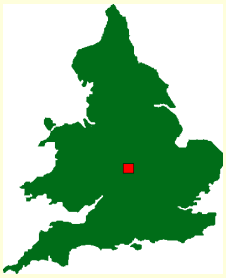
A case study of conversion to organic field vegetable production
Hunts Mill - Wellesbourne

Project funded by DEFRA

Conversion to organic field vegetable production Defra OF0126T & OF 0191

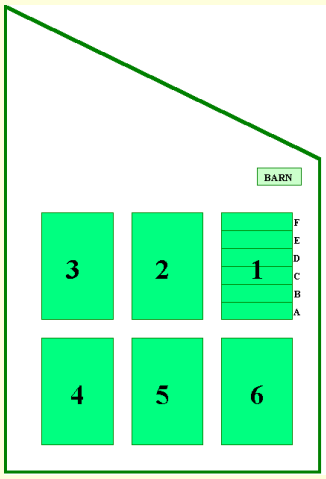
Project aims



- To monitor agronomic and economic performance during conversion to organic systems with field vegetable production.
- A main aim of the work at Hunts Mill, which is part of Warwick HRI at Wellesbourne, was to compare three rotations with differing initial fertility building periods (30 months, 18 months and 6 months). This was achieved by monitoring yields, soil nutrient status, weeds, pests, diseases and the financial costs and returns during the in-conversion phase and for the first full rotation. Each rotation included fertility building crops, vegetable crops and a spring cereal.
- Ten reference farms, including Warwick HRI at Kirton and nine commercial farms, representing contrasting scenarios of organic vegetable production were also monitored.
- To interpret and evaluate data and to produce appropriate information to aid farmers who are undergoing, or who are considering, conversion to organic systems, and to aid future policy making on related farming issues.

Farm details

Location: Nr Stratford-upon-Avon, Warwickshire
Farm size: 200ha (494ac)
Area converted: 13ha (33ac)
Farm type: Arable
Business : Horticultural research establishment
Altitude: 45m (148')
Rainfall: 591mm (23")
Soil type: Sandy loam
Prior land use: Vegetable trials and arable
Conversion: The monitored area of the site was divided into six areas of equal size (labelled 1-6). Each measured 100m by 80m producing an experimental area of 0.8ha. Each area was further split into six strips (labelled A-F) Hunts Mill was converted in two stages, areas 1-3 were registered (with SA Certification Ltd) in August 1995 and areas 4-6 in August 1996

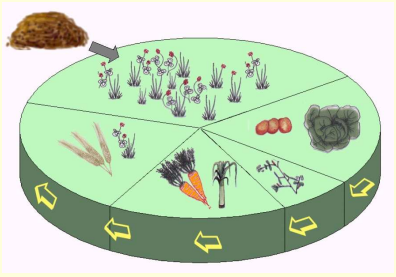


Farm description

Hunts Mill is part of HRI Wellesbourne, which is situated in the Avon Valley in Warwickshire. Until conversion began the Hunts Mill field had been cropped in a predominantly arable system since it was purchased by HRI in 1977. The soil is a poorly structured sandy loam, with low organic matter levels and marginal nutrient reserves for horticultural production.

Farming system

- The basic rotation planned was: 18-30 months grass/clover, cut and mulched or 6 months vetch => vegetable 1; high N demand (cabbages or potatoes) => vegetable 2; low N demand (onions, carrots, leeks or parsnips) => cereal undersown with grass/clover.
- Stockless system, fertility mainly built through grass/clover and over-winter green manures. Green waste compost was applied during the fertility-building periods.



	Initial fertility-building
Area 1	30 months grass/clover ley
Area 2	18 months grass/clover ley
Area 3	24 months grass/clover ley
Area 4	30 months grass/clover ley
Area 5	18 months grass/clover ley
Area 6	6 months winter vetch

- Wild flower strips were established alongside each area in 1999.
- Areas 4,5 and 6 phased one year behind areas 1,2 and 3.
- Changes to target rotation because of need to balance labour requirements and sales of certain crops from year to year e.g. area 3 was cropped with an arable-type rotation with no vegetables being grown apart from potatoes. Other changes had to be made later to enable perennial weeds to be controlled.

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Soils and soil fertility

- Little change in pH from the starting values of 6.0 to 6.6.
- No change in the total organic matter content of the soil (remained less than 2%).
- Nitrogen budgets positive in all areas (+9 to +64kg/ha/yr) but dependant on compost applications. Much of this compost N will not be readily available. Estimated leaching losses generally exceeded removals of N in crops. The timing of mineralisation is as important as the total amount supplied during the rotation. More mineral N available in the spring when incorporation of a ley was delayed as long as possible.
- Phosphorus budgets were clustered around zero (from -8 to +4kg/ha/yr). Areas where root crops (carrots and potatoes) had been grown had the most negative values. Extractable phosphorus remained steady (ADAS Index 4).
- Potassium budgets were generally negative (–62 to +19kg/ha/yr). As with P the most negative values were associated with cropping carrots and potatoes. Extractable K showed a slight decline, from Index 2+ to Index 2-.
- If crops such as potatoes and carrots continue to be grown somewhat greater compost applications will be needed in order to avoid 'mining' the soil of its reserves.
- Severe problems were experienced with soil structure. Despite increasing organic matter inputs (from leys and compost additions) and shallow ploughing in combination with various sub-soiling and top-soiling operations the soil was still very hard and capped badly. Compaction in the wheelings of the vegetable crops could be clearly seen in subsequent cereal crops as pale green lines and are likely to have contributed to poor cereal yields.

Crop performance

Marketable yields at Hunts Mill (t/ha except where stated)

	1998/99	1999/00	2000/01	2001/02	Average	OFMH
Potatoes	22.5	37.3	23.6	34.4	29.5	34.0
Cabbage (doz)	1326	2395	1361	850	1483	2750
Onions	18.1	11.5	8.2	-	12.6	15.0
Carrots	33.8	37.5	56.6	47.2	43.8	36.0
Leeks	11.6	9.7	11.0	9.6	10.5	15.0
Parsnips	-	-	-	23.0	23.0	20.0
Spring barley	2.5	1.9	1.6	1.8	2.0	2.9
Spring wheat	3.0	-	-	-	3.0	3.1

OFMH = figures for typical yields taken from the Organic Farm Management Handbook (Lampkin et al)

- Potatoes - one of the easiest crops to grow at Hunts Mill. Mechanical weed control effective. Blight was a threat in most years but managed effectively. No irrigation used. Skin finish not supermarket quality due to soil type and common scab.
- Cabbage - not very productive, largely reflective of soil type. Bird damage (both uprooting transplants and eating leaves) was a major problem. Weed control was effective with an inter-row hoe and hand hoeing within the row. Later, use of a finger weeder reduced the need for hand weeding. Management of common insect pests such as aphids, caterpillars and cabbage root fly (including soap and garlic sprays) increased production costs. Whiptail (Moybdenum deficiency) a problem, possibly related to impaired nutrient uptake due to cabbage root fly damage.
- Onions - sets performed better than modules. Weed control expensive, black plastic tried without success. Three-row bed system performed better than four rows (vigour and less disease). Neck rot, (seed-borne) caused loss of one module-raised crop and downy mildew reduced yields in two seasons.
- Leeks - variable yields. Three row system again performed better than four (soil fertility and disease). Nutrients were the likely limiting factor in the final leek crop of intensive rotation. Birds an obstacle to good establishment.
- Parsnips only grown once but performed well.
- Spring barley - performed well as first crop following fertility-building. Yields decreased at later stages in the rotation. Good seedbed essential. Problems of soil compaction from vegetable wheelings. Gross and net margin low in comparison to vegetables, but has value as a means of establishing following fertility-building crops.
- Wheat only grown once as barley thought to be better for under-sowing.
- In-conversion fertility building. Leys managed by cutting and mulching three or four times/year. On average 142kg N/ ha incorporated. No consistent benefit from additional year of ley, in terms of N. Vetch had to be incorporated earlier than was ideal.
- Winter cover crops - most vegetables harvested too late in the year for cover crops to be established. Vetch and grazing rye both had problems through late sowing and in the case of vetch early incorporation.
- Undersown white clover - grew well. Much greater biomass from May (as opposed to March) incorporation.
- No clear relationship between the yields of any of the crops and either the length of the initial fertility building period or with the proportion of time spent in fertility building during the first full crop sequence. This may be because the issue is clouded by the variability of crop yields that were influenced by many factors other than the underlying fertility.

Pests and diseases

- Seasonal differences more important than differences in rotational design on this site.
- A minimum intervention strategy was adopted at the onset of conversion and reliance placed on varietal resistance or cultural means of pest and disease control.
- Diversity of cropping (strips of different species) and of habitat margins may have contributed to low incidences of pests and diseases.
- Pests were only a regular problem in cabbage and the use of reactive strategies (soaps, garlic and fleeces) increased towards the end of the project.
- Carrots fleeced due to large local populations of carrot fly - this was a major cost.
- Potato blight was the major disease problem; it was effectively managed by flailing off the tops when disease pressure rose.
- Neck rot in onions, a seed borne disease, rendered half the crop unmarketable in one year.

Weed management

- The Hunts Mill site had a relatively low weed pressure.
- Annual weeds were effectively controlled by a range of approaches: undersowing cereals with grass/clover, using stale seedbeds, by appropriate timing of mechanical operations such as steerage hoeing, brush weeding, thermal weeding and by hand weeding/rogueing.
- Weeding occupied a high proportion of the casual labour demand (51% on average of all crops in all years). Sourcing and managing this labour was time consuming and difficult.
- Weed management was not the primary consideration in rotation design; there was a sequence of spring sown crops which would not be recommended in the long term. Carrots followed potatoes in the rotation and this proved difficult with respect to volunteer plants emerging in the competition sensitive carrot crop.
- Investment in equipment (e.g. flame weeder, finger weeder) has improved weeding efficacy.
- An increase in the presence of couch (*Elitrigia repens*) and black bent (*Agrostis tenuis*) was noted in 2000, especially in the potato crops, preventing harvesting in some spots. In 2001 some strips had to be taken out of production and fallowed for the summer. Patches of horsetail (*Equisetum* spp.), present at start, required extra hand labour for control, but are not increasing.
- In general the areas with the long grass/clover ley fertility building period had less weed problems than areas with 18 months grass/clover ley. The six month vetch crop followed by intensive cropping also appeared to keep weeds in check.
- There was an increase in viable weed seed numbers in all areas at the end of the first crop sequence, but less in the 30 month grass/clover rotations than in the 18 month ones. The rotations with the greatest proportion of cereals showed the highest increase in viable seed numbers, and increased species diversity.

Management and labour issues

- The management of the site was divided between HDRA and HRI. Casual labour was sourced principally from undergraduate students at HDRA.
- High management input was required for marketing as no previous experience or structures in place.

Marketing

- All crops from Hunts Mill were marketed commercially as *Dene River Organic Produce*.
- All vegetables graded and packed on farm and sold mainly to wholesale markets, maximising the financial outputs of the holding.

Farm output, variable and gross margins from all crops

- Average prices from four years of organic vegetables were 128% and marketable yields 81% of organic standards (OFMH), resulting in a financial output 106% of standard figures.
- Yields and prices were both above the averages of the reference farms. Compared with conventional data, yields were only 72% of conventional standards while prices were 274%.
- The most successful crops grown were carrots, potatoes and parsnips. Cabbage and leeks were difficult with variable economic performance; onions performed poorly in 1999 and 2000, and were not grown in 2001. Compared to organic standards, the Reference Farms and conventional standards the gross margins were close to organic standards (96%), however higher then reference farms (218%) and conventional standards (161%), respectively.
- Variable costs averaged £6230/ha for the five main vegetables (potatoes, cabbage, onions, carrots and leeks) grown over the 4-year period. Crop protection costs were relatively low.

Gross Margins at Hunts Mill (£/ha)

	98/99	99/00	00/01	01/02	Average	OFMH	% of OFMH
Potatoes	5056	5424	4583	6884	5487	5122	107
Cabbage	1931	9456	3175	907	3867	7978	48
Onions	2708	771	-327	-	1051	5558	19
Carrots	3482	5053	12247	6961	6936	9572	72
Leeks	3818	1104	4932	1999	2963	5506	54
Parsnips	-	-	-	18327	18327	6609	277
Spring barley	629	416	453	453	506	548	92
Spring wheat	672	-	-	-	672	641	105

Variable costs at Hunts Mill (average of five vegetables)

	£/ha	%
Casual labour	3460	56
Packing & transport	1294	21
Seeds & transplants	1136	18
Crop protection	307	5
Other	34	1
Total	**6230**	**100**

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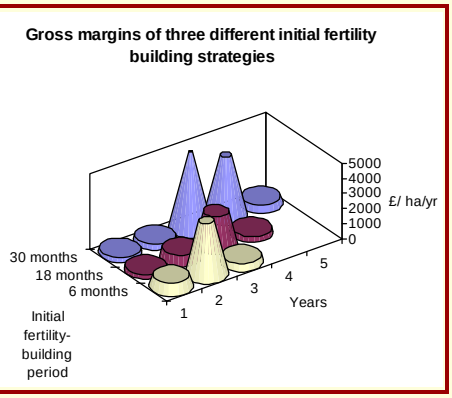
Economics of the different fertility-building strategies

- The rotation with the longest initial fertility-building period (30 months) had the highest average annual net margin of £1744/ha. This was greater than the rotation with the initial six months fertility-building period and significantly greater than the rotation with the 18 month initial fertility-building period.
- For the initial six months fertility-building rotation, the costs of over-winter green manures considerably reduced the overall profitability of the rotation, but may have longer term benefits to the system.

Length of rotation	Initial fertility	Areas	Output (£/ha/yr)	Gross margin (£/ha/yr)	Net margin (£/ha/yr)
5 years	30 months	1 & 4	4492	2106	1744
4 years	18 months	2 & 5	2978	878	514
3 years	6 months	6	4145	1590	1176



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General conclusions

Hunts Mill was successfully converted to organic field vegetable production despite the fact that the soil was in poor condition prior to conversion and of a type not ideally suited to vegetable production, particularly of brassicas. Compaction of the soil in the wheelings from vegetable crops was particularly evident in the performance of subsequent cereals. There was little change in the extractable nutrient content of the soil. However, additions of green waste compost were insufficient to replace all the P and K taken off when both carrots and potatoes were included in a crop sequence. Annual weeds were effectively controlled but the build up of perennial grasses was more serious. Pests and diseases were not generally a major issue.

The project investigated the effect of three basic conversion strategies in which the length of the initial fertility-building crop was varied. The best approaches seemed to be either to use a long ley during the whole two year conversion period or to go for a much more intensive cropping plan beginning with only a six month over-wintered green manure crop. The middle course (an 18 months ley) gave significantly lower economic returns and resulted in more weed problems.

There was very little difference between the fertility-building strategies on crop yields and the growing of in-conversion crops did not appear to have any detrimental effect. More attention to fertility building may be needed in further cycles of the rotation. Some crops were clearly lacking in nitrogen although the demands were moderated by adjusting plant spacing. The green manure crops would have performed better if they had been allowed to grow for longer in the spring; modifications to the cash cropping might have allowed this.

Project information

This leaflet has been produced as part of the DEFRA funded project;
Conversion to organic field vegetable production.
The project aimed to help farmers and growers thinking of converting to organic field vegetable production to make informed decisions with the aid of the agronomic and economic information collected through a case study approach. The project is led by IOR-HDRA in collaboration with the OAS at IOR-EFRC, Warwick-HRI, and WIRS.

www.organicveg.org.uk

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