Legume Pick 'n' Mix

*In Spring 2009, ORC set up a legume trial on an organic farm, Barrington Park in Gloucestershire, as part of a large research project called Legume LINK. One of its aims is to compare the performance of several legume and grass species for use in fertility building leys. ORC researchers **Thomas Döring** and **Oliver Crowley** report that the trial shows the advantage of mixing species grows over time.*

Photo: The species mixture of 10 of the legumes and all the grass species in its glory

Overall, 12 legume species and 4 grass species are included in the trial (see Table). A species mixture of 10 of the legumes and all the grass species is also included (see Photo). Some of these species, such as white clover, red clover and perennial ryegrass, are already commonly used in organic rotations. Others, such as crimson clover, alsike clover, sainfoin or birdsfoot trefoil are less frequently grown in the UK.

Apart from assessments of plant height, biomass and flowering time, we repeatedly estimated crop and weed cover in the trial plots. Here we report on these cover results for selected species – with more comprehensive analyses following in separate publications. In total, cover was assessed ten times, starting in May 2009 shortly after sowing and ending in July 2011. The plots were repeatedly mown and also, in 2010, occasionally grazed by cattle and sheep.

One of the early champions in establishing and covering the soil was crimson clover. This annual species germinated very quickly and its relative plant density was ahead of all other species during the early establishment phase.

Table: Average crop cover (%) of legume and grass species trialled in the Legume LINK project.

Species	incl. in ASM?	Aug. 2009	May 2010	July 2011	WC vol.*
Clovers					
Alsike clover	Yes	60	58	8	35
Crimson clover	Yes	35	32	1	45
Red clover	Yes	88	72	46	5
White clover	Yes	68	83	73	-
Other legumes					
Birdsfoot trefoil	Yes	78	58	73	0
Black medic	Yes	48	43	62	2
Large birdsfoot trefoil	Yes	5	0	4	50
Lucerne	Yes	65	72	67	0
Meadow Pea	Yes	12	20	0	83
Sainfoin	Yes	37	33	0	17
White sweet clover	No	37	33	0	6
Winter vetch	No	42	0	0	30
Grasses					
Italian ryegrass	Yes	70	59	49	53
Meadow fescue	Yes	68	70	53	43
Perennial ryegrass	Yes	78	58	44	63
Timothy	Yes	75	60	73	20

Incl. in ASM = included in all species mixture.
WC vol. = average cover (%) of white clover volunteers in July 2011.

However, over the summer of the first year, it spent most of its resources on flowering and seed production and this greatly reduced its vegetative growth. As a consequence, it covered the soil to a much lesser extent than the other clover species in late summer and autumn. Crimson clover is known for its ability to self-seed, and indeed we found new plants in spring of the second year. Finally though, in the third year, it was almost completely gone.

The Legume LINK project

Led by the Organic Research Centre, the Legume LINK project aims to improve fertility building using green manures. It will develop the means to create tailored legume mixtures optimized to fix the required quantity of nitrogen and perform reliably under varied local environmental conditions. Twelve legume species with a range of growth habits and physical compositions, together with four grass species are being trialled at six research sites. In addition, a mixture comprising the grasses and ten of the legumes is being grown on 34 farms across the UK.

Research partners in the project are Duchy College, IBERS Aberystwyth, The Arable Group, Rothamsted Research, and the Scottish Agricultural College. Industry partners are Abacus, HGCA, the Institute for Organic Training and Advice (IOTA), Organic Farmers and Growers, Organic Seed Producers, Scottish Organic Producers Association and the Soil Association. The project is funded by DEFRA through the Sustainable Arable LINK programme and by industry partners.

White clover, while it was looking good on its own plots, also started to look rather strong on the other plots where it hadn't been sown. With its creeping habit it encroached on almost all other species' plots. Notable exceptions were the lucerne and black medic plots where white clover was completely absent. Possibly this was because lucerne and black medic produced substantial amounts of biomass and grew relatively tall, thereby keeping the light-loving white clover out.

Lucerne itself, with its deep roots was well positioned to cope with the dry springs in 2010 and 2011. In contrast, sainfoin seemed promising in the first season, but then, at this trial site, substantially decreased in cover, and was completely lost from the area by July 2011.

An obvious way to make simultaneous use of the benefits seen in the different legume species is to grow a mixture of them. Also, a mixture provides insurance against uncertain growing conditions. If one species fails, another one, with different properties, will compensate for that failure. In addition, it can be expected that the mixture will also grow better than monocultures, since different species will complement each other in the ways in which they use the available resources.

This expectation is confirmed by our data: the All Species Mix (ASM) had a higher crop cover than the average of all its components when they were grown in monocultures. Even when compared with the average of the best five monocultures, the ASM came out on top – and its advantage over the monocultures grew over time (see Figure).

This clearly demonstrates the advantages of growing a species mix. Further ongoing research will fine-tune the composition of legume based mixtures so that their benefits can be maximised.

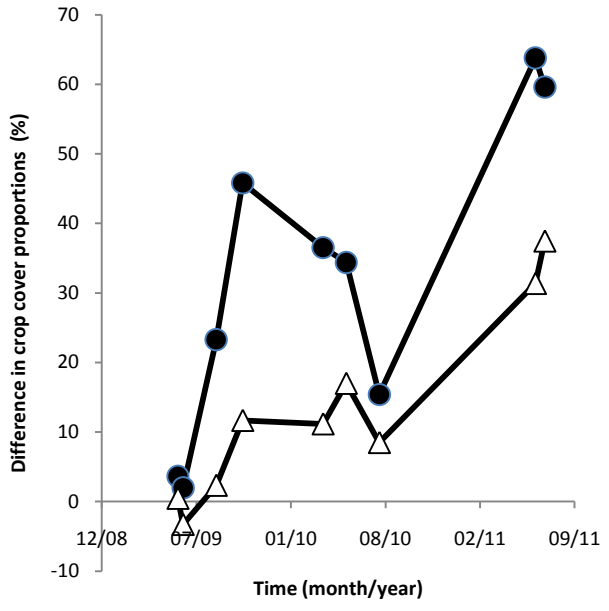

Figure: Absolute difference in crop cover proportions (%) of the all species mixture over the average crop cover % of several single species grown in monocultures.
Filled circles represent the difference when all single species are included in the monoculture average; open triangles represent the difference when only the five best species (red/white clover, black medic, perennial ryegrass and timothy) are included.

Legumes and nitrogen in organic farming

Estimating how much nitrogen legumes fix in organic systems, how much is then lost and how much is available for subsequent crops is notoriously difficult.

In 2003, Defra funded a project which reviewed the subject "Leguminous fertility-building crops, with particular reference to nitrogen fixation and utilisation: Defra Project OF0316". Written by Cuttle, Shepherd and Goodlass, it is well worth reading and can be accessed via www.organicadvice.org.uk/soil_papers/leguminous_fert.pdf

There are no definitive answers to these questions – for example estimates for N fixation are enormously varied in range:

- white clover from 100 to 200Kg/ha/year;
- red clover from 230 to 460;
- lucerne 230-340;
- field peas 70 – 200;
- field beans 150-250;
- lupins 150-200.

Arguably these are the biggest and most crucial questions relating to how the productivity of organic systems can be improved. And have been for so long, that they rank alongside questions about the meaning of life.

In fact getting nitrogen into the system by natural fixation is relatively easy. Keeping it there and being able to access it when the crop needs it, is another story altogether; the first is too easy, the second can be difficult.

This is why innovative research and development approaches like the Legume Link programme taking place in partnership with farmers on farms are so important.

Region, soil type, season and weather are critical factors – as is management, including rotational design, cultivation methods and timing and manure management.

There are strong reasons to suppose that the often observed experience of farms performing better the longer they are organic is really to do with the farmer developing knowledge and intuition about the farm's specific idiosyncrasies in relation to nitrogen accumulation, retention and supply.

Which is another way of saying; there is no blueprint, each farm is different.

ORC Annual Report 2010 published

ORC's annual report provides an overview of our work during the year, including research projects, advisory and information activities, policy engagement and much more. It also provides a summary financial report for 2009/10.

If you would like a copy, printed versions can be requested from elmfarm@organicresearchcentre.com, or phone 01488 658298. Electronic versions can be downloaded from our website www.organicresearchcentre.com