 2018 investigated the mineral, energy and protein content of leaves harvested in June and September from goat willow, alder and oak trees in Berkshire, Leicestershire and Wales. Metabolisable energy (ME) and crude protein (CP) differed between species and season. ME was highest in alder, followed by oak and then goat willow. CP was highest in June and again highest in alder, followed by willow and oak. (Note, alder is unpalatable and even deer typically pass by). Mineral tests showed that goat willow had highest levels of cobalt offering a good source to growing lambs when pasture content is low.

FURTHER READING

1. Agroforestrynet (2020) Handbook: agroforestrynet.eu
2. Whistance *et al.* (2019) tinyurl.com/53ed2f8s
3. Whistance (2018) tinyurl.com/2rnrnyud
4. Kendall *et al.* (2019) tinyurl.com/4x6kjka7

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

FOOD SYSTEMS

Multispecies leys

Selection and management to support pollinators

AUTHOR
Lisa Arguile

CONTACT
Lisa Arguile

ORC ACKNOWLEDGEMENTS
Mark Measures

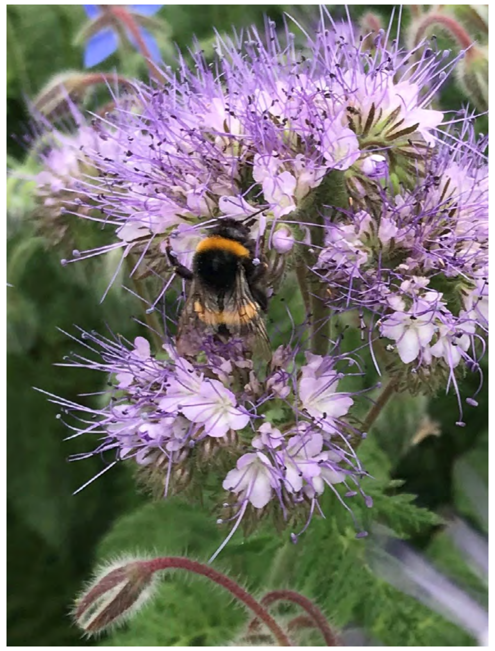
YEAR
2009-2012

FUNDING - PROJECT
DEFRA
- LegLINK

IOTA Institute of Organic Training and Advice

Multispecies leys have combined benefits for soil fertility, forage production and pollinator foraging[1]. With pollinators supporting reproduction within 35% of the world's food crops[2], incorporating multispecies leys within arable rotations provides a useful strategy to increase the abundance and diversity of pollinators on farm.

Within leys, species selection is important, and mixes can be tailored to increase floral diversity, nitrogen availability and forage quality. The LegLINK project (2009 - 2012) created an all species mix of 10 legume species and 4 grass species, with beneficial effects on pollinators. In addition, the project developed 4 common principles to be considered when forming a farm specific mix; (1) long flowering duration, (2) use at least 8 species, (3) include preferably 4 legumes, (4) include both grasses and herbs.



A visiting Bumble Bee, benefiting from the implementation of agri-environmental practices

The management of the ley will also influence pollinator populations as the mix needs to be given time to flower. Heavy stocking rates and multiple cuts can affect both the diversity and duration of flowering plants and so should be avoided when trying to increase pollinator populations.

Bee density on farm is known to correlate with floral resources. By selecting plants with long or converging flowering times, management practices can enable sufficient resources throughout the year. Current agri-environment schemes have helped support pollinators by encouraging the uptake of environmentally friendly practices. Recent work[3,4] demonstrates that the implementation of environmentally friendly practices does have beneficial effects on the abundance and diversity of bees on farm, especially when nectar flower mixes are used.

FURTHER READING

1. Döring *et al.* (2012) tinyurl.com/m44hm79c
2. Klein *et al.* (2007) doi.org/10.1098/rspb.2006.3721
3. Crowther & Gilbert (2020) doi.org/10.1016/j.jnc.2020.125895
4. Wood (2017) sro.sussex.ac.uk/id/eprint/66427

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 8 - Apr 2021

40th ORC

CROP DIVERSITY & AGRONOMY

Fertility building leys for crop production

Using legume-based mixtures to enhance nitrogen use efficiency

AUTHOR
Mark Measures

CONTACT
Dominic Amos

ORC ACKNOWLEDGEMENTS
Oliver Crowley, Thomas Döring, Sally Howlett, Bruce Pearce, Helen Pearce, Martin Wolfe

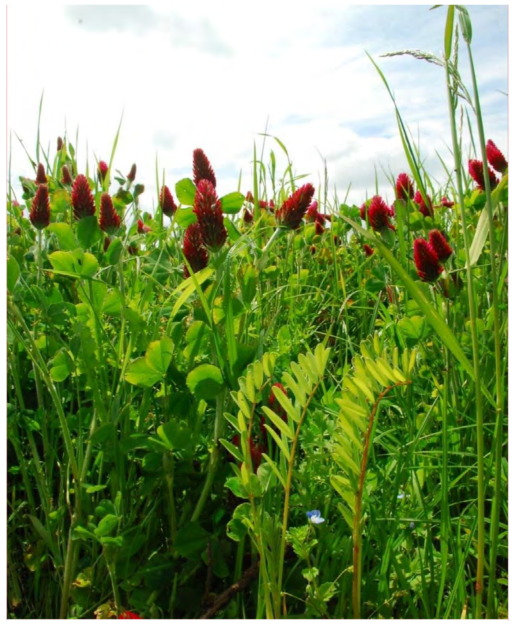
YEAR
2009-2012

FUNDING - PROJECT
DEFRA
- LegLINK

IOTA Institute of Organic Training and Advice

Soil fertility is the basis of organic farming and the principle means of building soil fertility is through the use of leguminous leys, in rotation with crops. The selection, diversity and management of appropriate forage mixtures including legumes, grasses and herbs has a major influence, not only on the yield of the ley and the crop but also on resilience to variable environmental conditions and wider wildlife populations. Also see: Research Digest no. 7 "Multispecies leys - Selection and management to support pollinators".

Not surprisingly different plant species affect soil fertility in different ways; the LegLINK project identified the main characteristics of the principal legume and grass species. There are several plant characteristics that have an impact on nitrogen release and mobilisation, namely: high C:N ratio, lignin and possibly polyphenol content. All of which result in slower N release, and potentially lower N losses and better utilisation.



Leguminous leys are the cornerstone of most organic systems, whether they are used for grazing, conservation or mulching

The research showed the benefits of diverse mixtures over simple two-way mixtures or monocultures. In the project, the "All species mixture" (16 species) was more productive than the farmer's own mixtures. However, modelling work showed that the species composition of optimal multifunctional mixtures would be site-dependent, highlighting the need to develop mixtures adapted to specific conditions.

Overall, the best multifunctional mixtures were found to contain Black Medic, Lucerne and Red Clover. There are benefits from the inclusion of grass species, but the correct balance of grass and legumes is important. The grass takes up the N fixed by the legumes and reduces the free N in the soil, the legume rhizobia respond to the lower soil N levels and fix more N, resulting in higher overall N fixation and hence greater biomass. In addition, the grass raises the C:N ratio, prolonging the release of N to subsequent crops.
In LegLINK, above ground yield of the ley was found to be positively associated with subsequent crop yield.

FURTHER READING

1. ORC Factsheet no. 6 (2021)
2. Döring *et al.* (2012) tinyurl.com/m44hm79c
3. Döring and Winkler (2013) tinyurl.com/yruufckj

Measuring and monitoring soil health

Practical advice for soil husbandry

AUTHOR
Dominic Amos

CONTACT
Dominic Amos

ORC ACKNOWLEDGEMENTS
Mark Measures, Anja Vieweger

YEAR
2015-2021

FUNDING - PROJECT
AHDB
- GREATSoils
- Soil Biology & Soil Health
BBRO
- Soil Biology & Soil Health
EIP Agri
- Agroecological Soil Management

Soil Health refers to soil functionality and its capacity to deliver ecosystem services and productivity. It is a complex interrelation between physical, chemical and biological properties, all combining to help soil fulfil its key functions. Drawing on experience from recent ORC projects, we aim to help guide farmers' sustainable soil management.

Any lab test should include a measure of soil organic matter as a key indicator of soil health and function, as it enhances soil properties and increases fertility. Whilst a standard test of pH, P, K and Mg provides useful information and should be routinely undertaken, this focusses only on basic chemistry and takes no account of physical or biological elements. Soil health assessments should account for structure with a spade test and texture should also be determined to inform results on other indicators and benchmarks. Earthworms are an excellent biological indicator and simple to assess. Assessment of microbiology is potentially useful with Active Carbon and Soil Protein tests giving the labile fractions that are useful indicators of medium-term fertility that are responsive to management. Microbial activity can be measured through potentially mineralizable nitrogen or the Solvita CO_2 burst respiration test, but the CO_2 burst bears some limitations, as high microbial activity is not necessarily related to other aspects of a healthy, well-structured soil with high earthworm populations.

An integrated health assessment including visual observation, biological activity, and nutrient reserves and availability is essential information for managing a healthy soil. Through the Soil Biology and Soil Health Partnership we aim to better understand the contributions these key indicators play in determining soil health through development of a scorecard, with UK and sector specific benchmarks being developed.

FURTHER READING

1. Measures (2019) tinyurl.com/a9w42bmz
2. Soil health: Let's get physical (chemical and biological): ahdb.org.uk/soil-health-scorecard
3. Amos & Vieweger (2018) tinyurl.com/4be53673
4. Stockdale (2018) tinyurl.com/4vyayud5

ORGANIC RESEARCH CENTRE 40th anniversary

The development and application of ORC's Public Goods Tool over the years

Assessing public good delivery and sustainability on farm

AUTHOR
Lisa Arguile

CONTACT
Lisa Arguile

ORC ACKNOWLEDGEMENTS
Nick Cooper, Catherine Gerrard, Roger Hitchings, Mark Measures, Susanne Padel, Bruce Pearce, Laurence Smith

YEAR
2010-present

FUNDING - PROJECT
DEFRA
- OCIS Public Goods Tool
- ELMs T&T

EU FP7
- SOLID

EU INTERREG
- TWECOM

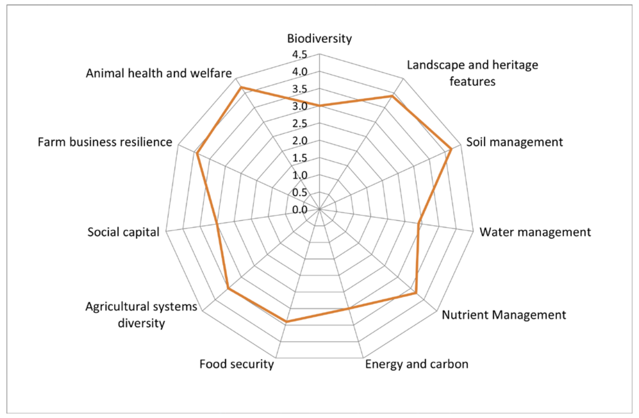
EU ERA-NET FACCE SURPLUS
- SustainFARM

EU Horizon 2020
- iSAGE

BBSRC
- SEEGSLIP

The interest of organic farmers and also policy makers in the provision of public goods on farm led to ORC developing its first Public Goods (PG) Tool, known as the OCIS PG Tool after the Organic Conversion Information System. The OCIS PG Tool assesses performance across 11 areas or "spurs": *Soil Management*; *Biodiversity*; *Landscape and Heritage*; *Water Management*; *Nutrient Management*; *Energy and Carbon*; *Food Security*; *Agricultural Systems Diversity*; *Social Capital*; *Farm Business Resilience*; *Animal Health and Welfare*. Each spur consists of activities (e.g., manure management) and questions on each activity are asked as part of an on-farm interview.

The OCIS PG Tool was tailored during the SOLID project (2011/2015) to evaluate the competitiveness and environmental sustainability of organic and low input dairy systems. It was then adapted within the UK Conventional Pilot (2014) to account for different farming systems, which saw the *Biodiversity* spur change to *Agri-environmental management*. Additional indicators on energy production and landscape character were then incorporated through work completed in the TWECOM project (2014/2015), creating the basis of the tool used today.



Radar diagram visualising the results from a completed OCIS Public Goods Tool assessment

Recent and current adaptions of the tool have occurred within iSAGE (2016/2020), to address the sustainability of sheep and goat production in Europe and create an online decision support tool; SEEGSLIP (2018/2021), to undertake a comprehensive analysis of pasture fed livestock systems; SustainFARM (2016/2019), to create a decision support tool for farmers producing both food and non-food products; and FOODLEVERS (2021/2022), to undertake an ecosystem services assessment. Finally, ORC is currently adapting the PG Tool within an ELMs Test &Trial (2019/2021) to assess public good delivery on farm. This adapts a comprehensive version of the tool, utilising aspects that were applied in SEEGSLIP.

FURTHER READING

1. Gerrard *et al.* (2011) orgprints.org/id/eprint/18518
2. Smith *et al.* (2011) tinyurl.com/pxk69vcn
3. ORC Factsheet no. 8 (2021)
4. SustainFARM Public Goods Tool v. 1.0: sustainfarm.eu/en/decision-support-tool

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

KNOWLEDGE EXCHANGE & POLICY

Sageguard: the farmer's decision maker

From a generic concept to a target-oriented design

AUTHOR
Chiara Tuoni

CONTACT
Chiara Tuoni

ORC ACKNOWLEDGEMENTS
Lisa Arguile, Marion Johnson, Samantha Mullender

YEAR
2016-2020

FUNDING - PROJECT
EU Horizon 2020
- iSAGE

iSAGE

Creating an online user-friendly tool to provide recommendations and advice for industry stakeholders that included farmers was a task identified within the EU project iSAGE (Innovation for Sustainable Sheep And Goat Production in Europe). The content was already contained within the ORC's PG (Public Goods) Tool. But what about a toolbox – how should it look and function?

ORC's PG Tool, an Excel-based sustainability assessment, was adapted during the iSAGE project to help assess sheep and goat farms across Europe. Sustainability themes were identified and clustered under 5 overarching dimensions: Livestock, Environmental integrity, Economic resilience, Good governance and Social wellbeing. Shaping the idea was only a matter of matching the PG Tool with a suitable framework – and possibly function and functionality. We knew that the function of the Toolbox should be to provide practical decision making. We also understood what the functionality should be: it had to be user-friendly. We decided that the generic concept of 'user-friendly' could be translated into 'portability' because the main users were farmers, and their principal activity was not sitting in front of a computer. So, the equation was "PG Tool : x = practical decision making : portability". Why not have waterproof cards held together by a metal ring like a keyring? Farmers could use these cards in the field as an offline resource helping create a sustainable system. And when online, they could explore them with the addition of further useful resources in our Sageguard.net platform. To make the transition from offline to online smooth, we added QR codes, links and numbers that link back to the iSAGE website from the cards.

The Sageguard Cards as a finished product

The name Sageguard is clearly a pun: our guidelines aim to safeguard the environment through embedding sustainability as a sage practice – as the iSAGE name suggests.

FURTHER READING

1. iSAGE project website: www.isage.eu
2. iSAGE Sageguard website: sageguard.net
3. ORC iSAGE Toolbox presentation: tinyurl.com/uvwz35f7
4. ORC Bulletin 132, p. 8: tinyurl.com/4au5kpu7

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

FOOD SYSTEMS

Using woodchip to build soil health

Sustainable application and economics

AUTHOR
Janie Caldbeck

CONTACT
Will Simonson

ORC ACKNOWLEDGEMENTS
Dominic Amos, Sally Westaway

YEAR
2017-2020

FUNDING - PROJECT
EIP-AGRI
- WOOFS

eip-agri

Sustaining and building soil organic matter (SOM) on regularly cultivated soils is a common challenge for farmers who often combine different methods to do so. Repeated compost applications alongside using legume leys and green manures can maintain or enhance SOM levels on stock-free farms but requires producing and composting on-farm (taking up space and time) or sourcing externally (costly and unsustainable). Using woodchip produced from tree and hedge management is an alternative; either composted or applied fresh as Ramial Chipped Wood (RCW). When used at an appropriate phase in a crop rotation it can increase SOM, water holding capacity and soil nutrient levels.

The ORC led the WOOdchip for Fertile Soils project to investigate using RCW as a sustainable source of organic matter for annual arable and horticultural production, encouraging farmers to manage woody elements on the farm as part of a whole farm system. Observations and results from 3 years of on-farm field trials are outlined in technical guides and include a focus on logistics and economics - see Further reading 2:

Freshly turned woodchip compost

- Farmers may choose RCW over compost when unable to produce compost, available compost or storage space is lacking, and / or they want to be input self-sufficient.
- Coppicing and chipping become cheaper per unit as volume increases and using larger more efficient machines becomes viable, but the scale of larger farming enterprises often creates less flexibility to change and adapt, ruling out doing things by hand or with smaller machines.
- RCW often makes most economic sense:
  - when coppicing to rejuvenate an old hedgerow
  - where local woodchip supply is limited, costly and/or quality cannot be assured
  - where hedge / tree management for logs produces brash not otherwise used.

Although both RCW and compost add to the SOM, they have different effects on the soil and can be used in a complimentary way.

FURTHER READING

1. Presentation by participatory trial farmer: tinyurl.com/2c3yk6ju
2. Westaway (2020) tinyurl.com/ushrkcdc
3. Project page on Agricology: tinyurl.com/4w5trs8w
4. ORC Bulletin 130, pp. 6-7: tinyurl.com/5esp9hem

ORGANIC RESEARCH CENTRE 40th anniversary

BUSINESS & MARKETS

Distribution of the added value in the organic food chain

A study of apple, milk and pasta supply chains

AUTHOR
Stefano Orsini

CONTACT
Stefano Orsini

ORC ACKNOWLEDGEMENTS
Susanne Padel

YEAR
2016

FUNDING - PROJECT
European Commission DG AGRI
- Distribution of the added value of the organic food chain

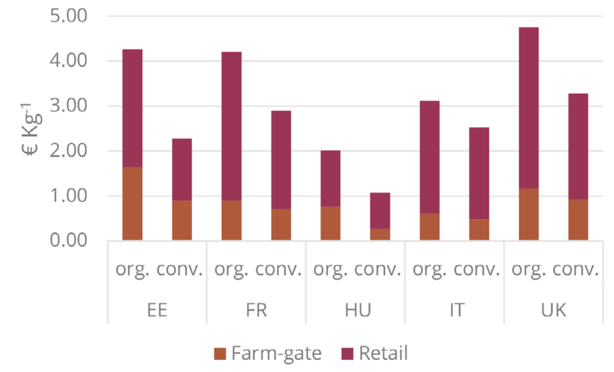
ORGANIC RESEARCH CENTRE

The Organic Research Centre (ORC) was a partner in a European Commission (DG AGRI) funded study to understand whether farmers are rewarded with a sufficient share of the added value in the organic supply chain. ORC worked with partners from across Europe (the Czech Republic, Denmark, Estonia, France, Germany, Hungary, Italy and Spain) to research three organic products: apples, milk and pasta.

The study focused on these three specific supply chain case studies and the main results were as follows:

- The farm gate and retail price of organic products was higher than conventional – see **Figure 1** for the apple supply chains in Estonia (EE), France (FR), Hungary (HU), Italy (IT) and the United Kingdom (UK).
- The farmers' share ranged from 3% to 65% of the added value created in the organic supply chains analysed (Sanders *et al.* 2016; Orsini *et al.* 2020). Examples of a fair distribution of added value were found in both supermarkets and alternative sale channels. The main challenge for organic farmers and other market players is not simply related to the question of whether or not to deal with supermarkets, but rather how to develop collaboration, physical infrastructures within specific sectors and improve the integration of supply chain operations.

Figure 1. Organic and conventional apple prices (€ kg^{-1})



The findings to some extent debunk the widely held belief that supermarkets use their position to extract bigger margins.
A challenge of carrying out the study as researchers was the lack of organic market data publicly available. Improving market transparency should be a priority for the organic businesses as it is critical to assist market players in their decisions.

Further reading

1. Sanders *et al.* (2016) doi.org/10.2762/678520
2. Orsini *et al.* (2020) doi.org/10.1108/BFJ-07-2019-0508

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

Business & Markets

Potential market opportunities for mixed farming and agroforestry

Applying innovative social science research methods

AUTHOR
Rowan Dumper-Pollard

CONTACT
Rowan Dumper-Pollard

ORC ACKNOWLEDGEMENTS
Stefano Orsini

YEAR
2020-2024

FUNDING - PROJECT
EU Horizon 2020
- AGROMIX

agromix

Wakelyns Agroforestry is involved in both field trials and monitoring as well in our socioeconomic assessment

To accompany ORC's contribution to the EU project AGROMIX (2020-2024), the ORC Business and Markets Team are leading an investigation into future market opportunities for mixed farming and agroforestry (MiFAS). Potential opportunities will first be finalised by convening a literature review and expert interviews. ORC will then incorporate different stakeholder groups (e.g., farmers, customers etc.) into the assessment of opportunities for MiFAS using Q-Methodology, an innovative social scientific research method applied to the study of subjective patterns in complex subject areas (Watts and Stenner, 2008). Previous EU-wide studies have demonstrated that MiFAS systems can be more sustainable than conventional monoculture farming, resilient to climate change and economic uncertainty, and provide many social benefits (Mosquera-Losada *et al.*, 2016; Leterme, 2016).

The preliminary findings from an evidence review and interviews with established agroforestry farmers conducted by the ORC team, highlighted three main contributing factors towards opportunities for MiFAS at farm level and within the wider supply chain:

- Appropriate tree selection and management allows additional profit to be made by the farmer from bioenergy in agroforestry systems.
- MiFAS practice and management affords numerous opportunities to extend growing seasons and periods in which the farm is profitable.
- Opportunities for MiFAS are not only associated with production systems and there is scope to incorporate public and private financing for the provision of ecosystem services.

Our findings from this task provide the basis for further investigations in 6 other European countries and will inform policy recommendations coming out of AGROMIX, targeted at increasing the uptake of MiFAS in Europe.

FURTHER READING

1. Watts and Stenner (2012) tinyurl.com/j2drwbu
2. Mosquera-Losada *et al.* (2016) tinyurl.com/44y2etp7
3. Leterme (2016) tinyurl.com/953vcvhe

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

BUSINESS & MARKETS

Organic Trade data in the UK

Evaluating different approaches for implementing organic trade data collection

AUTHOR
Stefano Orsini

CONTACT
Stefano Orsini

ORC ACKNOWLEDGEMENTS
Nic Lampkin, Susanne Padel

YEAR
2020

FUNDING - PROJECT
UK Department of International Trade (DIT)
- Evaluating the different approaches for improving UK organic trade statistics

ORGANIC RESEARCH CENTRE

In the UK, there is currently no organic trade data collection in the national statistical system. Accessibility to trade statistics is critical to assist businesses in identifying market prospects. This is especially relevant as new trade relationships are being negotiated between the UK and the rest of the world. Meanwhile, food exports and imports with the EU have decreased since Brexit (see **Figure 1**), and are expected to be hit further with the implementation of physical checks at the border after January 2022.

Defra commissioned a project to review the costs and benefits of the different methods for collecting organic trade data, to identify which method would be appropriate in the UK. Defra and ORC coordinated the project consortium which included: Organic Policy Business Research Consultancy (OPBRC), Soil Association Certification (SAC), Organic Farmers and Growers (OF&G), AHDB and Organic Trade Board (OTB).

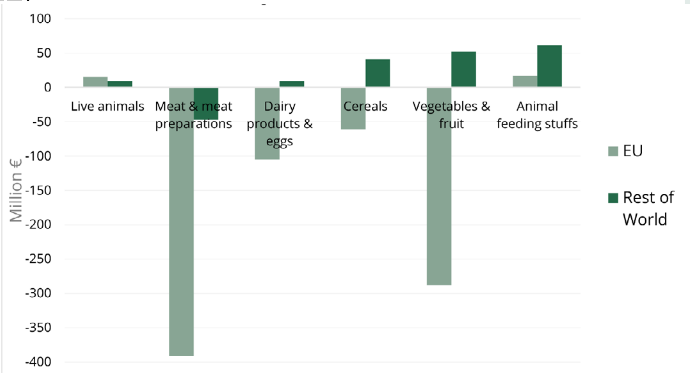


Figure 1 UK imports, YoY change Q1 2021. Breakdown between conventional and organic is not available. Source: ONS

One of the main recommendations is that Certificate of Inspection (CoI) – which is the form accompanying organic traded agri-food goods – should be used as source of information for organic trade statistics. The form ensures that organic products are compliant with the organic regulation of the import country and includes relevant information such as the volume of the imported goods, which are not captured in a data recording system at present. We therefore recommend that a system is implemented linking CoI to customs declarations and capturing the related data through Port Health Authorities.

The stakeholders of the UK organic industry consulted during the project are eager to see a data collection system implemented and believe it would strengthen the sector's ability to control organic integrity by making sure that quantities actually marketed in the UK are in reasonable balance with domestic production and net imports.

FURTHER READING

1. Office for National Statistics (ONS)
   Business, industry and trade

ORGANIC RESEARCH CENTRE
40th anniversary

Wheat breeding assessed for organics

An experiment with different tillage systems

AUTHOR
Ambrogio Costanzo

CONTACT
Ambrogio Costanzo

ORC ACKNOWLEDGEMENTS
Dominic Amos, Nick Fradgley, Tegan Gilmore

YEAR
2015-2017

FUNDING - PROJECT
EU FP7
- WHEALBI

Whealbi

Landraces of old wheat relatives (emmer, einkorn, rivet) markedly outyielded modern milling wheat cultivars in ORC field trials (ORC Research Digest no. 1), but why? In the past century, plant breeding has led to enormous productivity gains for wheat. However, this progress was achieved in conjunction with the use of fertilisers, fungicides and herbicides, and has proven weaker in organic and low input conditions[1] where these inputs are not used. In addition, organic cropping systems also need to reduce the intensity of tillage, by minimising ploughing, which can further alter cultivar adaptation and performance.

In 2015/16 and 2016/17, 13 bread wheat cultivars selected and/or used in British agriculture were compared, in an experiment run at the University of Reading's Crops Research Unit. Cultivars were grouped into: (i) landraces (seeds used before any formal breeding was developed), (ii) historic (1940s-1960s), (iii) modern milling and (iv) modern high-yield feed cultivars. This set of cultivars were grown in an organic rotation under both ploughed and shallow non-inversion tillage.

Old landrace of rivet wheat thriving (left), modern wheat cultivar failing (right): a not uncommon observation in organic farming

Overall, the shallow non-inversion tillage reduced yield compared to the ploughed system. In both systems, landraces were consistently less productive than all other cultivar groups and, among the latter, historic cultivars yielded as much as the modern milling ones. In non-inversion tillage conditions, even the inherently high-yielding feed cultivars showed no advantage compared to the historic milling cultivars[2].

Historic cultivars bear traits that improve their performance in organic and low-input systems, and that might have been lost during most recent modern breeding. As such, they can provide interesting opportunities both for organic farmers, especially if aiming to reduce tillage intensity, and for breeders looking at cultivars adapted to organic and low-input systems.

Further reading

1. Jones *et al.* (2010) doi.org/10.1017/S0021859610000146
2. Costanzo (2018) tinyurl.com/r2hev77n

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

Crop Diversity & Agronomy

Breeding for integrated weed management

Unpicking the complexity of weed-crop interactions

AUTHOR
Ambrogio Costanzo

CONTACT
Ambrogio Costanzo

ORC ACKNOWLEDGEMENTS
Dominic Amos, Charlotte Bickler

YEAR
2017-present

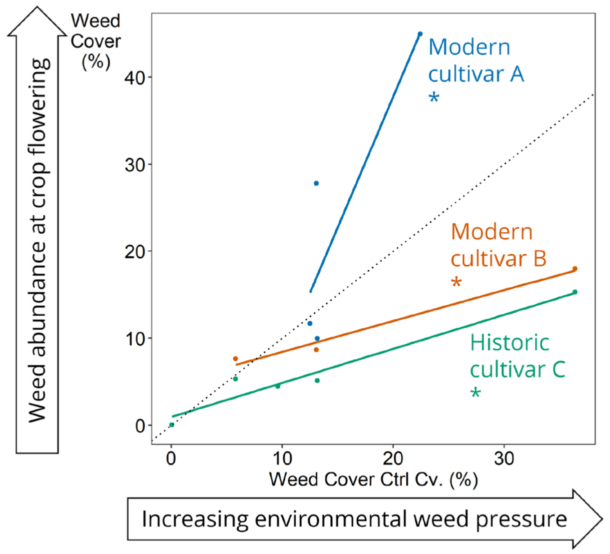
FUNDING - PROJECT
EU Horizon 2020
- LIVESEED
DEFRA
- LiveWheat

LIVESEED LiveWheat

How to effectively implement integrated weed management, i.e., to manage weeds without only relying on herbicides or intensive soil disturbance? A useful starting point is acknowledging that the main tool to regulate weeds is the crop itself[1], the way it is established and its traits. However, there have been very little developments in breeding for, and choice of, weed suppressive cultivars. This is mostly because crop-weed interactions depend on the abundance and composition of the weed community, climatic and environmental factors, and are therefore extremely complex[2].

To unravel this complexity, with the ongoing experiment presented in ORC Factsheet no. 2, we have been observing and assessing weed communities in organic winter wheat fields where different cultivars were grown alongside one another, obtaining a few interesting results[3]:

- wheat cultivars do differ in terms of weed abundance at crop flowering
- these differences are especially apparent in environments with high weed pressure
- long-straw, historic cultivars allow lower weed abundance than modern, short-straw cultivars
- amongst modern cultivars, those who have higher vigour (estimate of above-ground biomass) at the onset of stem extension allow lower weed abundance than others
- more weed-suppressive cultivars seem to show better nitrogen-use efficiency.



Dynamic stability of weed cover in three wheat cultivars grown in several farms: as weed pressure increases, "Modern cultivar B" and "Historic cultivar C" allow lower weed cover than the control cultivar, whereas "Modern cultivar A" is overwhelmed by weeds. Interim results, Spring 2020

Hence, although complex, cultivar choice and breeding for integrated weed management in wheat can be facilitated by considering, alongside yield and disease resistance, crop vigour in early stages. It is however important to observe and select cultivars in conditions as representative as possible of, or ideally directly into, the target environments and cropping systems.

FURTHER READING

1. Gaba *et al.* (2018) doi.org/10.1002/ecs2.2413
2. Nuijten *et al.* (2020) tinyurl.com/ykc3r7cc pp. 74-79
3. Costanzo *et al.* (2021) doi.org/10.1007/s13593-021-00706-y

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 18 - Jul 2021

CROP DIVERSITY & AGRONOMY

40th ORC

Organic vegetable transplant production

Meeting the industries needs: from substrate to spacing

AUTHOR
Bruce Pearce

CONTACT
Phil Sumption

ORC ACKNOWLEDGEMENTS
Christopher Stopes, Phil Sumption

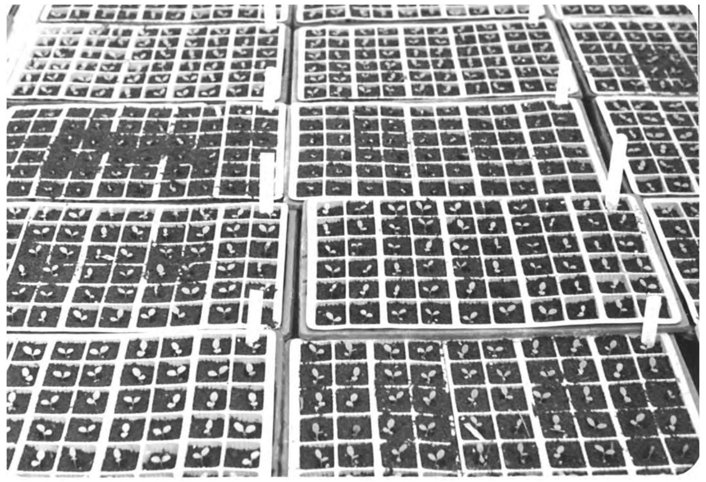
YEAR
1994-2003

FUNDING - PROJECT
DEFRA
- Organic transplants / evaluation and development of production techniques (OF0109)
- Overwinter transplant production for extended season organic cropping (OF0144)
- Alternative, non-animal-based nutrients sources, for organic plant raising (OF0308)

ORGANIC RESEARCH CENTRE

In the 1990s organic regulations were moving towards the use of organic vegetable transplants. However, the industry did not have the knowledge of how to produce transplants that would meet organic standards. The need was identified as far back as 1981, when the Organic Growers Association (now the Organic Growers Alliance, OGA) set up trials to test different growing media. Several research projects followed with the first certification of growing media granted to Turning Worms in 1986.

The Organic Research Centre was pivotal in researching and developing vegetable transplant production systems to comply with the new organic standards. Ahead of the removal of the derogation on the use of conventionally produced transplants at the end of 1997, ORC undertook several years of trials working with the industry to develop protocols for transplant production, overwinter production and alternative, non-animal-based nutrients sources.



Briefly, our results using organic transplants at a commercial organic grower's holding suggested that there may be a benefit, under adverse conditions (e.g. pest attack or drought), from using a larger plant. The disadvantage of using a larger cell size is that they make less efficient use of greenhouse propagating space and cost more in use of substrate, transport, and handling. It also means that organic growers may be using proportionally more peat in propagation than conventional growers. Our work on overwinter transplant production found that the effect of cell size (and thus plant density) on disease spread was minimal with both the cell sizes tested having similar spread of disease over 12 – 14 days. This would suggest that cell size is not a suitable method to control the spread of disease in organic transplant production systems.

FURTHER READING

1. Stopes *et al.* (2001) orgprints.org/id/eprint/7973
2. EFRC (2003): orgprints.org/id/eprint/9963
3. The Organic Grower (2007) tinyurl.com/2uzuyskc pp. 22-31
4. IOTA Research Review on Organic plant raising (2008): tinyurl.com/yjh8w467

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

KNOWLEDGE EXCHANGE & POLICY

Agricology

Practical Sustainable Farming Knowledge Hub

AUTHOR
Lydia Lishman and Katie Bliss

CONTACT
Katie Bliss

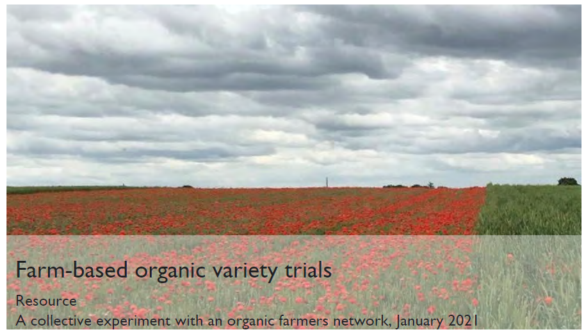
ORC ACKNOWLEDGEMENTS
Janie Caldbeck, Susanne Padel, Bruce Pearce, Pip Robb

YEAR
2015-present

FUNDING - PROJECT
Daylesford
DEFRA
Frank Parkinson
The James Hutton Institute
RSPB
WWF

AGRICOLOGY
SUSTAINABLE PRACTICAL FARMING

Agricology is an independent knowledge platform supporting all farmers and growers to transition to more sustainable and resilient farming systems. It was founded in 2015 by the Daylesford Foundation, The Organic Research Centre (ORC) and the Game & Wildlife Conservation Trust Allerton Project, with collaborative contributions from over 40 organisations, and is currently delivered by ORC.



Agricology shares knowledge and experience of agroecology from research and practice. It encompasses all production systems and a wide range of approaches, including organic, conservation agriculture and 'conventional'. The vision is that all farmers will be using agroecological and regenerative practices by 2030 to deliver productive, profitable, and resilient farming systems that enhance the environment and ensure a vibrant sustainable future of farming in the UK. The mission is to inspire all farmers with research evidence and farmer stories to instil changes in their farming system.

The web platform hosts a library of over 400 resources on different practices and principles from across the sector. Farmers share their experiences of the real-world application across their whole farming system in farmer profiles, videos and podcasts. Over 200 blogs and research project pages provide a space for researchers and others involved in the industry to share their expertise on key topics ranging from managing problem pests and weeds, to soil health, to agroforestry… The Agricology team have also hosted field days on-farm and online in collaboration with partners, providing a space for demonstration and discussion.

In a survey of platform users in 2020, 50% reported that they have been inspired to change their farming practice because of Agricology - it helped to “fill the knowledge gaps”, influencing them to “think differently” or feel “encouraged to continue on a path”.

FURTHER READING

1. agricology.co.uk
2. twitter.com/agricology

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 20 - Aug 2021

KNOWLEDGE EXCHANGE & POLICY

40th ORC

Ensuring research relevance through participation

Participatory research: whatever you think, think again

AUTHOR
Charlotte Bickler

CONTACT
Charlotte Bickler

ORC ACKNOWLEDGEMENTS
Participation is a guiding principle of ORC’s research that all staff past and present work to attain

ORGANIC RESEARCH CENTRE 40th anniversary

ORC is committed to working with farmers and other stakeholders to identify problems, co-create knowledge and work towards practical and applicable solutions for organic farming systems. How do we do participatory research?

1. Diagnosis, Prognosis and Falsifiability

To be "science", the work should deliver a 'falsifiable' discovery, or result: others must be able to control it, retrace the steps by which it was produced, and potentially end up with different conclusions. Participatory research is often seen as less rigorous than pure research. In reality, the appropriate involvement of "non-researchers" enables and empowers more people to control the results, making them more rigorous. A clear diagnosis – identifying the research question – and prognosis – work to generate the answer – are the two key steps to conduct collaboratively and, as such, must be reviewed throughout.

Involving varied participants in research will bring about different perspectives to critique the hypothesis

2. Context matters

Participatory research and on-farm experiments can enhance the relevance of results. However, the planning and experimental design requires extra attention. The essence of good participatory research is addressing a tangible problem in a specific context whilst creating new knowledge generalisable to other contexts. A scientific result must not only be 'falsifiable', but hopefully also 'hard to falsify', i.e. having a low probability of being an 'artefact' of the research.

3. "From each according to his ability, to each according to his needs"

A robust experimental design must be supported by a functional group. Context does not just mean location within the environment: the way the group works (or not) to move towards creating the result will add to the rigour. Space needs to be created for all group members to be heard and contribute at their appropriate level. It is possible for the 'discovery' to be constructed by joining the skills, needs and values of as many involved different players as possible.

FURTHER READING

1. ORC Bulletin 198, pp. 6-7: tinyurl.com/vp6avupf
2. Probst and Hagmann (2003) tinyurl.com/3ueee9fh

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

FOOD SYSTEMS

From field to fork

Multidisciplinary research along the whole food chain

AUTHOR
Will Simonson

CONTACT
Will Simonson

ORC ACKNOWLEDGEMENTS
Dominic Amos, Charlotte Bickler, Katie Bliss, Ambrogio Costanzo, Stefano Orsini, Abel Villa

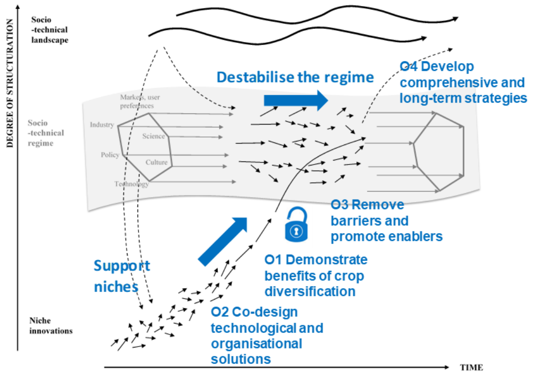
YEAR
2017-2022

FUNDING - PROJECT
EU Horizon 2020
- LIVESEED
- DiverIMPACTS

LIVESEED DiverIMPACTS

Farming and food systems are inherently complex in nature and scientific advances must recognise this through their multi-disciplinary approach. In this way, ORC's overall objective to accelerate progress towards more healthy and resilient farming requires research effort spanning and connecting natural and social sciences and multiple subject areas within them. Any one project brings in expertise from different areas, and this ensures that each strand of research is targeted, contextualised and therefore impactful.

In the 4-year LIVESEED EU Horizon 2020 project, ORC's crops researchers investigated the role that heterogenous crops, and breeding for organic systems, can play in improving organic crop yields. This was supported by undertaking traditional, farmer-led variety testing to increase knowledge of varieties' performance in organic systems. This agronomic expertise was complemented with that in business and markets, with an ORC-led socio-economic work package exploring the attitudes of stakeholders towards organic seed and organic breeding and assessing how different measures could improve the market and the regulatory arrangements for organic seed and breeding.



Framework of multi-disciplinary research behind DiverIMPACTS - adapted from Olivier *et al.* (2018); Geels (2002)

The results of research in the field are inconsequential without supportive attitudes and policies along the value chain.

Similarly, in DiverIMPACTS field experiments have quantified the impacts of crop diversification (rotation, intercropping and multiple cropping) at a farm, landscape and societal level. But this EU Horizon 2020 project also seeks to understand how the wider socio-technical system – upstream and downstream of production – can enable and sustain crop diversification to enhance these benefits. ORC uses its skills in convening stakeholders and actor-oriented research to identify needs in training/education, value chains and national and local level policy instruments.

FURTHER READING

1. Winter *et al.* (2021) doi.org/10.1080/21683565.2021.1931628
2. Orsini *et al.* (2020) doi.org/10.3390/su12208540

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

ANIMAL HUSBANDRY

Resilience and sustainability in sheep and goat farming

Findings from seven UK case studies

AUTHOR
Lindsay Whistance

CONTACT
Lindsay Whistance

ORC ACKNOWLEDGEMENTS
Lisa Arguile, Marion Johnson, Stefano Orsini

YEAR
2016-2020

FUNDING - PROJECT
EU Horizon 2020
- iSAGE

iSAGE

Sheep and goat farmers face challenges including climate change and fluctuating markets and often live in rural areas with limited support networks. iSAGE, an EU project (2016-2020), was set up to help address issues through industry innovation.

In the UK, seven case studies were carried out by ORC with partners, investigating: 1. breeding for natural resistance to intestinal parasites, 2. on-farm use of copper supplements for *Haemonchus* burden in lambs, 3. improving sheep welfare with improved farmer-vet relationships, 4. assessing the benefits of grazing grass-clover or herbal leys, 5. the resilience of breeds and systems to climate change, 6. sustainability tools and certification to increase system resilience, and 7. industry support to increase engagement of young farmers.

Findings included:

1. Breeding for parasite resistence is possible, reducing reliance on anthelmintics.
2. Copper is effective against *Haemonchus* burdens. Workload and cost acceptable, with higher growth rates in supplemented lambs.
3. Flock Health Clubs improve farmer-vet relationships and knowledge, create farmer networks and encourage proactive health management, increasing productivity.
4. Herbal leys produced more forage and lambs grazing them had higher growth rates and lower worm burdens compared to grass-clover leys.
5. Breed is important to farmers but landscape and flock management were more important for managing climate change effects.
6. Public Goods Tool was considered a good entry level assessment of on-farm sustainability whilst Holistic Management training was more in-depth but cost more. Ecological Outcomes Verification certification promotes an economic return but uptake is low in UK.
7. Young farmers on the Next Generation programme (NSA) valued the training, made positive changes to their practice, developed support networks and actively promote the sector.

Weighing lambs before feeding them a copper supplement

FURTHER READING

1. iSAGE Innovation Leaflets: isage.eu/innovation-leaflets
2. Breeding technical projects: signetdata.com/technical/projects
3. Flock Health Clubs website: flockhealth.co.uk/Flock-Health-Clubs
4. Next Generation programme (NSA): nationalsheep.org.uk/next-generation

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 23 - Sep 2021

ORC 40th

ANIMAL HUSBANDRY

Environmental performance & animal welfare in organic poultry production

Creation and study of a silvopoultry system

AUTHOR
Lisa Arguile

CONTACT
Lisa Arguile

ORC ACKNOWLEDGEMENTS
Cindy Engel, Bruce Pearce, Vanessa Pegg, Lois Philipps, Lindsay Whistance, Martin Wolfe

YEAR
2001-2004

FUNDING - PROJECT
Juliet and Peter Kindersley
- Silvo-Poultry: An Agroforestry System for Organic Chicken Production at Sheepdrove Organic Farm

SHEEPDROVE

Poultry production is conventionally an intensive system focused on efficiency. This creates challenges for animal health and welfare that result in behavioural and physical issues. Environmental impact assessments alone do not consider animal measures, and intensive systems can therefore be seen outperforming their extensive counterparts that encourage natural behaviours unless a multicriteria approach is taken. The reason for this is a higher resource use efficiency and smaller land use impact.

Silvopoultry systems (SP) integrate poultry production with trees, offering a way to reduce the environmental impact by sharing the land use cost between enterprises and capturing emissions at the same time. SP also mimics the natural habitat of chickens, providing additional enrichment that improves animal health and welfare. A study of broilers produced under olive trees showed SP tripled estimated forage intake, did not impact production, reduced footpad dermatitis and breast blisters, compared to a free-range system with no enrichment.

Sheepdrove organic's silvopoultry system

In 2002 the Organic Research Centre supported Sheepdrove Organic Farm (SOF) with the creation of their own SP system demonstrating a way in which organic poultry production could develop to become more sustainable by allowing the animals, farmer and wider environment to benefit at the same time. After moving to the SP system SOF recorded final weights which were both lower and more variable than before. Temperature had no effect on final weight in the seven weeks prior to processing and negligible (<1%) migration was observed between sheds of different production stages. Instead, management and nutrition were identified as the possible cause for the lower and variable body weights. A further explanation may be variation in the use of the range, with birds that utilise the range more extensively having higher daily energy requirements.

FURTHER READING

1. Leinonen and Kyriazakis (2013) d-nb.info/1044488840/34
2. Pearce (2003) orgprints.org/id/eprint/10297
3. Pegg and Pearce (2004) orgprints.org/id/eprint/10295
4. Pegg *et al.* (2003) orgprints.org/id/eprint/10320

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 24 - Sep 2021

40th ORC

ANIMAL HUSBANDRY

Sustainable Organic and Low-Input Dairying

Results from the SOLID project

AUTHOR
Lindsay Whistance

CONTACT
Lindsay Whistance

ORC ACKNOWLEDGEMENTS
Katharine Leach, Susanne Padel

YEAR
2011-2016

FUNDING - PROJECT
EU FP7
- SOLID

SOLID Sustainable Organic and Low Input Dairying

Opportunities exist to increase the sustainability of organic low-input (LI) dairy systems across Europe. Compared to high-input dairy farms, LI dairy farms are smaller, less specialised, have more grassland, and rely on more forage and less maize. They also generate more labour alongside lower productivity, so smart decision making that adds value to products is key. The Sustainable Organic and Low Input Dairying (SOLID) project (2011-2016) worked with farmers to address key challenges surrounding forage and feeding, use of natural resources, and management of animals and the environment. A close collaboration between researchers and farmers helped promote the development of context-specific solutions to increase both sustainability and competitiveness of LI organic milk production.

Cattle mob grazing herb rich leys

Results showed that although well-adapted native livestock breeds are typically preferred, more conventional breeds can also be farmed successfully in organic LI systems if well managed. Energy requirements for body maintenance were found to increase for dairy cows on high forage diets, and a range of novel and local feed sources were identified as potential sources of energy and protein, including by-products and herb-rich pasture mixes, the latter also being used as a strategy to minimise antibiotic use. Within dairy supply chains, information sharing along the chain was important, and innovation uptake was supported through increased collaboration between stakeholders.

Overall, organic LI dairy cow and goat systems were considered to be competitive, but for future sustainability, greater attention should be paid to continuous improvement of farm management practices particularly relating to animal welfare and milk quality. Alongside this, developing shorter, more effective supply chains would promote collaboration, competitiveness and sustainability.

FURTHER READING

1. ORC Bulletin 111: tinyurl.com/3m6caxvb and 112: tinyurl.com/tmwn4p
2. SOLID Dairy Farming: farmadvice.solidairy.eu
3. The SOLID Farmer Handbook: tinyurl.com/4e2vaxa5
4. Sustainability and competitiveness: core.ac.uk/download/pdf/86565817.pdf

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

AGROFORESTRY

Agroforests as habitat

The importance of agroforestry for biodiversity

AUTHOR
Will Simonson

CONTACT
Will Simonson

ORC ACKNOWLEDGEMENTS
Jo Smith, Colin Tosh,
Lindsay Whistance

YEAR
2019-2023

FUNDING - PROJECT
EU Horizon 2020
- AGROMIX
CPRE
- Hedge Fund

agromix

Among the benefits of trees on farms is in creating habitat for biodiversity. The trees and associated vegetation offer food sources and areas for shelter, dispersal and reproduction for many types of organisms. Much of this biodiversity is functionally important for farm productivity: so-called agrobiodiversity. In doctoral research co-supervised by ORC, Tom Staton reviewed evidence showing the positive effect of silvoarable systems on pollinators and natural enemies of crop pests (1). His experimental work revealed how the flowering understories of the trees contribute to this effect (2).

Hedgerows, as one of the most traditional ways of integrating trees and shrubs into the farm system, similarly have this important habitat value. A review by ORC on the ecosystem services of UK hedgerows and what benefits a 40% expansion might bring to nature, the society and economy, showed that part of this effect is to do with enhanced habitat connectivity for highly mobile creatures such as hoverflies and bats (3). Shelter belts also have this function as ecological corridors, and in a new initiative promoting optimum shelter belts across six farms in the Cotswolds, ORC will be monitoring the biodiversity gains from these plantings, alongside the outcomes for crops and livestock.

Wakelyns Agroforestry, Suffolk: trees on the farm create a range of habitats for biodiversity

Losing species from ecosystems undermines ecosystem stability. The relationship between biodiversity and resilience is one aspect of important new research being undertaken by ORC and its partners under the Agromix project. At Wakelyns Agroforestry, Suffolk, and five other experimental sites in Europe, different types of biodiversity were sampled in and between the tree rows of agroforestry fields, as well as control areas of open field and woodland. The results will be used to seek to answer the question: how resilient are mixed farming systems, and what role does biodiversity play in that resilience?

FURTHER READING

1. Staton *et al.* (2019) doi.org/10.1016/j.agsy.2019.102676
2. Staton *et al.* (2021) doi.org/10.3390/agronomy11040651
3. CPRE and ORC (2021) tinyurl.com/nre9wb58

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

AGROFORESTRY

Land Equivalent Ratio modelling at Wakelyns

More yield from the same space through intercropping

AUTHOR
Colin Tosh

CONTACT
Colin Tosh

ORC ACKNOWLEDGEMENTS
Will Simonson, Konstantinos Zaralis

YEAR
2011-2016

FUNDING - PROJECT
EU FP7
- SOLID

SOLID Sustainable Organic and Low Input Dairying

The land equivalent ratio (LER)[1] is a measure of productivity in mixed cropping systems. It is based on an equation, which can be explained by giving some values of the ratio and what they mean in real terms.

If we consider a field with two crops in it, an LER value of 1 means that crop 1 and crop 2 have yielded about half as much from the field as they would have done grown across the same space in monoculture. There is no overall loss, but most farmers would likely be unimpressed by and LER of 1.

LER values above 1 generally mean that you are getting more yield overall from your two crops planted together than you would if you planted either across the whole field in monoculture.

Mediterranean silvoarable

An LER value above about 1.4 is rare and indicates a very productive mixed cropping system. Consider a theoretically possible but unlikely ratio of 2. Here you would have to use two fields of monoculture to get the same yield as you are getting from your single mixed crop field. You can imagine how the higher values of LER might be reached by looking at the picture of French wheat/nut/poplar agroforestry systems. Here you essentially have a regular wheat field with a woodland/orchard placed within it, with no space wasted even for tree understory strips. The trees use the third dimension (height) as growth space, so the wheat takes very little hit in yield and vice versa.

Research by ORC at Wakelyns Agroforestry, Suffolk, within the EU SOLID[2] project calculated an LER of 1.44 for a mixed coppiced willow/herbal ley system[3]. Impressive. More recent economic modelling by ORC has shown that coppiced hedgerows used for home wood fuel have a net present value (NPV) to the farmer of £1,156 per 100m of hedge[4]. Herbal leys can be used to fatten livestock and to improve soil fertility in arable rotation. Mixing compatible crops with a high LER can be functional and profitable for the farm.

Further reading

1. Mead and Willey (1980) doi.org/10.1017/S0014479700010978
2. SOLID project website: solidairy.eu
3. Smith & Westaway (2020) tinyurl.com/y64ugjts
4. CPRE and ORC (2021) tinyurl.com/nre9wb58

ORGANIC RESEARCH CENTRE 40th anniversary

40th ORC

AGROFORESTRY

The silvopastoral trial at Elm Farm

Agroforestry for integrated livestock and bioenergy production

AUTHOR
Colin Tosh

CONTACT
Colin Tosh

ORC ACKNOWLEDGEMENTS
Will Simonson, Jo Smith, Lindsay Whistance

YEAR
2011-2017

FUNDING - PROJECT
EU FP7
- SOLID
- AGFORWARD

SOLID Sustainable Organic and Low Input Dairying

AGFORWARD Agroforestry for Europe

The silvopastoral trial at ELM Farm, Berkshire, (2011-2019)[1] was a custom experimental plot funded by the EU SOLID[2] and AGFORWARD[3] projects and designed to examine the economics and practicalities of silvopasture with biofuel production. The system consisted of a pasture herbal ley, with willow and alder tree strips.

The findings are of great relevance as agroforestry is assessed by Defra for inclusion in the post-Brexit Environmental Land Management system:

- The system returns a positive Net Present Value (NPV) but involves a large initial outlay and a 5-year period of tree maturation before returns can be realised. This initial low output phase continues to constrain adoption of agroforestry and may need subsidy support.
- Trees have no impact on ley or arable within strips during the establishment phase, and a minimal impact thereafter.
- Jute sheet mulching improves sapling establishment compared to a no-mulch control. Woodchip and plastic mulch also produce high rates of sapling survival and perform equally well. The mulches of organic origin are preferred as they will decompose naturally.

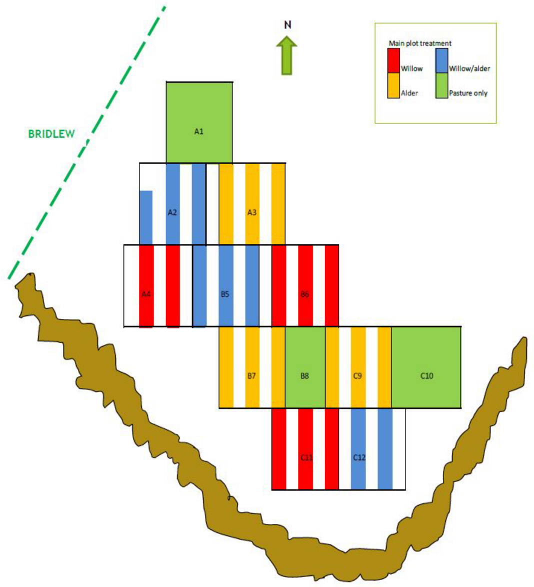


Diagram of the silvopastoral trial at Elm Farm. Pasture alleys are 21m wide and tree strips, 3m wide. Alleys, shown white in the diagram, contain pasture

- Tree rows contain a high diversity of wild plants (none of which caused significant weed problems in alleys) and an abundance of beneficial organisms such as earthworms.
- Cattle enjoy the trees, scratching on them and lying among them. Cattle will also browse on tree leaves and prefer willow to alder. Willow can act as a food buffer during times of low grass availability.
- These behavioural interactions can damage trees and conflict with bioenergy production. Conflicts can be lessened with single strand electric fencing or introducing cattle only prior to biofuel harvesting to strip leaves.

Further reading

1. Westaway & Smith (2020) tinyurl.com/y2wcrvo4
2. SOLID project website: solidairy.eu
3. AGFORWARD project website: agforward.eu

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 28 - Nov 2021

40th ORC

ORC's LEGACY

ORC led initiatives

Organic Arable, Organic Seed Producers, OMSCo, OGA, Organic Resource Agency

AUTHOR
Vicky Smith
CONTACT
Vicky Smith

ORC ACKNOWLEDGEMENTS
Mark Measures, Bruce Pearce, Phil Sumption, Andrew Trump, Lawrence Woodward

INITIATIVES

- Organic Arable (OA)
- Organic Seed Producers Ltd (OSP)
- Organic Milk Suppliers Co-operative (OMSCo)
- Organic Growers Alliance (OGA)
- Organic Resource Agency (ORA)

ORGANIC RESEARCH CENTRE

When the ORC was founded, as Elm Farm Research Centre, it was done so with a pioneering spirit and a genuine desire to push the boundaries and discover how organic farming practices could be incorporated into UK agriculture. That quest for knowledge has helped to develop practical and sustainable solutions for the industry.

Over the last 40 years the ORC has supported organic farmers to find viable markets for their products

As well as having an impact on policy, collaborating with some of the world's leading scientists to carry out cutting edge research and creating information hubs such as Agricology to share our research widely across the whole farming community, over the last 40 years the ORC has also supported organic farmers to find viable markets for their products. This was achieved through enabling the formation of several pioneering organisations including **Organic Arable (OA)**, **Organic Seed Producers Ltd (OSP)**, which was an offshoot of ORC's Seeds for the Future project, and the **Organic Milk Suppliers Co-operative (OMSCo)**. ORC also helped growers to form the **Organic Growers Alliance (OGA)**, and the **Organic Resource Agency (ORA)** developed as an offshoot of ORC's research programme.

Some of these networks still continue to prove invaluable to the agricultural industry today. Speaking in a recent ORC 40th anniversary podcast on Business and Cereal Markets within the organic sector, Andrew Trump, Managing Director at Organic Arable, explained that OA was set-up in 1999 with the support of ORC and the organisation continues to be farmer run, delivering what organic farmers need in relation to grain marketing, as well as supporting organic research such as the no-till with living mulches field lab and LiveWheat, and delivery of projects such as CERERE and LIVESEED. ORC's determination to drive positive change is as alive now as it was 40 years ago and forms the heart of who we are as an organisation.

Further reading

1. ORC 40th Anniversary Communication Hub: tinyurl.com/87za38rc
2. 40th Anniversary Podcast - Episode 5 with Organic Arable: tinyurl.com/wbrh24u4
3. Organic Arable website: organicarable.co.uk
4. OMSCo website: omsco.co.uk
   OGA website: organicgrowersalliance.co.uk

ORGANIC RESEARCH CENTRE
40th anniversary

ORC Research Digest no. 29 - Nov 2021

40th ORC

ORC's LEGACY

Organic advice and conversion

OAS, OCIS and IOTA

AUTHOR
Vicky Smith

CONTACT
Vicky Smith

ORC ACKNOWLEDGEMENTS
Mark Measures, Phil Sumption, Lawrence Woodward

INITIATIVES
- Organic Advisory Service (OAS)
- Organic Conversion Information Service (OCIS)
- Institute of Organic Training and Advice (IOTA)

ORGANIC RESEARCH CENTRE

Over the last 40 years the ORC offered many additional pioneering services which included providing advice on organic farming - supporting farmers, growers, landowners, research centres, colleges, and other businesses.

In 1985 Elm Farm Research Centre launched the UK's first advisory service for organic farming, the **Organic Advisory Service (OAS)** which offered technical, management, marketing and business support to farmers and growers on conversion planning and subsequent ongoing organic management. The work of the OAS included the government funded the **Organic Conversion Information Service (OCIS)** which was launched in 1996 and ran until 2011, delivering over 10,000 visits. The objective of the service was the provision of impartial expert information direct to producers on their farms. The service was free, and at the time of its launch, Sir Martin Doughty, chair of Natural England said: "One of the potential barriers to conversion is a lack of knowledge by non-organic producers about organic principles and production methods – a barrier which OCIS, delivered by the Organic Research Centre, will help to remove".


The OAS team of advisers in the late 1990s

The **Institute of Organic Training and Advice (IOTA)**, a professional body for organic trainers and advisers was launched in 2005 with support and funding from ADAS, ORC, Organic Centre Wales and Soil Association. Set up by Mark Measures and aimed at raising the standard of advice and the management of organic farms, IOTA enabled farmers searching for advice, access to a list of accredited advisers with accredited expertise. IOTA ran as an independent organisation for 10 years, before amalgamating with ORC. Speaking in a recent ORC bulletin on ORC's services, Mark Measures said: "What ORC has contributed to, and in many instances has secured, are the many commercially successful organic farmers and growers in the UK, some now run by their third generation".

Further reading

1. Where to Go Now for Advice? tinyurl.com/2p7h58en
2. 40th Anniversary Podcast - Episode 4 with OAS and IOTA: tinyurl.com/wbrh24u4
3. OAS - Organic Advisory Service (Elm Farm Research Centre): tinyurl.com/47kvxuxp

ORGANIC RESEARCH CENTRE 40th anniversary

ORC Research Digest no. 30 - Dec 2021

40th ORC

The Organic Principles

The foundation of ORC's work and the organic movement

AUTHOR
Charlotte Bickler
CONTACT
Charlotte Bickler
ORC ACKNOWLEDGEMENTS
Susanne Padel, Lawrence Woodward

ORGANIC RESEARCH CENTRE

The Organic Research Centre has been involved in the development of the Principles of Organic Agriculture and their translation into farming standards across the world and in the EU in particular. These principles provide aspirations to work towards across the sector and guide us in our daily work. In September 2005 the International Federation of Organic Agriculture (IFOAM) adopted the Principles of Organic Agriculture:

Principle of Health - Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

Principle of Ecology - Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

Principle of Fairness - Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

Principle of Care - Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

"By providing farmers with the skills to grow food organically we will be developing a crucial vehicle for bringing about a more equitable, healthy and genuinely sustainable world"

Lawrence Woodward, ORC's co-founder, 1996

Health, ecology, fairness and care are a synthesis of wider values that began to be outlined as 'The Underlying Principles of Organic Farming' in the 1980s. These included a range of aspects that still resonate today: from working within a closed system to use of appropriate technology; maintaining soil fertility to producing high nutritional quality food in sufficient quantity; reducing the use of fossil fuels to delivering animal and human welfare.
Driven by these ambitions, the organic movement has grown to provide an alternative to conventional agriculture in its broadest sense. Yet the challenges of globalisation and suitable growth are never far. Understanding how best to translate the Principles of Organic Agriculture into regulation, standards and practice remains an evolving process that we should not lose sight of.

Further reading

1. Woodward *et al.* (1996) tinyurl.com/mu8xfxbn
2. IFOAM Organics International (2005): tinyurl.com/5jkt5ujh
3. Luttikholt (2007) tinyurl.com/2hfe62zz
4. Padel *et al.* (2009) orgprints.org/id/eprint/5509

ORGANIC RESEARCH CENTRE
40th anniversary

Walking through the library at Elm Farm, I was taken back to a university lecture... I can still see the big man beaming at the front of the lecture hall, trying to teach us what he had learned working for the most renowned Italian companies. The subject was more than appropriate: Knowledge Management. The first thing he said was illuminating: "*A corporate culture is mainly transmitted at the coffee machine*". No matter the beverage, I believe everyone can agree on how much information, how many stories, tips we've received at the coffee machine, or the kettle! From there we carry the information, stories, tips with us. So that we are in fact the channel of the culture itself.

My reflective journey through the Elm Farm library was after the decision that the farm would be sold, and we would become a landless research organisation. It was my second day of work at the Organic Research Centre, and I reflected on how many annotations we would lose. No, the books were not an issue: we are in a digital world by now, and we have the resources to find again a lost book. Indeed, with a book lost, you are losing something else: the tracks of the way of thinking – sometimes of the lifestyle – of its readers. Elm Farm was more than a headquarters, that place was often the underlying reason behind an initiative, the starting point of a trial, the implicit concept behind a project. Yet the world is constantly changing, and new opportunities lay ahead.

Here we are. Without a shared coffee machine or kettle, working from home. The question that follows is the second thing my lecturer said. How to preserve the culture when its channels shift and change? "*The archive is the organisation's historical memory*". Keep it clean and updated, so that it can help you with the right answers to your questions. Now more than ever the archive is everything, to know who we are working for and to better pass its message down. This series of 40 Working Papers, highlighting the important research and activities led by ORC over its 40 years of existence, are here to stay. We have longer accounts of work that ORC pioneered outlined in Factsheets, whilst Research Digests give a snapshot of other important projects and enterprises.

The storybook of ORC is here: an archive of relevant works to find, to consult, to reference, again and again.

Chiara Tuoni
ORC Research Communicator

How to preserve the culture when its channels shift and change? "*The archive is the organisation's historical memory*". Keep it clean and updated, so that it can help you with the right answers to your questions.

The Organic Research Centre
Trent Lodge, Stroud Road,
Cirencester, Gloucestershire GL7 6JN
United Kingdom

Company Registration: 1513190
Registered Charity: 281276

organicresearchcentre.com