

# Salad days

The impact of lettuce production and consumption  
on people and the environment



Food Facts No 8

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The impact of lettuce production and consumption on  
people and the environment

*by Alexis Vaughan*



# *Latuca sativa* - a general introduction

Lettuce is one of the most popular salad crops in the world and occupies the largest area of production for salads<sup>2</sup>. The iceberg variety has always been most popular in North America, as it can be transported long distances, whereas in many European countries the softer butterhead (also known as 'round') lettuces are more common. In China the Celtuce, a lettuce with a swollen fleshy stalk, is widely grown for stir-frying.

All lettuces have come from the wild species *Latuca serriola* which has a very bitter taste. Lettuces were known to be cultivated 6,500 years ago by the Egyptians, who started to breed out the bitterness. The Romans introduced lettuce into Britain, though this was still fairly bitter and needed blanching. Modern breeding of lettuces has concentrated on disease and bolting<sup>3</sup> resistance, and on cosmetic additions such as the colour and shape of the leaves.



## Different types of lettuce

Lettuce (*Latuca*) is an annual plant belonging to the family Compositae. There are four main species of *Latuca*: *L. sativa*, *L. serriola*, *L. viross* and *L. salinga*, of which *L. sativa* is the species which is commonly cultivated. The six subspecies of *L. sativa* are classified according to their leaf shape, size and degree of rosette and head formation<sup>4</sup>:

**Crisphead:** Two types:

- a) Iceberg - The first iceberg developed was the cultivar Great Lakes in the USA which is highly crisp and still popular.
- b) Batavia - The most famous example in the UK is Webb's Wonderful. These tend to be more variable in size and shape than the Iceberg group above, but develop in the same way.

**Butterhead or Round:** These lettuces originated in Europe and are still the most popular. Butterhead leaves are thin and have a soft, oily texture.

**Cos or Romaine:** The name comes from the island of Kos in the Mediterranean. They tend to have an upright stature with elongated leaves but colours are variable.

**Leaf or Cutting:** These cultivars are often grown in home gardens under glass.

**Latin:** Originally from Europe, these lettuces are similar to Cos but with shorter leaves.

**Stem or Asparagus**

These lettuces are grown for the thickened stem. The leaves are removed and the stems can be eaten raw or cooked.

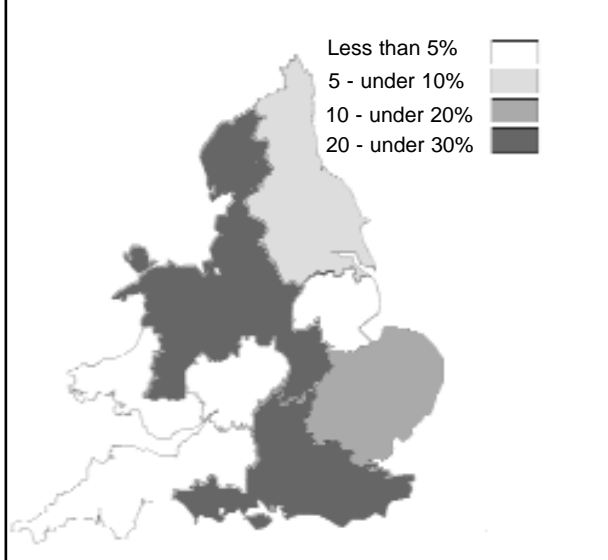
# Production - how much and where

## United Kingdom

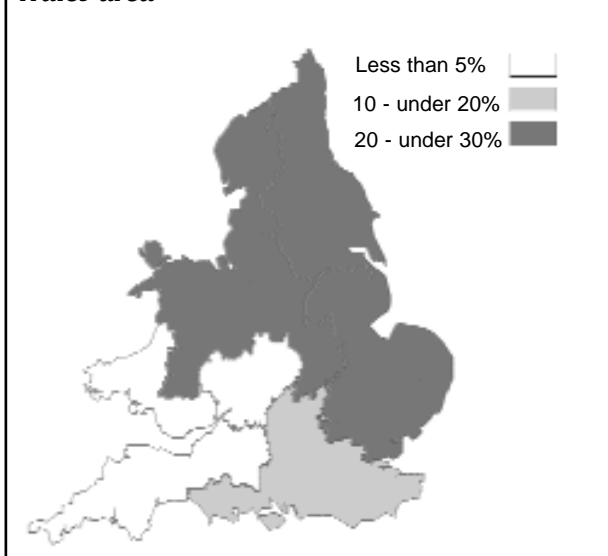
Lettuces can be grown in the field or protected in polytunnels or glasshouses, which allow lettuces to be grown in the UK for twelve months of the year. The majority of field lettuces in the UK are grown in the south east and west midlands, while protected lettuces tend to be grown in the north of England, as shown in the maps. Field grown lettuces have risen slightly in area grown but production of protected lettuces in the UK have been declining from a high of 1,539 hectares in 1988 to 666 hectares in 1997, corresponding to an overall decline in production from 46,800 tonnes in 1988 to 24,100 tonnes in 1997. An increase in lettuce imports has been a factor in the decline of UK protected lettuces (see the section *Lettuce Miles*). There was an estimated 100 hectares of organic salad production in 1997<sup>5</sup>, less than 1.5% in area of all lettuces grown in the UK.

from the UK). Imports have even started coming in from California, USA, which produces more lettuces than any country in the world.<sup>9</sup> Nearly a quarter of all lettuces imported into the United Kingdom come from Spain (see Case Study *Lettuce production in Spain*).

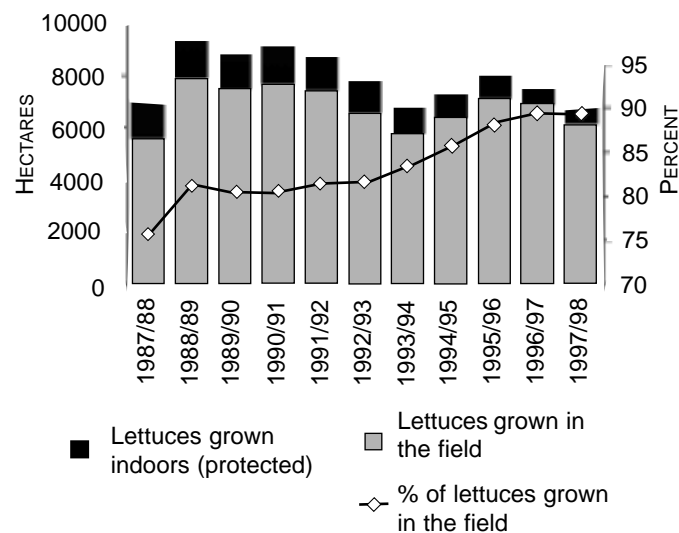
**Field Lettuce: Proportion of England & Wales area<sup>7</sup>**



**Protected Lettuce: Proportion of England & Wales area<sup>8</sup>**



**Area of lettuce production in the UK<sup>6</sup>**



## Lettuce miles

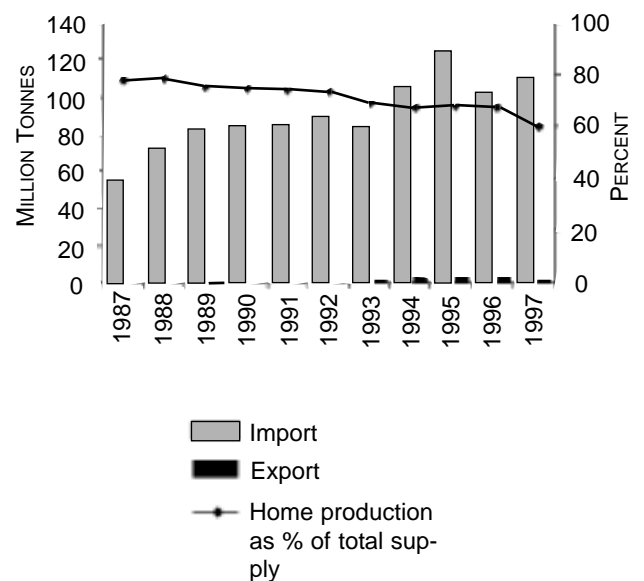
Lettuces are travelling longer and longer distances. Even though the UK is able to grow lettuces throughout the year, imports have increased from 21.8% of the total supply in 1987 to 47.1% in 1998 (see Tables *UK lettuce supply* and the graph: *Imports and exports of lettuces*



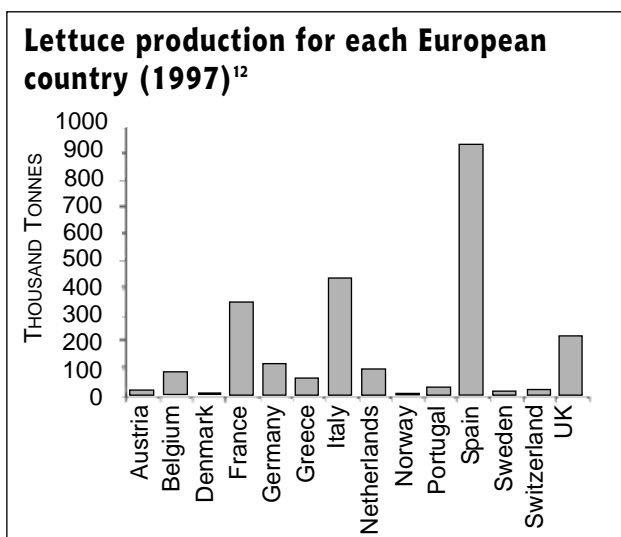
Lettuces can be grown both in the field and in polytunnels

<b>UK lettuce supply 1997<sup>10</sup></b>			
	<b>Volume (tonnes)</b>	<b>Market Share</b>	<b>Value £'000s)</b>
France	6,523	2.2%	<b>£9,925</b>
Italy	3,223	1.1%	<b>£3,372</b>
Netherlands	2,511	0.9%	<b>£2,519</b>
Spain	57,802	22.5%	<b>£44,871</b>
USA	1,327	0.4%	<b>£1,600</b>
Others	60,345	20.0%	<b>£34,251</b>
<b>Total imports</b>	<b>141,834</b>	<b>47.1%</b>	<b>£96,538</b>
UK production	159,441	52.9%	<b>£96,113</b>
<b>Total</b>	<b>301,275</b>	<b>100%</b>	<b>£192,651</b>

### Imports and exports of lettuce from the UK<sup>11</sup>



# CASE STUDY: Lettuce production in Spain

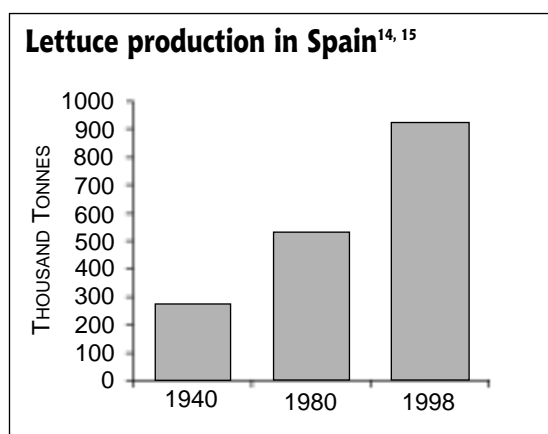


Lettuce is a traditional and popular vegetable in Spain. Lettuces are grown throughout the country and supply both the home and export market.<sup>13</sup> Over recent decades, Spain has become increasingly important as a lettuce producer as shown in the graph: *Lettuce production in Spain*. At 924,600 tonnes in 1998, Spain grows over four times as many lettuces as the UK, and more than anywhere else in Europe (see graph: *Lettuce production for each European country*).

Climate, coupled with demand for year-round lettuces, has made Spain the European lettuce capital. Most of the Spanish lettuces grow adjacent to the Mediterranean, on the east and south eastern coasts. In both autumn and winter, day- and night-time

temperatures are optimum for lettuce growth (18-25°C and 10-15°C respectively).<sup>16</sup> Moreover, the sunny and warm environment helps lettuces grow faster and larger. This means that the lettuces can be grown in the open air at the very times when, in the UK, they need expensive greenhouse technology to cope with the cold winters. (Only 10% of Spanish lettuces are grown under cover, mainly in the much colder north western part of Spain.<sup>17</sup>) Spanish lettuces are cheaper than those grown in the UK, especially between November and May, a fact recognised by UK lettuce suppliers. Of the 391,000 tonnes that Spain exports (around one third of total production), 15% (57,802 tonnes<sup>18</sup> in 1998) is exported to the UK. Three-quarters of the lettuces exported to the UK are icebergs. These are increasingly dominating Spanish production, despite its own preference for the Cos and Romaine varieties.<sup>19</sup>

The optimum conditions of the sunny Spanish Mediterranean fall short, however, in one department: rainfall. Take, for example, the small coastal region of Murcia, wedged between Andalusia to the south, and Valencia to the north. Murcia grows 33% of all Spanish lettuces, and provides around 45% of those for export.<sup>20</sup> With a long history of horticultural production, Murcia also has a long history of irrigation. Irrigation is necessary because rainfall in Murcia is only 300mm every year and is also highly unpredictable (this compares to the relatively reliable average 900mm in the UK). Moreover, irrigation water easily evaporates because of the hot temperatures. Since lettuces need a



Radicchio rosso

substantial amount of water for good growth, the lettuces grown in Murcia are irrigated with drip systems. Water is sent through a pipe straight to the roots, so reducing evaporation potential. In fact, lettuce production helps make Spain the country with the most irrigated land in western Europe.<sup>21</sup>

### Environment

A study<sup>22</sup> by the Instituto Valenciano de Investigaciones Agrarias in Valencia, Spain, found excessive rates of nitrate leaching from horticultural areas. Using Geographic Information Systems (GIS) and the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model, the amount of nitrates leaching from agricultural land could be calculated. A large proportion of Murcia leached over 375 kg of nitrogen per hectare per year. This figure compares with the amount that should be applied, e.g. around 200 kg N/ha following cereals in a rotation.<sup>23</sup> The study also found that for the vegetable growing area, only 41% of the applied nitrogen was used by the crop and 35% was leached into surface and groundwater. This would indicate that growers are applying an estimated 1 tonne of nitrogen per hectare. A link was also found between fertigation (nitrogen applied during irrigation) and high nitrate concentrations in groundwater.

### Pathogens

The different climate, soils, and horticultural systems in Spain affect the type of pests that plague lettuce producers. For example, in November 1997, a key month for export, there was torrential rain in Spain, which combined with warm temperatures, provided a breeding ground for caterpillars. Consequently the lettuce crop was reduced, causing prices to increase by 55% for British consumers.<sup>24</sup> Viruses can also be problematic, infection often being transmitted from other horticultural crops grown close by. For example, tomato spotted wilt has been passed on to lettuces from tomatoes.<sup>25</sup> And much of Mediterranean Spain has soils with very low fertility, with serious implications for lettuce growth. These factors have promoted the high inputs of fertilisers (see above for an example), pesticides and herbicides. The



Iceberg

transportation of lettuces to the UK also exposes lettuces to pathogens. Although the journey only takes between 32 and 72 hours by truck, high temperatures can cause wilting and bacterial attack. Condensation can form inside the plastic wrapping which destroys the lettuces if the humidity exceeds 65-75% by bacteria such as *Botrytis cinerea* and *Sclerotinia sclerotiorum*.<sup>26</sup> To avoid this, lettuces are frequently plastic wrapped and boxed as soon as they are cut then vacuum cooled to between 0-3 °C to remain at that temperature during the entire journey.<sup>27</sup>



Butterhead

# On leaving the farm

As soon as lettuces have been harvested they are usually sent to a distribution centre to be vacuum cooled, loaded into refrigerated transport and sent off to the supermarket (or wholesaler). On a typical large farm it takes approximately two hours for the last lettuce harvested to reach the lorries for distribution. Lettuces need to be cooled quickly to prevent decomposition, which is why supermarkets prefer to use icebergs which last longer than other varieties. There is also interest in breeding or genetically engineering lettuces which last longer - see the section *In the laboratory*.

In general lettuces are not cleaned, especially those with leaves which are held tightly together such as icebergs. However there has been a rise in the use of ready-washed lettuce bags (by 25% each year over the last few years),<sup>54</sup> especially in supermarkets. The lettuce is cooled and plucked into individual leaves and then washed. The main reason for washing is sanitation, not only for protection against post-harvest diseases but to protect consumers from foodborne diseases such as E-coli 0157:H7, salmonella, cryptosporidium, hepatitis, and cyclospora.<sup>55</sup> Diseases are usually spread from human or animal faeces, from the unwashed hands of farm labourers or from manure that has not been properly composted. Chlorine, in the form of sodium hypochlorite solution, at a concentration of between 75 - 150 parts per million (ppm), is used to disinfect the lettuce leaves and to kill all bacteria and

*“Our slogan is, 'Keep it cold, keep it clean and keep it moving'. We have to protect what we call the 'cold chain' to make sure it's as good on the eighth or ninth day as it was on the first day it was packed.”*

Chris Nelson, vice-president of Ready Pac in Irwindale, California.<sup>53</sup>

## Iced lettuce

Iceberg lettuce was called "Crisphead" until the 1920's. The lettuce was renamed when large quantities were transported long distances underneath mounds of ice to keep it cool.



insects. From December 1999 it will be illegal to clean organic lettuces with hypochlorite solution. So is this chlorinating process safe? Mary Ellen Camire, Head of Food Science at the University of Maine (USA) said:<sup>56</sup>

*"With a chlorine rinse, there is also a long-term possible risk associated with carcinogens".*

However, she goes on:

*"But I prefer to choose my poison - the risk of food-borne microorganisms is greater than the risk of developing cancer longer term".*

Other techniques used to sanitise lettuces include ozonation (use of ozone) and the use of hydrogen peroxide. After cleaning, the bags are then filled with a gas which is low in oxygen. Studies in the USA have shown that vegetables packed in bags with low oxygen levels preserve more of their vitamins and nutrients than non-packed vegetables.<sup>57</sup>

## Chlorine-free lettuce

If you wish to buy pre-washed and packed lettuce in a bag, buy organic - guaranteed not to be cleaned with a chlorine solution as from December 1999.



# Lettuce look at the alternatives

## Organic lettuces

The market for organic lettuces still outstrips the supply of UK grown organic lettuces. With over 80% of all organic fruit and vegetables imported,<sup>66</sup> there is great potential for UK farmers to fill this gap.

### Conversion to organic horticulture

Conversion from conventional to organic horticulture takes two years to allow for the build up of organic matter and nutrients in the soil. For this reason crops are often not grown during this conversion period, which is compensated for through the government's sponsored Organic Aid Scheme (OAS). Payments for the OAS have recently been increased to £450 per hectare spread over five years (first year receives £225 per hectare). However the conversion payments are usually insufficient compensation for the temporary drop in yield. It has been estimated that it currently takes between five and seven years before the farmer can pay back debts and generate a profit when converting to organic horticulture.<sup>67</sup> Arable farmers receive a payment of £315 per hectare per year for the Set-Aside Scheme (currently up to 10% of the arable land). Arable farmers can use the set-aside area to convert to organic production, claiming the additional £225 in the first year, giving a total of £540 per hectare for the first year. As horticulturists do not have a set-aside area, horticulture growers tend to be at a disadvantage.

Current organic conversion payments provide little incentive for the larger horticulture companies to convert. With the additional complication of building up fertility during the two year conversion period, most incentives to grow organic lettuces in the UK will come from the supermarkets. Supermarkets ask the grower to plant a quantity of lettuces while a proportion of the farm is converted to organic production for a future supply of organic vegetables. Some supermarkets will also agree to buy the produce that is being grown in conversion whilst paying the organic premium.

### Growing times for lettuce

<b>Sowing Time</b>	[Shaded]					
<b>Month</b>	<b>April</b>	<b>May</b>	<b>June</b>	<b>July</b>	<b>August</b>	<b>Sept.</b>
<b>Cutting Time</b>				[Shaded]		

Converting to organic horticulture is not simply a matter of changing the types of sprays used. For example the grower would need to consider:

- optimising crop rotations for nutrition and control of pests and diseases;
- the use of green manures, for example a one year grass-clover ley or a winter crop of legumes;
- the use of beetle banks, small fields, companion planting and other techniques which increase the populations of predators.

If managed correctly organic production of lettuces is not usually less productive than conventional lettuce production. However production can be less predictable, mainly because of the erratic availability of nitrogen in the soil which in turn is highly dependent on the weather. For example, high rainfall in the spring will considerably reduce available nitrogen for lettuces.

Organic horticulture does provide a viable alternative to conventional vegetable production. However for farmers to take the leap into the conversion process, more financial and institutional support needs to be provided by government.

## Grow your own

Lettuce is considered by many gardeners as an 'essential' component of a vegetable garden. They are easy to grow and require little attention apart from occasional weeding and watering. Lettuces can be grown and harvested throughout the year, using a heated glasshouse in the winter and cloches in the early spring and late autumn. For summer lettuces you can sow lettuce seeds straight into the soil in a partially shaded area after the last frosts have passed. The rows of lettuces need to be roughly 25 cms apart. Weeding needs to be done fairly regularly and if the weather is very hot they will need watering. Lettuces require a moist, slightly alkaline soil with high levels of organic matter. It is best not to grow lettuce in soil which has recently had manure dug in so this needs to be done in the winter before planting.<sup>68</sup> When the heart of the lettuce is full and hard (for hearty varieties), it is ready for harvesting. With cut-and-come-again lettuces, the seeds are scattered over a wide area in early spring and can then be harvested repeatedly.<sup>69, 70</sup>

# CASE STUDY: Scragoak Farm - box scheme and on-farm shop

Scragoak Farm is located in East Sussex near Hastings on an area of 4.4 hectares. Roughly 0.2 hectares is used for lettuce production and half the farm has been given over to natural woodland. The farm was set up in 1976 by David and Karen Wenman and has been growing organic vegetables ever since. The vegetables are retailed mainly through a box scheme and also through a farm shop. The box scheme delivers between 600 and 700 boxes each week to the local area, including Brighton. Six people work full time on the farm business and a further three people are hired to work in the summer months.

The seeds are started off in modules in polytunnels to guarantee the seedlings have a healthy start. Nutrition is provided through fertigation (nutrients in the irrigation) with a mixture of seaweed extract and fish emulsion. The lettuces are then planted directly outside. Several varieties are grown to create a 'salad bag' which is included in the box scheme. Flowers and spinach, also grown on the farm, are added to the salad bag.

The farm has been particularly successful considering it is located on a very heavy Wealden clay which necessitates adding a large amount of organic matter to ensure good plant growth. The whole farm also operates on a standard 5 year rotation and is part of the Soil Association Organic Farms Network. The Farm Network allows people to visit farms and find out more about food production (see Soil Association in *Contacts*). To visit the farm see *Contacts*.



Young lettuce seedlings on Scragoak Farm



Scragoak Farm. Note the irrigation system and polytunnels



David and Karen tend their organic lettuces

Scragoak Farm is also a place to visit for all ages



# CASE STUDY: The Co-operative - Riverford Organic Vegetables

South Devon Organic Producers Co-operative was formed in 1998 with over 200 hectares of land. One of its primary aims was to meet demand for UK organic produce. Over 100 people are employed, half of them on a full time basis. The core of the co-operative is Riverford Farm which markets all the vegetables under the Riverford Organic Vegetables brand. In this way each co-operative member has a secure market for their produce which in turn ensures the continuing viability of small to medium sized mixed farms. The vegetables are sold either to wholesalers, retailers or through the box-scheme, of which the latter makes up the majority of all sales for the co-operative. Over 4000 boxes are delivered each week in Devon, Cornwall, Somerset, Dorset, Gloucester, and London.

## Riverford organic lettuces

Over 24 hectares of lettuces are usually grown including the following varieties: Lollo Rosso, Oak Leaf, Webbs Crisp, Iceberg, Cos, Round or Flat lettuce, and Frisee. The iceberg lettuce is probably going to be dropped as it has little taste and little nutritional content, though it does have a long shelf life.

## Nutrients

The biggest problem that the co-op producers have found in growing organic vegetables is to keep the levels of soil nutrients at the correct level, especially nitrogen. Icebergs, for example, require very large amounts of nitrogen, and it can be difficult to match the size criteria imposed by supermarkets.

## Pests and diseases

Riverside Organics have innovative growing methods that reduce the need for sprays on organic lettuces. To reduce downy mildew farmers provide wider spacings

between lettuces, select resistant varieties, grow the lettuces on more exposed parts of the field and ensure that the field is always free of weeds between the plants. They have also shown how important it is to keep the plant healthy from seed to harvest. Healthy seedlings ensure less trouble with downy mildew. Aphids are controlled mainly by encouraging natural predators, using beetle banks and having smaller field sizes. Fatty acids, such as Savona, are also sprayed regularly on the lettuces to kill the aphid populations, usually after an inspection of the field for aphid numbers. In some rare instances, when aphid populations do reach unacceptable levels, Derris, a natural pesticide which has been approved by the United Kingdom Register of Organic Food Standards (UKROFS), has been used.

## Weed control

Inter-row cultivations are used, usually with a tractor, and occasionally hand weeding.

To find out more about Riverford Organic Vegetables see *Contacts*.

*“Organic farming of lettuces is less predictable, not less productive”,*

Guy Watson of Riverford Organic Vegetables.



# CASE STUDY: The Henry Doubleday Research Association (HDRA)

HDRA specialises in organic horticulture production from the garden to the commercial field and carries out scientific research into organic horticultural techniques. HDRA is also concerned about the loss of fruit and vegetable varieties and has therefore established the HDRA Heritage Seed Library which contains hundreds of vegetable varieties from different sources - see the box: *HDRA Heritage Seed Library lettuce seeds*.

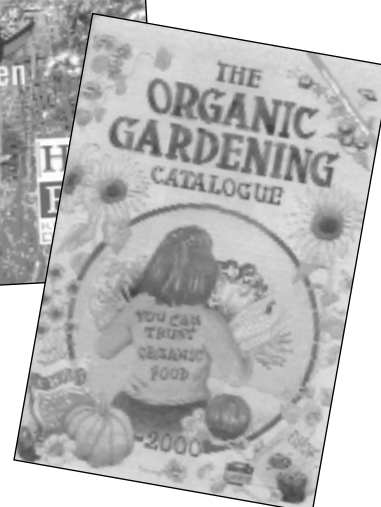
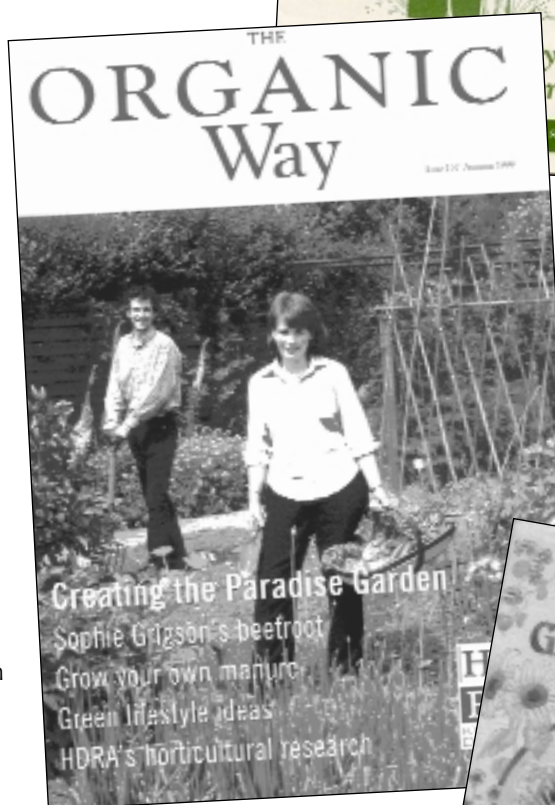
HDRA provides help and information for gardeners interested in organic horticulture:

HDRA has two organic display gardens open to the public at Ryton near Coventry and at Yalding near Maidstone which provide an opportunity to see many varieties of fruit and vegetables, as well as ornamental plants.

Members of HDRA get free entry to the HDRA gardens and practical organic gardening advice.

HDRA has a number of local groups.

HDRA has a *Grow your own* campaign to encourage everyone to grow their own vegetables, whether it be in an allotment or in your garden. A booklet has been produced for those starting from scratch<sup>71</sup> which includes information about lettuces. A number of other printed materials are available such as the *Cook's Garden Planner* (free) as well as over 100 fact sheets about pests and diseases in the garden.



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## PROJECT STAFF

James Petts (CityHarvest)  
Alexis Vaughan (Food and  
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Jacqui Webster (Food Poverty)  
Victoria Williams (Food Poverty)

## VOLUNTEERS

Gavin Dupee  
Jo Foster  
Amanda Glover  
Pete Spriggs  
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Fiona Mabet

## Sustain

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To advocate food and agriculture policies and practices that enhance the health and welfare of people and animals, improve the working and living environment, promote equity and enrich society and culture.



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94 WHITE LION STREET LONDON N1 9PF

tel: 020-7837-1228 • fax: 020-7837-1141

e-mail: [sustain@charity.vfree.com](mailto:sustain@charity.vfree.com)

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