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Benefits of non-traditional crops

grown by small-scale growers in the Midlands

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Foreword

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In a world where the supermarket triumphs, where corn syrup is king and fast, highly processed food is the norm, is it not heartening to hear, that on tiny patches of land across our cities a different picture is being painted?

Here in back gardens, allotments and community gardens we find a diverse array of food crops grown by many different ethnic origins. Exotic plants bought from far away places that have found home here in the UK. These crops may not be readily identifiable by many, they may seem strange or rare, but they often speak of home to the grower, of other cultures and other heritages. When these seeds are saved, replanted and passed on, they start to tell a new story, one that reflects the great multiculturalism of Britain. These seeds are a living story, being retold and with this adapting and evolving. Gardening, particularly in the media, is often seen through the limited prism of white, middle class values, yet here across our cities we see a different picture growing.

Gardening skills are best passed on through practice. The act of seed saving, of sowing and harvesting these exotic crops increases important skills within the gardening community. It also ensures that the plants themselves have a wide gene bank. These crops show local adaptations, which increases the gene diversity. But they are more than just genes: these crops teach of people's heritage. By seed saving and sowing, by swapping and sharing they help to strengthen a community bond. That many of these crops are grown on allotments with hugely diverse communities shows how a simple seed can be a bond necessary for good relations. It is vitally important that the seeds, their custodians and the land that they are grown are all recorded, preserved, shared, and celebrated. Garden Organic's Sowing New Seed review is an important piece of work and a wonderful read on the surprising world growing under our noses.

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Local Food

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Executive summary

Non-traditional (or exotic) crops are plant species that are grown in relatively small quantities and which are not traditionally cultivated in a country or region. All of the food crops grown on a large commercial scale in the UK originate from other countries, but most are considered 'traditional' because of their long history of cultivation here. However, there has been a relatively recent and significant increase in the number of exotic crops that have arrived in the country, mainly grown on a small-scale in gardens and allotments, although some have entered into commerce. These exotic crops are often intimately linked with the ethnic origins of their importers and maintainers and are a principal source of culinary and nutritional diversity for many people. They are therefore an important part of the UK's social and cultural heritage as well as being a significant component of our plant genetic resources for food and agriculture—the plant diversity that we depend on for food security and the economic stability and growth of agriculture. Recognizing the diversity and value of exotic crops, and the fact that this diversity had not previously been surveyed, documented or actively conserved, Garden Organic initiated the Sowing New Seeds project. With support from the Big Lottery Local Food Fund, the project set out to collect and conserve non-traditional crops grown in the Midlands along with the knowledge associated with their cultivation, and to promote and facilitate their wider cultivation in allotments, schools, community groups and home gardens in the region.

A major aspect of the project was a survey of exotic crops grown in allotments in the Midlands to provide baseline knowledge of the species in cultivation, along with information on where, by whom and why they are grown, as well as knowledge of their origin, special characteristics and cultivation requirements. Results of the survey involving 107 plot-holders from 31 allotment sites revealed that 26% of all food crops recorded are exotic and that they are grown by almost half of the survey participants who belong to 13 different ethnic groups. Encouragingly, a high proportion of plot-holders have been growing exotic crops for more than ten years. The majority save their own seed, indicating that these crops are performing well in the UK and that this diversity is being maintained over the longer term, with grower selection providing the basis for their continuing success. Further, the majority of maintainers swap seed with other growers, which means that exotic crops are likely to be gradually diversifying in response to different growing conditions—a positive sign for their value for local food security and as national genetic resources with potential for use in crop improvement programmes.

While the continued cultivation of exotic crops in gardens and allotments is key to the maintenance of crop diversity in the UK, the conservation of this diversity in seed banks is vital to ensure that unique diversity is not lost through discontinued cultivation—frequently a result of crops not being passed on from one generation to the next. This so called '*ex situ*' form of conservation also allows access to plant resources for use in breeding research and crop improvement programmes. To this end and with the appropriate permissions of the growers, the Sowing New Seeds project collected seeds, tubers and cuttings of a wide range of exotic crops for storage in the Heritage Seed Library at Garden Organic and has promoted their cultivation through the provision of propagation material and growing requirements. This exotic crop diversity is therefore safeguarded for the benefit of current and future generations.

Through the Sowing New Seeds project, Garden Organic has highlighted the diversity and value of exotic crops cultivated in the UK, collected material for conservation in the Heritage Seed Library, and provided a platform for sharing knowledge and promoting the importance of these crops for our heritage and food security. Critically, this report emphasizes that to ensure the continued conservation of these crops, including the maintenance of adaptive diversity (i.e., genetic diversity adapted to local growing conditions), growers need to be encouraged and supported to continue to cultivate them and to save their seed, as well as to pass them on to younger generations. Further, allotments are particularly important storehouses of exotic crop diversity and there is therefore a strong imperative to protect them from development. The report also highlights the multitude of benefits that growers obtain through cultivating exotic crops, which are not only related to nutrition and culinary requirements, but also to general health and well-being, culture and a range of other forms of life enrichment. Looking to the future, many exotic crops currently grown on a small scale may enter into commerce and thus expand the diversity of our nationally available food crop base. Such a shift may be particularly important in the face of the increasingly detrimental impacts of climate change on crop production in some areas (not only in the UK but also overseas)—particularly those that have become highly genetically uniform. Perhaps just as importantly, the increasing trend to 'grow your own' may increase exotic crop diversity within the amateur gardening sector, which could be more important for future nutrition, health and food security than we currently appreciate.

Acknowledgements

We would like to acknowledge the many people that contributed to this report and the Sowing New Seeds project. Many growers on allotments patiently gave up their time to take part in the survey and generously added their home-saved seed to our collection. Adrian Stagg and Nikki Bradley of Birmingham City Council were very helpful in providing us contact details for the Birmingham allotment sites. Allotment secretaries were instrumental in granting us access to sites and introducing us to plot holders.

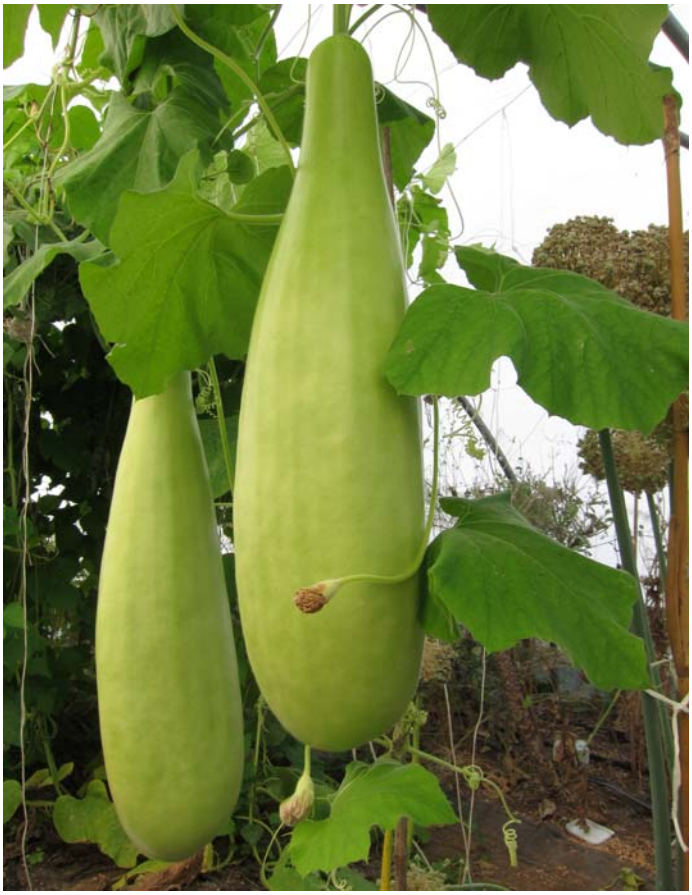
We also gratefully acknowledge the Big Lottery Local Food Fund for providing the funds to carry out this work. The project was also received financial support from the Brooke Trust, Cadbury Trust, Grimmet Trust, Sheldon Trust, Oram Foundation and the Open Gate Foundation.

Introduction

What are non-traditional crops?

Non-traditional crops are plant taxa[1] that are grown in relatively small quantities and which are not traditionally cultivated in a country or region. They are also sometimes referred to as 'speciality', 'ethnic' or 'alternative' crops, but many people also use the term 'exotic'. Non-traditional crops are distinct from exotic cultivars[2] which are cultivated varieties of traditional crops (i.e., those traditionally grown in a country) but with an exotic origin. An example of a non-traditional crop in the UK is okra (*Abelmoschus esculentus* (L.) Moench)—while it is cultivated in many tropical, subtropical and warm temperate regions, including parts of southeastern Europe, it is not traditionally cultivated in the UK. In comparison, an example of an exotic cultivar is climbing French bean (*Phaseolus vulgaris* L. var. *vulgaris*) 'Cherokee Trail of Tears'—the latter which is a crop traditionally grown in the UK but a cultivated variety of French bean that originated in the USA.

Non-traditional crops are often introduced and grown by particular ethnic groups and may be passed on to friends, neighbours or fellow allotment-holders, with some subsequently being grown on a commercial scale. Thus, some non-traditional crops may gradually become more widely cultivated, and over time will be considered less exotic, or naturalized. The exact point at which a crop is no longer considered to be exotic is somewhat subjective. However, on the whole, once a crop has entered into commerce (e.g., it is readily available to purchase in non-specialist greengrocers and/or supermarkets, or seeds are offered by commercial seed companies), then it can be no longer considered exotic. The non-traditional crops of the UK today are therefore those that have either been introduced very recently, or ones that have been cultivated in the nation for longer, but which have not been considered for commercial exploitation. An example of a recently introduced crop is kiwifruit, *Actinidia deliciosa* which was grown by the RHS and flowered for the first time in the UK in around 1909. However, due to the impacts of war and harsh winters it was not proposed as a possible fruiting crop for England until the 1970s[i]. Other crops, such as calalloo, (*Amaranthus* species), bottle gourd or dudi (*Lagenaria sicaria*), honeyberry (*Lonicera caerulea*) and goji berry (*Lycium chinense*) were cultivated as ornamental novelties in England as early as the 16th and 17th centuries, but have only been grown as edible crops in the UK since around 1950 when people began to arrive who grew them for consumption. Crops such as calalloo are not difficult to cultivate but have remained largely unknown to the wider growing community and are thus still thought of as exotic. Further, some commercial growers have tried to cultivate a number of exotic crops that have failed because they have not found suitable varieties, for example, white maize[3] (*Zea mays*) and chayote (*Sechium edule*). Therefore, 'exotic' or 'non-traditional' is a relative and dynamic term when applied to crops—relative in terms of the scale on which they are grown and dynamic in the sense that many crops that would have been considered exotic historically are now entering the mainstream.



Dudi is popular exotic crop among Indian and Bangladeshi communities

Origins of food crops in the UK

The movement of crops around the world has been taking place for hundreds of years. For example, while potato is a staple crop grown throughout most parts of Europe, it was once considered exotic after being introduced to the region from South America in the late 16th century. In fact, all of the food crops now grown on a large commercial scale in the UK originate from other countries where their wild ancestors were first brought into cultivation, domesticated and gradually developed in different regions to create the crops that we know today. Although the exact origins of many of our food crops are not known and opinions vary, there is evidence that points to a number of important regions of crop diversity—the so-called 'Centres of Diversity' identified by the Russian botanist Nikolai Vavilov. One of the most important of these is the area known as the Fertile Crescent in the Near East where the native ancestors of crops such as wheat, barley and pea were first brought into cultivation thousands of years ago. Over time, these and other crops originating from this region were domesticated and have been diversified to produce the numerous cultivated varieties that have been grown throughout the ages, and have been transported

[1] Species, subspecies or botanical varieties.

[2] Cultivars are plant taxa that have been subjected to deliberate selection by humans for their desirable characteristics and maintained through propagation.

[3] Although there is at least one commercial grower now cultivating white maize.

from one region to another such that they are now widely grown in many parts of the world. Likewise, crops such as onion, garlic, carrot and spinach are thought to have originated in central and southwestern Asia, aubergine and cucumber in India, while in addition to potato, tomato, beans (*Phaseolus* species), squash, corn (maize), pepper (*Capsicum annuum*) and sunflower are native to and were first domesticated in the Americas. Amongst other important food crops, oats, beetroot, radish, cabbage and lettuce are believed to have their origin in the Euro-Mediterranean area, while the Euro-Siberian region was the source of fruit crops such as grape, apple, cherry, plum and pear, as well as being an important area for the development of vegetables such as asparagus, parsnip, kale and a number of other brassica crops.

The crops mentioned above are all thought of as 'traditional' in the UK because they have been in cultivation in the nation for several hundred years. Some of the earliest crops, including lettuce are thought to have arrived in England with the Roman legions early in the 1st millennium. However, it was not until the early 16th century that vegetable and fruit crops became fashionable with the rich, largely due to the influence of Tudor kings and members of the court[ii]. Thus, 400•500 years ago, vegetables and fruits started to attract greater attention, becoming more widely cultivated and diversified into a more extensive range of varieties.

Non-traditional crops in the UK: recent trends and values

Today, non-traditional crops are frequently grown in home gardens, allotments and community gardens and are often intimately linked with the ethnic origins of the growers. For example, at Spitalfields City Farm in London, women from the east London Bangladeshi community grow a wide range of exotic crops via the Coriander club[iii]. The relationship between specific crops and ethnic identities has already been documented. For example, one study found that maize, squashes and calalloo are frequently associated with Afro-Caribbean gardeners, while salad crops, beans and tomatoes are grown by Italian plot-holders, and Indian growers favour the cultivation of a wide range of herbs[iv]. In some instances, interactions between different ethnic groups may result in a fusion of different customs and lifestyles[v]—a trend that is likely to have an important impact on exotic crop diversity. Particularly in the case of allotments, which are cultivated by a wide cross-section of the community, the diversity of crops grown reflects the diversity of cultural origins of the maintainers. This crop diversity is therefore important for keeping cultural heritage alive, as well as being an important component of the social history of the UK, reflecting the changes in ethnic origins of the nation's residents over time.

Many non-traditional crops have entered into commerce, reflecting not only the cosmopolitan nature of the UK population, but also a general and widespread interest in a diverse range of food genres. This is evidenced by the monetary value of non-traditional crops: in 2001, the value of the UK exotic vegetable market was estimated at £419 million and the exotic fruit market at £219 million—growth rates of 62% and 65% since 1997 respectively[vi]. The current value of the exotic fruit and vegetable market in the UK is hard to come by as figures are generally not available for the entire market. However, some examples of the 2012 UK market value of individual exotic crops are pak choi valued at £4,777,000, ginger at £2,029,000 and sweet potato at £36,607,000[vii], illustrating the significant value of these vegetables in modern commerce. This exponential growth rate in the commercial market for exotic fruits and vegetables is likely in part to be a manifestation of our increasingly multicultural society. In the 1991 census, approximately 3 million people described themselves as belonging to non-white ethnic groups; including Indian, Pakistani, Bangladeshi, Chinese, Black Caribbean and Black African. This number rose to 4.6 million in 2001 and according to 2011 census data published so far for England, Wales and Northern Ireland, has now risen to more than 6 million. These ethnic groups play a key role in contributing to the overall culture of the UK, especially with regard to the dynamic nature of food culture[viii].

Although much of the exotic fruit and vegetable produce sold in the UK is imported from overseas, some farmers are growing exotic crops in the UK, realising that there is a profitable market. For example, an Essex farmer expanded from growing Bangladeshi vegetables in his allotment to commercial production on his organic farm for sale in local shops in his London community, while a journalist who moved from Zimbabwe to the UK started to grow the crops he missed and now cultivates while maize for sale to the African community across the country[ix]. Another example is a farmer in West Yorkshire who started to grow speciality Asian crops on the suggestion of the local Asian gardening group who cultivate allotments close to the farm; this diversification was a financial lifeline for the farmer, who previously had produced only dairy and cereals[x]. The same author lists a number of exotic vegetable crops that she believes have potential for commercial cultivation in the UK; including calalloo, sweet potato, okra and quinoa.

The increase in demand for exotic vegetables by the mainstream population in recent years may also be influenced by increased wealth and relative ease of foreign travel, along with the promotion of exotic cuisine by TV chefs and other food media[xi]. It has also been reported that the main purchasers of exotic foods are shoppers who also seek quality, innovation and variety[xii]. In addition, globalization of food supplies is likely to have played a role in increased popularity, making ethnic foods accessible to the masses[xiii]. However, despite the supply chain being dominated by international players, a 2003 UK food report acknowledged a trend towards sourcing home grown produce[xiv]. This may avoid the freight costs and reduce the carbon footprint involved in transporting exotic produce around the world and respond to recent concerns over food miles and global climate change[xv].

Indeed, climate change in itself may be considered a factor likely to elevate the importance of exotic crops. Where growth is not limited by water or nutrient supply, rising carbon dioxide levels and a longer growing season may increase the likelihood of growth and survival of such novel crops in the UK[xvi]. Results of a recent study into European commercial plant nurseries showed that 73% of garden species are able to survive an average of 1000km further north than their known natural range limits[xvii].

Sowing New Seeds: about the project

The motivation for Sowing New Seeds

Although we know that there is a wide range of non-traditional crops cultivated in the UK, there has previously been no specific research into the number, location and maintainers of these crops. Therefore, the number of exotic fruit and vegetable crops grown in the UK is currently unknown. Some new crops and/or varieties may be introduced and some may be lost, but there is currently no way of monitoring these trends.

Many of the exotic crops and varieties cultivated successfully in the UK (except for those formally bred for the UK environment by commercial breeders) are likely to have been subjected to multiple rounds of selection and seed saving over a number of years, enabling them to acclimatize to our temperate climate. As a consequence, they are often maintained by the older generation and unless people are willing or given the opportunity to become a guardian of these crops, they are under threat of extinction once the original maintainer dies. Furthermore, little of the experience and knowledge of growing exotic crops in the UK is documented.

There is therefore a need to create an inventory of non-traditional crops grown in the UK and to document their uses, special characteristics, growing requirements, where they are grown and by whom, as well as to actively promote the importance and continued cultivation of these unique and diverse crops. Further, by collecting and conserving seed samples in a safe seed bank facility, further research can be carried out into the diversity and cultivation requirements of these crops, as well as ensuring that they will not be lost if their cultivation in gardens and allotments is discontinued.

Sowing New Seeds: aims and objectives

The overarching aims of this three-year project led by Garden Organic were to a) capture and preserve as many non-traditional crops grown in the Midlands as possible along with knowledge associated with their cultivation, and b) promote and enable their wider cultivation in allotments, schools, community groups and home gardens in the region.

To achieve these aims, the specific objectives of the project were to:

- Collect seeds/vegetative material of non-traditional crops, as well as the knowledge associated with their cultivation, and safeguard both seeds and knowledge for future generations;
- Promote exotic crop cultivation through the provision of factsheets, a grower's guide, a demonstration garden, seed swaps, community events and demonstrations;
- Make seeds, skills and knowledge available to those who want to grow them;
- Support groups within the Midlands to grow exotic crops.

One facet of the project involved a survey of allotments in the Midlands. The survey allowed a partial inventory of crops and varieties of the region to be created, including information on where, by whom and why they are grown, as well as knowledge of their origin, special characteristics and cultivation requirements. The next section provides a brief introduction to allotments in the UK and specifically in the Midlands, and then summarizes the survey method and results, including a review of the range of non-traditional crops grown in relation to culture.

Allotments in the Midlands: storehouses of non-traditional crop diversity

UK allotments: an introduction

Allotments have featured in the UK for hundreds of years, with evidence of their existence dating back to Anglo-Saxon times; however, the allotment system of today can be traced back to the 19th century when land was provided to the poor in which to grow food[xviii]. In 1908 the Small Holdings and Allotments Act came into force which placed a duty on local authorities to provide allotments according to demand; then, after the First World War, land was made available to all through the 1919 Land Settlement Facilities Act[xix]. The 1922 Allotments Act was instrumental in strengthening the rights of allotment-holders, but the most important change came about with the 1925 Allotments Act which "established statutory allotments which local authorities could not sell off or covert without Ministerial consent"[xx]. Today, district authorities, unitary authorities and local councils are responsible for the management of UK allotments.

The current and most widely accepted definition of an allotment was provided by the 1922 Allotment Act which defined it as an area of up to 40 poles for the cultivation of fruit and vegetable crops that were to be consumed solely by the occupier and their family. Forty poles is an ancient measurement equivalent to a quarter of an acre (c. 1000 m^2) which was deemed a sufficient amount of land with which to feed a family of four[xxi]. At many sites, this has prompted the division of plots into 'half-size' or 'starter' plots which are considered to be more suitable for beginners, those with busy work lives and for smaller families[xxii].

The demand for allotments has increased exponentially in the last two decades. A 1996 survey of allotment waiting lists carried out by the National Society of Allotment and Leisure Gardeners (NSALG) revealed that at that time there was an average of only four people waiting per 100 plots[xxiii]. This figure increased to 49 people per 100 plots in 2009 and to 59 in 2010[xxiv]. The number of people and the amount and value of the produce grown in UK allotments is quite staggering—it has been estimated that an excess of 200,000 tonnes of fresh fruit and vegetables is produced annually by some 300,000 families tending UK plots, and that this produce is worth around £560 million[xxv].

The Uplands Allotment is one of the largest allotment sites in the UK

Allotments in the Midlands

Many allotment sites in the Midlands started out in the mid-19th century as leisure gardens close to the industrial city centres to provide green space to the wealthy and only became used as places to grow food at end of the century. Their use for growing edible produce peaked in the first and second world wars when food was rationed and from then on has declined. Today, Birmingham (the largest city in the Midlands) has the biggest supply of allotments of any local authority in the UK with 115 sites located throughout the city containing nearly 7000 plots in total. Over 80% of these sites are managed by allotment associations which are represented by the Birmingham and District Allotments Council[xxvi]. Birmingham City Allotments fall within Policy 24 of the Birmingham Parks and Open Spaces Strategy[xxvii] which refers to the 2001 Strategy for Allotment Provision, highlighting the commitment of Birmingham City Council to securing the long-term sustainability of allotment sites. Birmingham has seen a significant rise in demand for allotments in recent years, particularly in the west of the city[xxviii]. Attempts to increase allotment provision have been made; for example, with the recent reopening of the Victoria Jubilee site in Handsworth[xxix] and Birmingham City Council's initiative to identify derelict sites with potential for regeneration into allotments, community gardens and green spaces[xxx].

Birmingham is renowned for its cultural diversity which is a result of a long history of immigration into the city. In the 2011 Census for England and Wales, 42% of Birmingham residents classified themselves as being from a mixed/multiple, Asian/Asian British, Black/African/Caribbean/Black British, or another ethnic group other than White[4;xxxi]. The nurturing of culturally defined crops in allotments may help immigrants to maintain their identity[xxxii]. Indeed, included within Policy 24 of the Birmingham Parks and Open Spaces Strategy is the objective to "support access to allotment sites for asylum seekers, newly arrived people and other socially disadvantaged groups"[xxxiii]. A number of community groups in Birmingham use agricultural activities based in allotments, community gardens and parks as a means to aid the integration of recent migrants. Projects include 'Concrete to Coriander' in Small Heath Park, 'Confused Spaces' in Balsall Heath and community vegetable growing in Georges Park, Lozell's[xxxiv].

Other cities in the Midlands with a significant number of allotment sites include Leicester with 45, Nottingham with 43 and Coventry with 36. Sites of particular historical interest include Stoney Road, Coventry which was created in 1787 when the Marquis of Hertford divided Cheylesmore Park into small detached gardens for workers[xxxv]. The site, which was converted to allotments in 1853, is characterized by high holly and beech hedges and seven elaborate, brick built summerhouses that still stand on the plots. St. Anne's allotment in Nottingham was originally created as a walled garden in the 1830s for wealthy professional people who wanted a green space away from the city centre[xxxvi]. Towards the end of the 19th century it was used by poorer workers but the high cost of the allotments meant that they had to sell some of the higher value produce, especially roses.

[4] Adapted from data from the Office for National Statistics licensed under the Open Government License v.1.0.

Sowing New Seeds allotment survey

How the survey was carried out

The survey involved the participation of 107 plot-holders from 31 allotment sites primarily located in Birmingham but with the addition of a small number of sites in Coventry, Leamington, Leicester and Nottingham, Smethwick and Wednesbury (Box 1).

Information was collected using a questionnaire which was either completed by the researchers during face-to-face interviews with plot-holders, or remotely by the respondents either in hard copy or online. The questionnaire was structured in two main sections. Section 1 collated information on: i) participant details, including age, gender and ethnicity; ii) site details, including the number of plots cultivated, location, size and other plot attributes such as soil type and growing facilities; iii) crops grown, noting reasons for growing them and the cultivation practices used; iv) cultivar preferences and seed-saving/swapping; and v) sources of knowledge used to cultivate the crops. Section 2 collated information on the cultivation requirements of selected crops or cultivars of the plot-holder's choice.

Range of food crops grown at the allotments

The survey recorded more than 170 food crops in 28 flowering plant families that are cultivated in 145 or more plots [5] at the 31 allotment sites sampled. The precise number of distinct crops is unknown because of the range of common names that may be used to refer to the same crop or one name that may be used to refer to two or more different crops. In many cases it is possible to standardize common names; for example, 'calabrese' can be grouped with 'broccoli', 'salad onion' with 'spring onion' and 'corn' with 'sweetcorn'. The nomenclatural situation is further complicated by different ethnic groups having their own common name for the crops they cultivate. Some names are difficult to resolve; for example, 'sag' may refer to any type of leafy greens, 'kodu' to a range of cucurbits (marrow, pumpkin, squash, bottle gourd etc.) and 'methi' to two different species of *Trigonella* L., depending on whether the crop is small- or large-seeded. These and other anomalies are being addressed through an ongoing process of growing samples of the crops at Ryton Gardens so that their characteristics can be recorded and their scientific names identified.

Figure 1 shows that potato is by far the most popular of the 27 most common crops grown. The figure shows the crops that were recorded 20 or more times in the survey (i.e., the number of occurrences of the crop recorded across all surveyed plots), and includes one exotic crop calalloo—also known as amaranth (*Amaranthus* L. species). A further 24 crops were recorded between 10 and 19 times and 122 between 1 and 9 times. The two largest groups of crops grown are leaf/flower/salad vegetables containing 43 different crops and sweet fruits with 30 (Figure 2). *Brassica* L. is the plant genus containing the largest number of crops (23) in the survey, showing the amazing breadth of crop diversity within this group alone. The genus contains crops such as cabbage, broccoli, kale, mustard, radish and turnip.

The next largest number of crops is in the genus *Phaseolus* L. which contains nine bean crops, while *Allium* L. (onion, garlic, leek, chives etc.) and *Cucurbita* L. (squash, courgette, marrow, pumpkin etc.) each contain eight crops. The remaining crops occur in 74 genera, each containing five or less crops.

Box 1. Allotment sites included in the survey (* = sites at which the cultivation of exotic crops was recorded)

Birmingham

1 Bells Sports Field Allotments, Kings Norton*
2 Birches Green Allotments, Erdington
3 Chudleigh Road, Erdington
4 Coney Green Drive, Northfield
5 Court Lane Allotments, Erdington*
6 Hazelwell Allotments, Bournville*
7 Hurst Mill Allotments, Kings Norton*
8 Lower Tinkers Farm Allotments, Northfield
9 Marsh Hill Allotments, Stockland Green
10 Meadow Road
11 Moor Green*
12 New Hall Allotments, Sutton Coldfield
13 Quinton Allotments
14 The Hill Allotments, Four Oaks
15 Thornbridge Allotments, Great Barr
16 Uplands Allotments, Handsworth*
17 Walsall Road*
18 Warstock Lane
19 Woodside Allotments, Northfield
20 Yardley Green Allotments*

Coventry

21 Eden Street*
22 Henley Mill*
23 Markfields*
24 Radford Road*
25 Red House*

Leamington

26 St. Mary's*

Leicester

27 Rowley Fields*
28 Saffron Lane*

Nottingham

29 St. Anne's*

Smethwick

30 Londonderry*

Wednesbury

31 Black Horse*

[5] Seventeen survey participants did not provide information on the number of plots they cultivate.

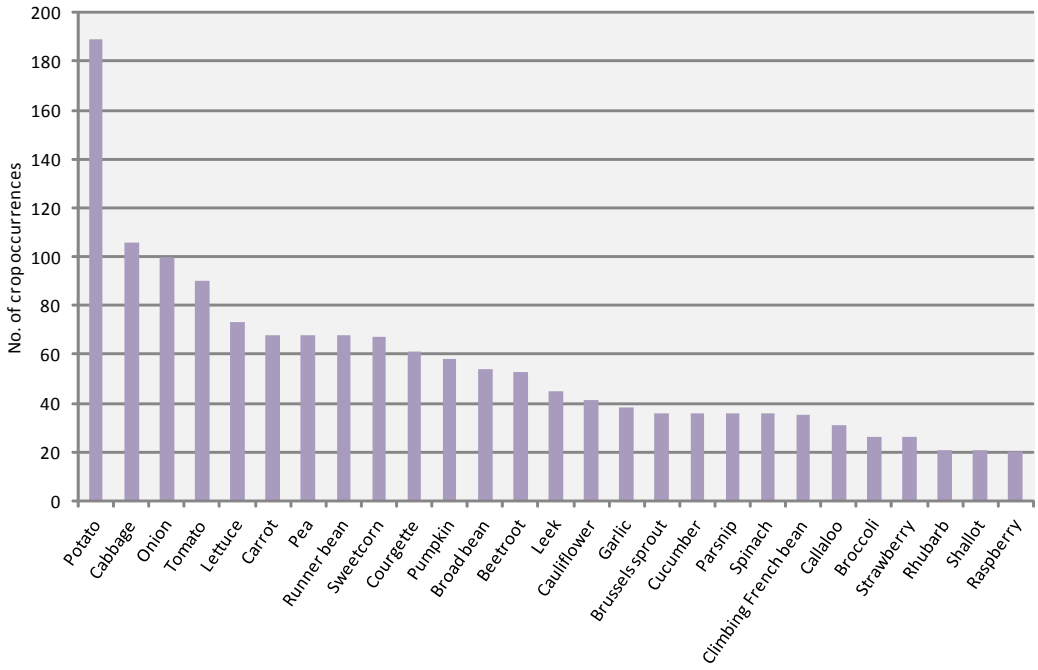


Figure 1. The 27 most popular food crops cultivated across a minimum of 145 plots at 31 allotment sites in the Midlands

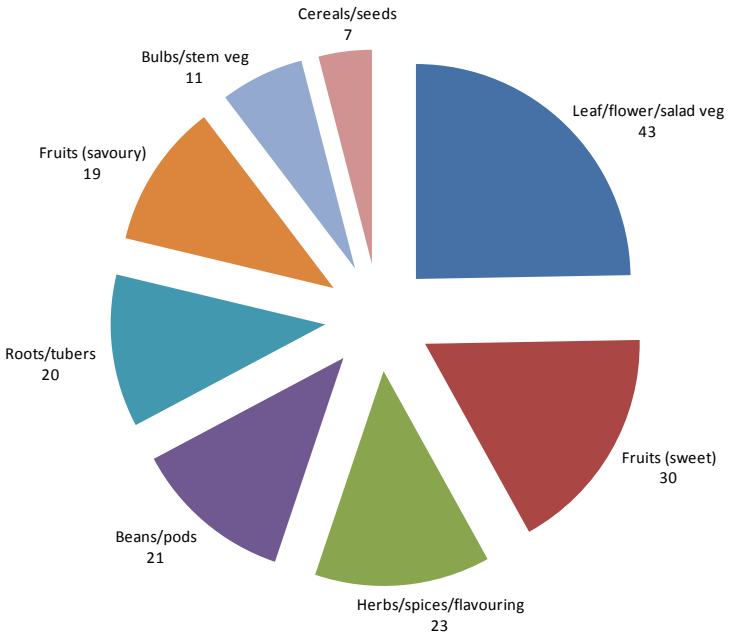


Figure 2. The number of crops cultivated per crop group [6]

[6] Crops are grouped according to their main uses. The savoury fruits group includes crops such as cucumber, pumpkin and tomato.

Results indicate that 46 exotic crops[7] in 17 flowering plant families are cultivated in the plots sampled—around 26% of all food crops recorded in the survey (Table 1). Apart from calalloo which was recorded 31 times, these exotic crops were recorded a maximum of five times each.

They are cultivated at 19 (61%) of the allotment sites included in the survey (see Box 1) by 50 (47%) of the survey participants in 74 (51%) of the total allotment plots sampled. Figure 3 shows the number of exotic crops cultivated per crop group compared with the number of non-exotic crops

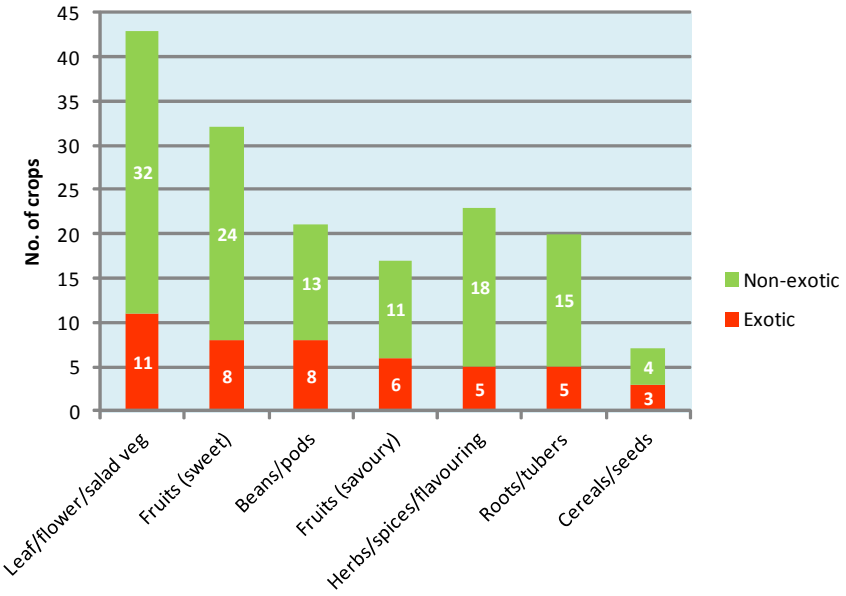


Figure 3. The number of exotic and non-exotic crops cultivated per crop group

[7] Plant taxa (species, subspecies or botanical varieties) that are grown in relatively small quantities and which are not traditionally cultivated in a country or region. Note that these are distinct from exotic cultivars (cultivated varieties).

In addition to the exotic crops recorded in the survey, as many as 75 exotic cultivars of crops traditionally cultivated in the UK may be grown at the allotment sites. The caveat here is that as with the uncertainty over the precise number of crops cultivated, we also cannot be sure of the exact number of cultivars grown. This is because a) not all participants provided the names of cultivars, either because they are unknown or the cultivar does not have a name; b) cultivar names may be incorrect or misspelt; c) growers may assign their own cultivar name or give it a generic name based for example on the colour of the crop; or d) individual plantings of the same cultivar may be interpreted as distinct cultivars due to the variation between them.

However, with regard to exotic cultivars, apart from distinct named cultivars that are known not to be available in the UK seed market, the country of origin can be used as an indicator that a cultivar is exotic, particularly when combined with the knowledge that the seed was sent to the grower from overseas and/or it has been home-saved. The country of origin should however be used with caution; for example, some exotic cultivars (e.g., climbing French bean 'Cherokee Trail of Tears') are available to purchase in the UK, while others are available via Garden Organic's Heritage Seed Library (HSL) or seed swap events. A survey respondent may state that they obtained the cultivar in the UK, but if the name is unknown or they have little knowledge of its origin, there is no way of knowing whether it is an exotic cultivar, except through the lengthy and time-consuming process of growing the cultivar as part of a controlled experiment and comparing it with all the existing similar cultivars commonly available in the UK. Conversely, a cultivar obtained from a foreign country may not necessarily be exotic—it is only through the collection of further knowledge from the grower, and by growing the cultivar as part of a controlled experiment that its status can be confirmed. Despite these limitations, we do know that at least some exotic cultivars of traditional crops are grown in allotments in the Midlands. One such example is Jamaican pumpkin, a variety with a firmer flesh than the varieties traditionally consumed in Europe.

Relationship between food crops and demography

Information was collected on the ethnicity, gender and age of the 107 survey participants. Sixteen ethnicities were recorded, including 'mixed other' and 'other' (Figure 4). Forty-two percent of participants described themselves as 'white British', 27% as 'black Caribbean', 8% as 'Asian Indian' and 6% as 'white European'. The remaining 12 ethnicities were recorded for three or less participants each. Seventy-one percent of the participants are male and 29% female (Figure 5). The majority of participants (37%) are in the age group 56 - 70 and the minority (11%) are between the ages of 26 and 40 (Figure 6). A significant percentage of participants (28%) are aged 70 or over and 22% are aged 41 to 55. Two participants did not provide their age. The high proportion (55%) of black Caribbean growers in the >70 age group is notable because it will be important that if they are growing unique crops and/or crop cultivars that they are passed on to younger generations to ensure that this diversity is not lost when they eventually cease to maintain them.

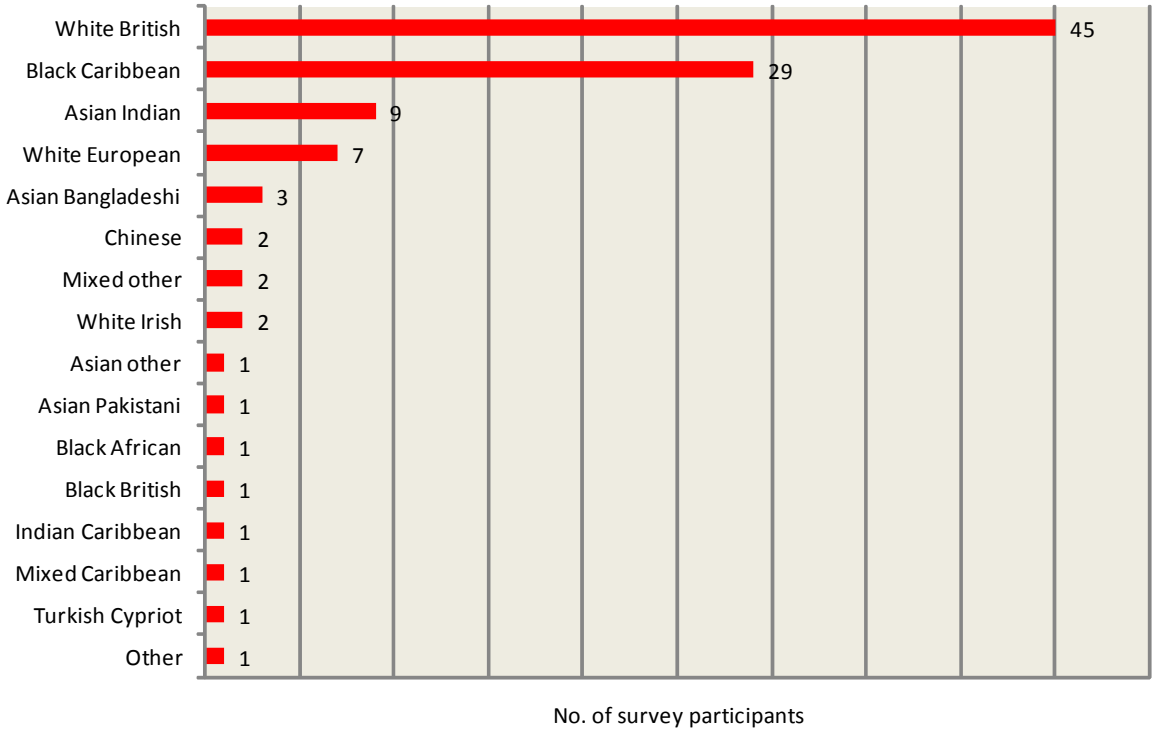


Figure 4. Ethnicity of the survey participants

Table 1. Exotic food crops cultivated at 19 allotment sites in the Midlands

Crop group[8]	Family	Scientific name[9]	Vernacular name(s) recorded in the survey
Leaf/flower/salad veg	Amaranthaceae	*Amaranthus* sp.	Amaranth, calalloo
			Dhata, red amaranth
			Dugi, amaranth
			Lal sag
	Asteraceae	*Chrysanthemum coronarium*	Chop suey greens
	Brassicaceae	*Brassica oleracea* var. *alboglabra*	Chinese broccoli
		Brassica oleracea var. *viridis*	African kale, chomolia, covo, viscos
		Brassica sp.	Lai
		Lepidium sativum	Halloon
	Chenopodiaceae	*Chenopodium giganteum*	Tree spinach
	Malvaceae	*Hibiscus sabdariffa*	Sorrel
Beans/pods	Fabaceae	*Cicer arietinum*	Chickpea
		Lablab purpureus	Sim bean
		Lens culinaris	Lentil
		Phaseolus lunatus	Butter bean, sugar bean
		Vigna mungo	Black gram
		Vigna unguiculata	Cowpea
		Vigna unguiculata subsp. *sesquipedalis*	Yard long bean
	Malvaceae	*Abelmoschus esculentus*	Okra
Bulbs/stem veg	Asteraceae	*Lactuca sativa* var. *angustana*	Chinese stem lettuce, stem lettuce
Fruits (sweet)	Actinidiaceae	*Actinidia deliciosa*	Kiwifruit
	Bromeliaceae	*Ananas comosus*	Pineapple
	Caricaceae	*Carica papaya*	Papaya
	Cucurbitaceae	*Citrullus lanatus*	Watermelon
	Musaceae	*Ensete lasiocarpum*	Banana
		Musa sp.	
Fruits (savoury)	Cucurbitaceae	*Cucumis metuliferus*	African horned cucumber
		Cucurbita ficifolia	Shark fin melon
		Cucurbita pepo	Chapan, ram's kodu, winter squash
		Cucurbita sp.	Asian marrow, kodu
		Lagenaria siceraria	Bottle gourd, dudi, kodu
		Luffa acutangula / cylindrica	Loofah
		Sechium edule	Chayote, cho-cho
	Solanaceae	*Solanum nigrum*[10]	Kabo[9]
Roots and tubers	Apiaceae	*Petroselinum crispum* var. *tuberosum*	Hamburg parsley
	Araceae	*Colocasia esculenta*	Dasheen, mukki
	Asteraceae	*Smallanthus sonchifolius*	Yacón
	Brassicaceae	*Raphanus caudatus*	Rat-tail radish
	Dioscoreaceae	*Dioscorea alata*	Yam
Herbs/spices/flavouring	Fabaceae	*Trigonella foenum-graecum*	Fenugreek, methi (large-seeded)
		T. corniculata	Methi (small-seeded)
	Lamiaceae	*Thymus* sp.	Tanya
			Jamaican thyme
Cereals/seeds	Chenopodiaceae	*Chenopodium quinoa*	Quinoa
	Poaceae	*Oryza sativa*	Rice
		Zea mays	African white maize

[8] Crops are grouped according to their main uses; however, some crops have multiple uses. For example, fenugreek (*Trigonella foenum-graecum*) can be used as a green manure crop as well as a spice/herb crop.

[9] sp. = species to be identified

[10] IMPORTANT: *SOLANUM NIGRUM* CARRIES A RISK OF TOXICITY. DO NOT EAT IT UNLESS YOU ARE SURE YOU KNOW WHAT YOU ARE DOING. It may be that this record is not pure *S. nigrum*, but *S. americanum*, its hybrids and relatives which closely resemble *S. nigrum*. The genetics of the nightshades are not fully researched and toxicity varies according to species, season, region of cultivation, climate conditions, age of leaf and cooking method.

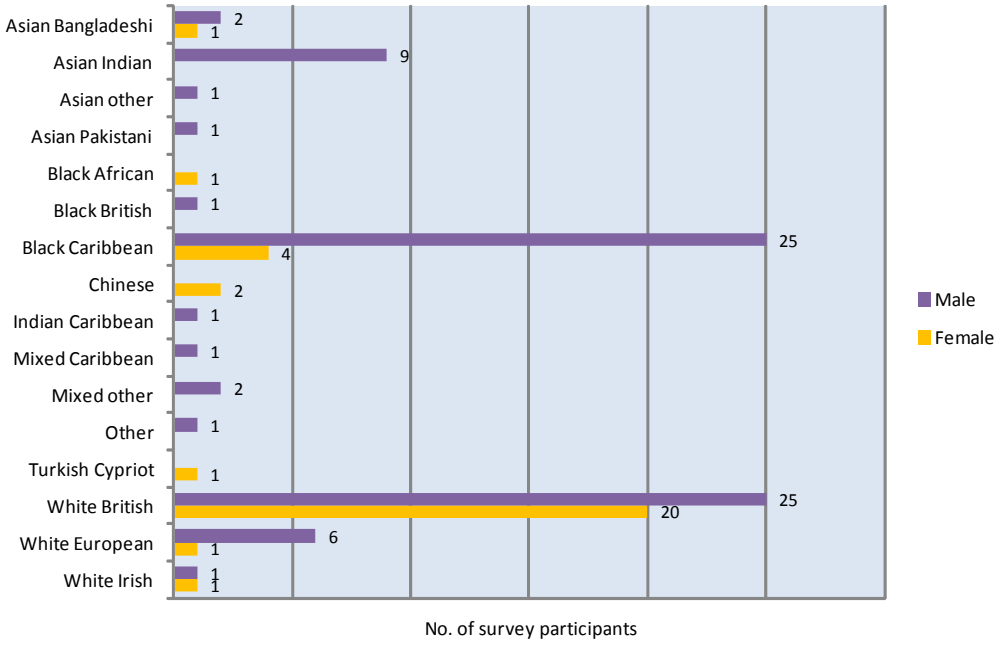


Figure 5. Ethnicity and gender of the survey participants

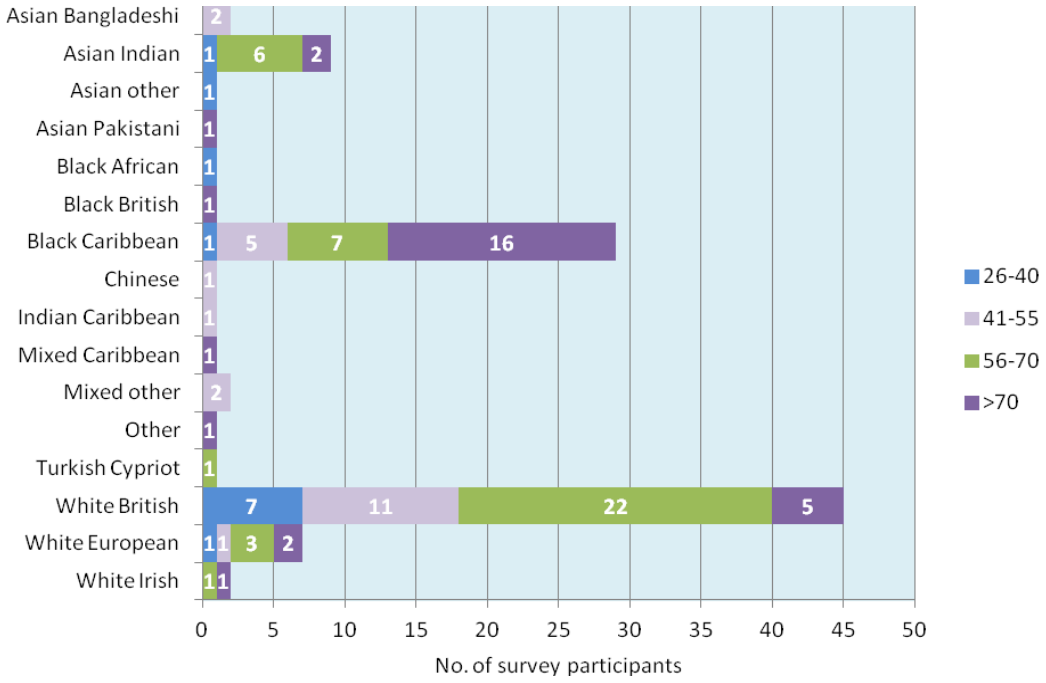


Figure 6. Ethnicity and age groups of the survey participants

As already noted, 50 (47%) of the survey participants reported that they grow exotic crops and these are cultivated in around half (74) of the plots sampled. Forty-nine of these plot-holders reported that they also grow other crops which are traditionally grown in the UK[11]. The demographic details of these 50 plot-holders and the exotic crops they cultivate are shown in Table 2. Only three of the ethnicities recorded in the survey are not represented in this subgroup of plot-holders—'Asian other', 'black British' and 'mixed Caribbean'.

[11] One participant did not respond to the whole survey and only provided cultivation details for one exotic crop.

Table 2. Demography of plot-holders who participated in the survey and who cultivate exotic crops, showing the crops grown

Age group	Ethnicity	Gender	No. of participants	Exotic crops cultivated[12]
26 - 40	Asian Indian	Male	1	Methi (*Trigonella* sp.)
	Black African	Female	1	African kale[13] (*Brassica oleracea* var. *viridis*), calalloo (*Amaranthus* sp.), cowpea (*Vigna unguiculata*), sugar bean (*Phaseolus lunatus*)
	White British	Female	1	African horned cucumber (*Cucumis metuliferus*), cho-cho (*Sechium edule*)
41 - 55	Asian Bangladeshi	Male	2	Calalloo, dhata, lal sag (*Amaranthus* sp.), dudi (*Lagenaria siceraria*), kodu (*Cucurbita* sp. or *L. siceraria*), lai (*Brassica* sp.), sim bean (*Lablab purpureus*)
	Black Caribbean	Female	1	Dasheen (*Colocasia esculenta*), okra (*Abelmoschus esculentus*)
		Male	4	Calalloo (*Amaranthus* sp.)
	Chinese	Female	1	Amaranth (*Amaranthus* sp.), Chinese broccoli (*Brassica oleracea* var. *alboglabra*), Chinese stem lettuce (*Lactuca sativa* var. *angustana*), shark fin melon (*Cucurbita ficifolia*)
	Indian Caribbean	Male	1	Calalloo (*Amaranthus* sp.), Jamaican thyme (*Thymus* sp.)
	Mixed Other	Male	1	Rat-tail radish (*Raphanus caudatus*)
	White British	Female	1	Yacón (*Smallanthus sonchifolius*)
		Male	3	Calalloo (*Amaranthus* sp.), Hamburg parsley (*Petroselinum crispum* var. *tuberosum*), quinoa (*Chenopodium quinoa*), tree spinach *Chenopodium giganteum*)
56 - 70	Asian Indian	Male	6	Calalloo (*Amaranthus* sp.), chickpea (*Cicer arietinum*), fenugreek (*Trigonella foenum-graecum*), halloo *Lepidium sativum*), kabo (*Solanum nigrum*[14]), lai (*Brassica* sp.), methi (*Trigonella* sp.), okra (*Abelmoschus esculentus*), rat-tail radish (*Raphanus caudatus*), winter squash (*Cucurbita pepo*)[15]
	Black Caribbean	Female	1	Calalloo (*Amaranthus* sp.)
		Male	3	Banana (*Ensete lasiocarpum* or *Musa* sp.)[16], calalloo (*Amaranthus* sp.), dasheen (*Colocasia esculenta*), papaya l *Carica papaya*), pineapple (*Ananas comosus*), rice (*Oryza sativa*), Jamaican thyme (*Thymus* sp.), watermelon *Citrullus lanatus*), yam (*Dioscorea alata*)
	Turkish Cypriot	Female	1	Lentil (*Lens culinaris*)
	White British	Male	1	Kiwifruit (*Actinidia deliciosa*)
	White European	Male	1	Chickpea (*Cicer arietinum*)
>70	Asian Indian	Male	2	Black gram (*Vigna mungo*), methi (*Trigonella* sp.), Tanya (*Thymus* sp.)
	Asian Pakistani	Male	1	Chickpea (*Cicer arietinum*)
	Black Caribbean	Male	14	African white maize (*Zea mays*), butter bean (*Phaseolus lunatus*), calalloo (*Amaranthus* sp.), chayote (*Sechium edule*), okra (*Abelmoschus esculentus*), sorrel (*Hibiscus sabdariffai*), Jamaican thyme (*Thymus* sp.)
	Other	Male	1	Calalloo (*Amaranthus* sp.)
Age not given	Asian Bangladeshi	Female	1	Kodu (*Cucurbita* sp. or *Lagenaria siceraria*), mukki (*Colocasia esculenta*), dugi (*Amaranthus* sp.), lai (*Brassica* sp.), yard long bean (*Vigna unguiculata* subsp. *sesquipedalis*)[17]
	Chinese	Female	1	Bottle gourd (*Lagenaria siceraria*), chop suey greens (*Chrysanthemum coronarium*), loofah(*Luffa acutangula*), stem lettuce (*Lactuca sativa* var. *angustana*)

[12] Crop common names as reported by the survey participants with corresponding scientific names in parentheses.
[13] Reported by one plot-holder under three different names—'chomolia', 'covo' and 'viscos'—which may relate to different cultivars.
[14] IMPORTANT: *SOLANUM NIGRUM* CARRIES A RISK OF TOXICITY. DO NOT EAT IT UNLESS YOU ARE SURE YOU KNOW WHAT YOU ARE DOING. It may be that this record is not pure *S. nigrum*, but *S. americanum*, its hybrids and relatives which closely resemble *S. nigrum*. The genetics of the nightshades are not fully researched and toxicity varies according to species, season, region of cultivation, climate conditions, age of leaf and cooking method.
[15] Reported by one plot-holder under two different names—'chapan' and 'ram's kodu'—which may relate to different cultivars.
[16] Two different species are cultivated by one plot-holder—*Ensete lasiocarpum* and *Musa* sp.
[17] Participant also reported the cultivation of 'zinger'; however, the scientific name of this crop is yet to be identified.

Reasons for growing food crops in allotments

Figure 7 summarizes the main reasons for allotment-holders in the Midlands growing their own food crops. These results are based on responses from 101 participants—46 who grow both exotic and traditional crops and 55 who grow only traditional crops (six participants did not respond to this question). The satisfaction of growing their own food, the fact that the produce is fresher, and the opportunity for exercise contributing to personal fitness are clearly important to both groups of growers, while the availability of the food crops and cost are least important. Results show overall larger percentages in the traditional crop grower group across all categories of reasons. This is simply a reflection of the greater number of respondents in this group that selected each reason, although why this might be the case is not clear. Putting this factor aside, there are otherwise no strong relative differences between reasons indicated by growers of both exotic and traditional crops and those who only grow traditional crops, although meeting people and cost appear to be slightly more important to plot-holders who only cultivate traditional crops.

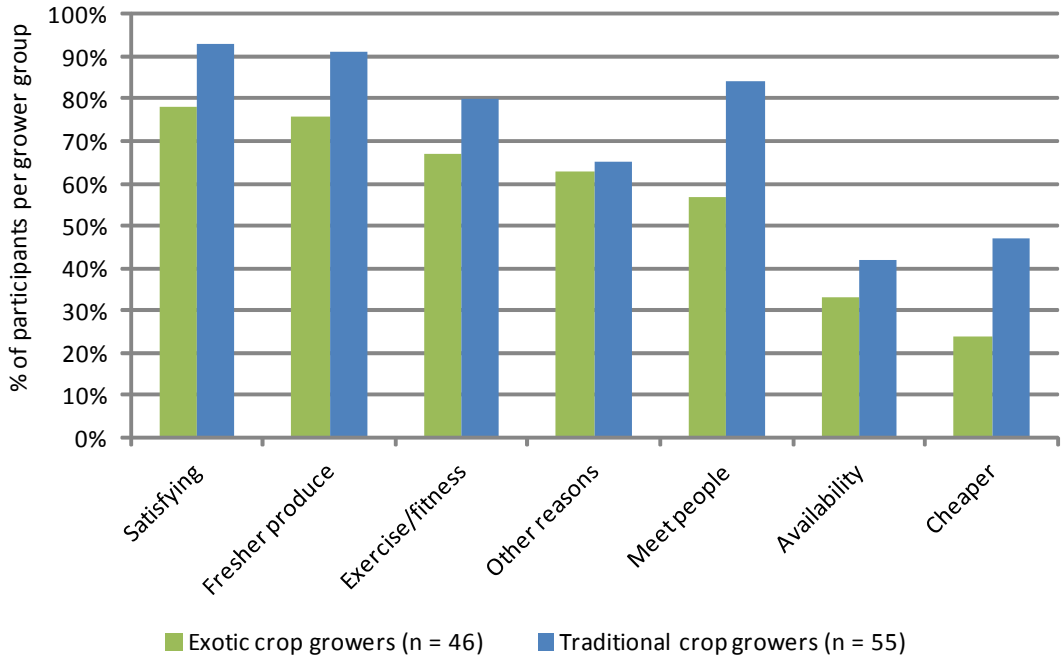


Figure 7. Reasons for growing food crops in allotments in the Midlands, showing the percentages of participants in each of the two grower categories who selected each reason

[18]Other reasons given for growing crops in the allotments are: the enjoyment of being outside in the fresh air and away from the home environment; knowing that the produce is organically grown and better for the environment (including avoidance of GM produce); the satisfaction of watching the crops grow, harvesting them and seeing them on your plate; the availability of produce through the winter months; the superior quality of the produce; the ability to give food to other people (including donating food to a local temple); the enjoyment of being part of or volunteering for the local community; meeting like-minded people and looking after each other; the spiritual benefits of being close to the soil and in a peaceful setting; religious purposes; the importance of growing crops for mood; a way of life or hobby; the relaxed atmosphere (better than going to the supermarket); an interest for retirement; activity for children; love of gardening; an interest in self-sufficiency; understanding nature (e.g., learning about birdsong); the enjoyment of experimentation and the learning process; and the satisfaction of entering produce in competitions. There is no clear distinction between other reasons given by growers of exotic crops and those who do not grow exotic crops.

In addition to recording general reasons for growing food crops in allotments, the survey participants were asked to indicate their reasons for choosing particular crop varieties (i.e., cultivated varieties of crops) (Figure 8). The results are based on responses from 91 participants—40 who grow both exotic and traditional crops and 51 who grow only traditional crops (16 participants did not respond to this question). It is clear that taste is equally important to both groups of growers, while knowing that the variety grows well is more important to growers of traditional

[18] This question was answered by 46 (92%) of the survey participants who grow exotic (and traditional) crops and 55 (96%) who only grow traditional crops.

crops than it is to exotic crop growers. Interestingly, cultural heritage appears to be more important to those who cultivate traditional crops than those who grow exotic crops. This result seems somewhat counter-intuitive and it may be that a larger sample size would reveal less disparity between the two groups. What is clear from the results is that while availability and variety name are overall the least important reasons given for variety choice, they are factors that are significantly more important to growers of traditional crops. This is not unexpected, since traditional crop varieties tend to be purchased each year while exotic crops are passed on from grower to grower or seed is saved from one year to the next. Regarding the importance of variety name, again the results are not surprising since a much wider range of cultivars of traditional crops is commercially available and therefore the name is likely to influence choice, while exotic crops have fewer cultivar names and the names tend to be linked to a specific source or simply a general name for the crop that is known by the grower.

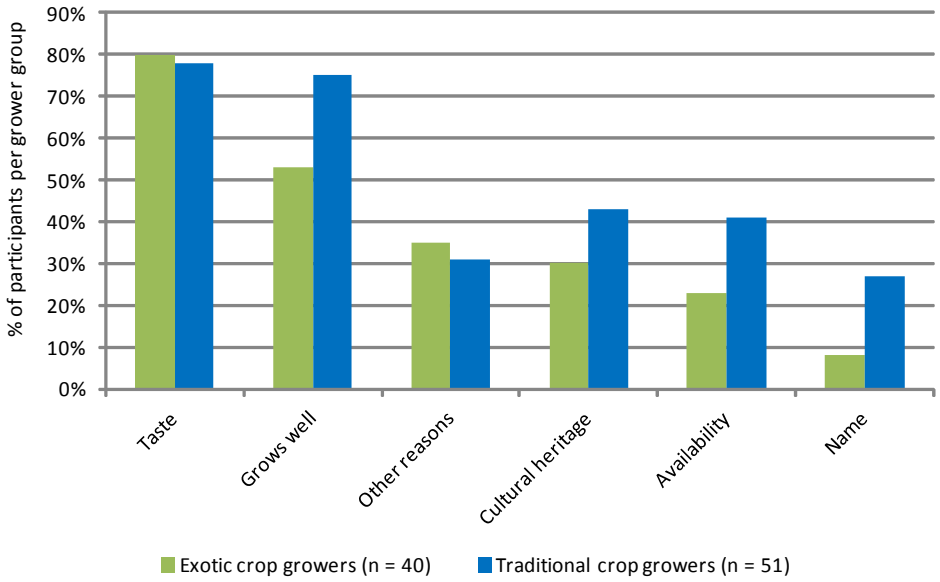


Figure 8. Reasons for choosing particular crop varieties, showing the percentages of participants in each of the two grower categories who selected each reason[19]

[19] This question was answered by 40 (80%) of the survey participants who grow exotic (and traditional) crops and 51 (89%) who only grow traditional crops.

Table 3 shows the other reasons given by the survey participants for choosing particular crop varieties. While there was no clear distinction between other general reasons for growing crops given by growers of exotic crops and those who only grow traditional crops, other reasons given for choice of varieties reveal some differences between the two groups. For example, participants who only grow traditional crops are concerned about using varieties that are adapted well to the region's climate and to local environmental conditions, cultivation of organic varieties, use of older varieties or those of sentimental value, as well as being influenced by seed catalogues, eating qualities other than taste, and cost; while exotic crop growers cited uniqueness, inheritance and pest resistance as important reasons. Familiarity, reputation and aesthetics influence the choice of varieties by both grower groups.

Table 3. Other reasons given by survey participants for choice of crop varieties (E = exotic crop growers; T = traditional crop growers only)

Reasons	E	T
Familiarity (being used to growing or eating the variety, or knowing the variety since an early age)	•	•
Reputation/recommendations from other growers/seeing varieties growing well on a neighbouring plot	•	•
Aesthetics (e.g., attractive foliage)	•	•
Exhibition qualities (e.g., size, consistency and uniformity)	•	•
Uniqueness (i.e., the variety is unusual or looks different)	•	
Inheritance from parents or siblings	•	
Pest resistance	•	
Eating qualities other than taste (e.g., texture of fruit)		•
Recommendations in seed catalogues		•
Adaptation to climate and specific local environmental conditions		•
Trial and error (if the variety grows well, will purchase it again the following year)		•
Preference for organic seeds		•
Preference for older varieties		•
Sentimental value (e.g., a variety grown by a parent)		•
Preference for British varieties/wary of growing varieties from abroad (potential for invasiveness)		•
Cost/special offers		•

Seed sources and continuity in crop cultivation

Survey participants were asked to provide information on the original source of the crops that they grow, whether they save and swap seeds, whether they grow the same varieties each year, the length of time they have been growing crops, and specifically for how long they have been growing them in their allotment plot(s). The origin of a crop provides an insight into whether it is an exotic taxon (a species, subspecies or botanical variety) or an exotic cultivar, and whether the individual population grown may potentially contain unique diversity. Greater diversity of crop resources (the number of different crop taxa grown, the number of different cultivars and variability between and within populations of cultivars) is important for the sustainability of our food resources and thus for food security. The uniformity of commercial cultivars has led to an overall reduction in crop diversity which renders them more vulnerable to failure in unexpected and extreme environmental conditions (e.g., drought

or flooding) or due to new strains of pests and diseases, and results in reduced cropping windows. Furthermore, a reduction in crop diversity means that the pool of genetic diversity available for use in crop improvement programmes is depleted. Therefore, there is a critical need for increasing crop diversity by encouraging the continued maintenance of as wide a range of crops and cultivars as possible, including those grown at allotment sites and in home and community gardens.

Figures 9a and 9b show the origin of the crops grown in the survey allotment plots. The percentages shown are the proportions of crop occurrences (or populations) and are based on 118 exotic crop occurrences and 2053 traditional crop occurrences. Not surprisingly, a higher percentage of exotic crop populations than traditional crop populations originate from self-saved propagation material (seed or cuttings) because these crops are generally not commercially available in the UK. Nonetheless, a significant percentage of exotic crop populations are also reported to have been bought, although they may have been bought overseas, from a grocery or from another grower. It is also notable that 21% of traditional crop populations originate from self-saved material, indicating that these (mostly commercially produced[20]) crops may be slowly diversifying in response to grower selection in a range of growing conditions (see further discussion on self-saved seed below). Of the total crops recorded in the survey (more than 170), 101 (>50%) were reported by participants to be sourced from self-saved material. It is also encouraging to see that seed is being sourced from plant/seed swap events, again enhancing crop diversity and knowledge sharing. Figure 9b shows that 3% of traditional crop populations are sourced from allotment schemes; however, these schemes do not provide growers with exotic crops (Fig. 9a), nor indeed exotic cultivars.

[20] Only 2% of populations of exotic cultivars of traditional crops are sourced from self-saved material.

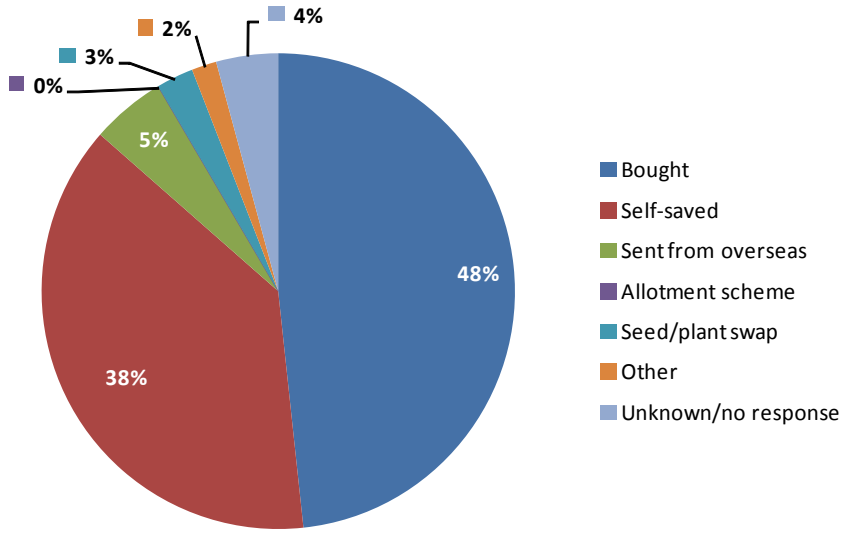


Figure 9a: Origins of exotic crop populations (n = 118)

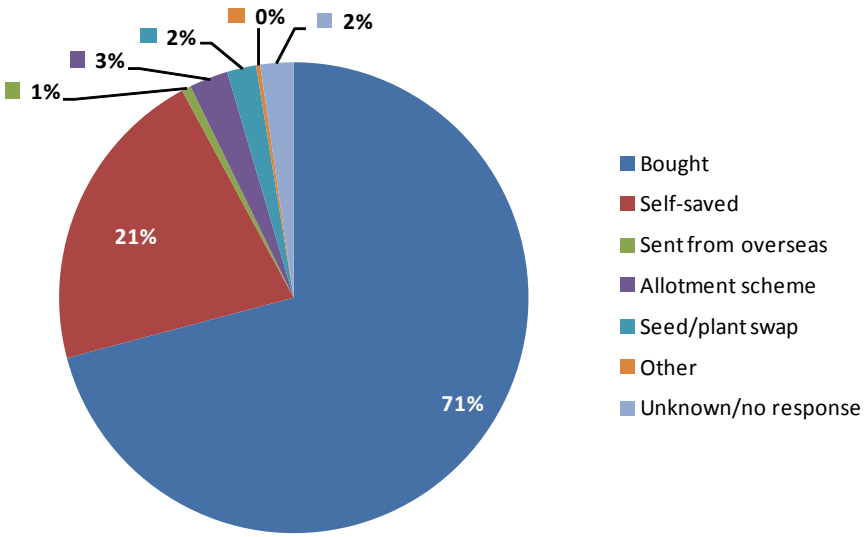


Figure 9b: Origins of traditional crop populations (n = 2053)

Figures 9a and b. Origins of propagation material of a) exotic and b) traditional crop populations reported by survey participants

Figures 10a - c (page 22) show the numbers of participants in each grower group who save their own seeds, swap seeds with other growers and would be willing to take place in organized seed swap events. The results are based on a total of 101 survey participants - 46 who grow both exotic and traditional crops and 55 who grow only traditional crops (six participants did not respond to any of the questions in this part of the survey).

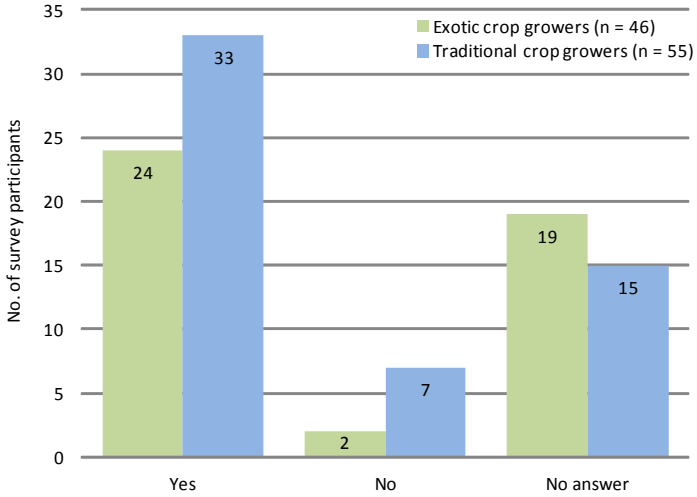


Figure 10a: Do survey participants save their own seed?

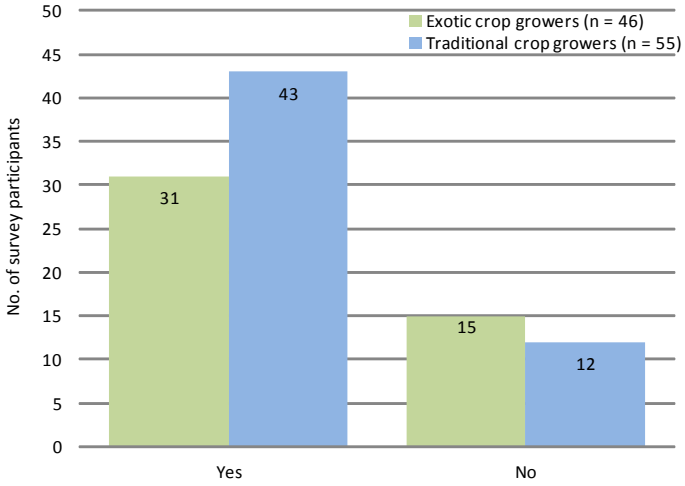


Figure 10b: Do survey participants swap seed?

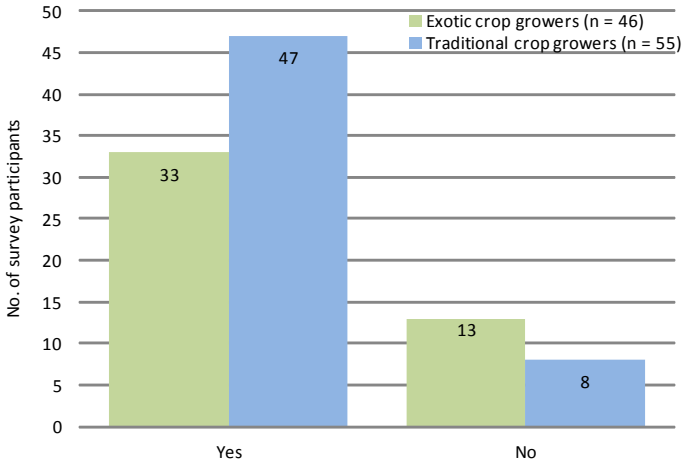


Figure 10c: Would survey participants take part in an organized swap seed swap event?

Figures 10a - c. Seed-saving and swapping by survey participants

It is extremely encouraging to find that a high percentage of participants (c. 56%) save seed from at least one or more of their crops for cultivation in the next growing season (Fig. 10a). As already noted, this indicates that many of the crops grown in the plots are well-suited to the sites. Also, the process of selecting, saving and replanting seeds from one season to the next encourages greater diversity within and between crop populations which makes the crop better adapted to local environmental conditions, less likely to fail due to adverse weather conditions or pest and disease attacks, and more likely to have a wider cropping window, thus avoiding gluts. Not only is this adaptation and diversity important for those people who benefit and may even depend on these crops for food security, but it is also potentially significant as a genetic resource for national food security through its use in crop improvement programmes. Some participants noted which crops they save seed from. Crops mentioned were pea (*Pisum sativum*), various beans (*Phaseolus vulgaris*), okra (*Abelmoschus esculentus*), marrow, pumpkin and squash (*Cucurbita* spp.), chayote (*Sechium edule*), cucumber (*Cucumis sativus*), calalloo (*Amaranthus* spp.), spinach (*Spinacia oleracea*), chard (*Beta vulgaris*), mustard (*Brassica juncea*), pak-choi (*B. rapa* subsp. *chinensis*), choi sum (*B. rapa* subsp. *chinensis* var. *parachinensis*), Chinese broccoli (*B. oleracea* var. *alboglabra*), chop suey greens (*Chrysanthemum coronarium*), lettuce (*Lactuca sativa*), chicory (*Cichorium intybus*), sweetcorn and white maize (*Zea mays*), pepper and chilli (*Capsicum annuum*), tomato (*Solanum lycopersicum*), shallot (*Allium cepa*), garlic (*A. sativum*) and parsley (*Petroselinum crispum*). Some participants also noted that they save their own potato tubers (*Solanum tuberosum*).

A high proportion of participants (c. 34%) did not answer the question about seed-saving. Some appeared to believe it was illegal as they had heard it was against the law to sell non-EU registered seed and thought this applied to seed swapping as well. Through the Sowing New Seeds project and other initiatives aimed at encouraging gardeners to grow their own crops, we hope that the practice of saving seeds will be encouraged and that growers with knowledge of saving seeds will be willing to teach these techniques to others to foster knowledge sharing, broaden crop diversity, improve crop sustainability, and ultimately, increase options for food security. Comparing the two groups of growers (i.e., those who grow exotic and traditional crops and those who only grow traditional crops) in terms of seed saving, a higher percentage of growers of only traditional crops currently save their own seeds (60% vs. 52%). However, these results will remain invalid until the reasons for the large number of participants who did not answer this question (41% of exotic crop growers and 27% of growers of traditional crops only) are investigated.

Figure 10b shows that as well as a significant proportion of survey participants saving their own seeds, the majority (c. 73%) swap seeds with other growers. Seed swapping is another way of increasing crop diversity—by passing seeds on to other growers, those populations will (if grown successfully) adapt to the new site in which they are grown. This adaptation may take a number of years and may be very gradual, but the inherent genetic diversity within the crop will slowly evolve in response to changing environmental conditions, particularly if the grower that has received the seeds, also saves and replants seeds from one season to the next and in turn shares them with other growers. Seed swapping also ensures that rare cultivars are more widely grown and therefore less likely to be lost, and furthermore engenders knowledge sharing, community spirit and trust which are important social aspects to support crop diversity and sustainability. There is however a caveat to seed-swapping. When a cultivar has become adapted to a particular environmental niche through many cycles of selection, seed saving and replanting, it contains unique genetic diversity that enables it to grow successfully at that location and which may be important as a resource for improving other crops (if samples can be collected and made available to the crop improvement community via seed banks). The introduction of new seeds of populations of the same crop or of closely related crops that can readily interbreed will lead to a change in the diversity inherent in the original crop population adapted to that site. On the whole, this should not be a major concern for growers of crops in allotment plots, community gardens or home gardens because the chances of new diversity negatively affecting the existing crop populations are relatively small, especially when introduced populations are from diverse material that has not been intensively bred to grow in a limited environmental niche and to produce uniform crops. However, from a conservationist's point of view, the diversity in one crop that could potentially be diluted or otherwise changed through unintentional interbreeding with other crops is an important genetic resource for food security. The two ways of tackling conservation of crops are *in situ* (i.e., where they are cultivated by the growers) and *ex situ* (in seed banks). This complementary approach to conserving plant genetic resources is expanded on in the next section. Having introduced this caveat, we should emphasize that there is nothing wrong with swapping seeds with other growers, and that on the whole the outcomes of seed-swapping are positive for the growers themselves and for crop diversity and sustainability.

Participants were also asked whether they would be willing to take part in organized seed swap events (Figure 10c). The response to this question was overwhelmingly positive, with around 79% of participants stating that they would be happy to take part in such events. It is also pleasing to note that of the 27 growers who stated that they do not currently swap seed, 14 said that they would be happy to take part in organized seed swap events. Comparing the two groups of growers (i.e., those who grow exotic and traditional crops and those who only grow traditional crops) in terms of seed swapping, higher percentages of participants who only grow traditional crops currently swap seeds (78% vs. 67% of exotic crop growers) and would be willing to take part in organized seed swap events (85% vs. 72% of exotic crop growers). However, it is not possible to draw any conclusions from these results without further investigation. Only 13 survey participants stated that they neither swap seed nor would wish to take part in an organized seed swap event—seven who grow exotic crops and six who grow only traditional crops.

Seed swaps make an important contribution to maintaning genetic diversity

The surveyors also asked plot-holders whether they grow the same varieties each year (Figure 11) and whether they have grown particular varieties in the past that are no longer available to them. The majority of participants (61%) stated that they grow a mixture of the same and some new varieties each year, 20% that they always grow the same varieties each year, and 15% that they grow different varieties each year. Four participants did not answer this question. While the cultivation of different varieties of a range of crops each year provides growers with a wide range of produce and choice in any particular year, in terms of increasing and sustaining crop diversity and food security in the long term, it is the cultivation of the same varieties over many years of selection and seed-saving that is important. We therefore need to know which growers are saving seed from the same crop varieties from one year to the next.

A more in-depth study of specific crops cultivated by plot-holders is required in order to ascertain exactly how many of the same crops and varieties are being grown over subsequent years. However, we do know from this study that of the 20 participants who always grow the same varieties each year, half save their own seeds (five who grow exotic and traditional crops and five who only grow traditional crops) which indicates that the crops they grow are becoming diversified in response to the specific environmental conditions of the sites, as well as to grower selection for desired characteristics. Furthermore, six of these seed-saving participants (two of whom grow exotic crops) also swap seeds with other growers—a further means of increasing and sustaining crop diversity. Seven of the remaining ten participants did not answer the question about seed-saving and three do not save seeds.

Thirty-nine (63%) of the 62 participants who grow a mixture of previously grown and new varieties each year also save their own seeds (12 of these plot-holders grow exotic crops) and of these, 33 also swap seeds with other growers—again, a very encouraging indication of increased diversification and sustainability of local food security. Of the remaining 23 plot-holders, 20 did not answer the question about seed-saving (nine of whom are exotic crop growers), and three growers (of only traditional crops) do not save seeds.

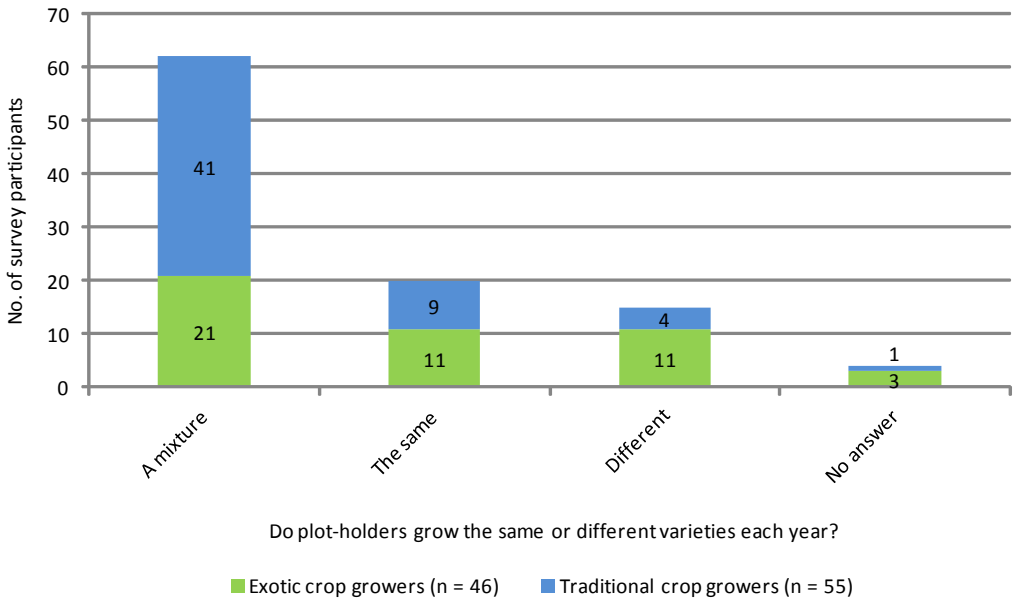


Figure 11. Choice of crop varieties from one year to the next

Fifty-five participants noted that there are no varieties that they have grown that are no longer available to them (20 of whom grow some exotic crops), 17 participants noted some varieties that they could no longer obtain, and the rest (29 participants) did not answer the question. Of the participants who said there are varieties that are no longer available to them, three cultivate exotic crops. One noted that in a wet year they had lost a bottle-shaped green and yellow pumpkin with a long neck which originated in Jamaica, another noted that an "old-fashioned" Brussels sprout variety which cropped for a long time is no longer available, and the third was unable to remember the variety names.

Figures 12a and b show how long the survey participants have been growing their own crops and how long they have been growing crops in their allotment plot(s). The results are based on a total of 105 survey participants—48 who grow both exotic and traditional crops and 57 who grow only traditional crops (two participants who grow exotic crops did not respond to these questions).

It is important to know about the length of time that growers have cultivated their crops because the longer a crop has been grown from self-saved seed in the same location, the more likely it is that it will have become adapted to the specific environmental conditions of that location, as well as to grower selection for desired characteristics. For example, populations of the same cultivar grown in one plot with free draining sandy soil and in another with heavy clay soil may be morphologically and/or genetically distinct due to a process of adaptation to the local environment. Many factors play a part in adaptation, including rainfall and light levels, exposure to wind, soil type and cultivation practices, as well as the biology of the crop species itself. When a grower saves seed from one year to the next, they select seed from the plants that have given the best performance that season. This process of artificial selection leads to diversification in crops and is important for crop sustainability and food security. Furthermore, this diversity may be valuable as a source of new genes for improving other food crops. Plant breeders are constantly seeking new sources of genetic variation and this may be found in locally adapted crops such as those cultivated by allotment plot-holders—particularly those that have been grown for many years from self-saved propagation material. As already noted, seed-swapping is another way of nurturing crop diversity—by sharing self-saved seed with other growers, the diversity within that specific crop population is less likely to be lost and the population may diversify further through adaptation to the niche conditions of other growers' plots.

A significant number of survey participants (c. 56%) have been growing crops for between 10 and 50 years and a handful for more than 50 years, showing that there is a wealth of expertise and knowledge within the allotment community (Fig. 11a). The larger number of people who grow traditional crops only and have cultivated crops for ten years or less may be indicative of a recent surge in interest in home-grown produce for the range of reasons shown in Figure 7. The small number of people who have been growing their own crops for more than 50 years flags up the need to ensure that any non-commercial crops grown by these individuals (particularly those that have been self-saved) are passed on to other growers for continued cultivation.

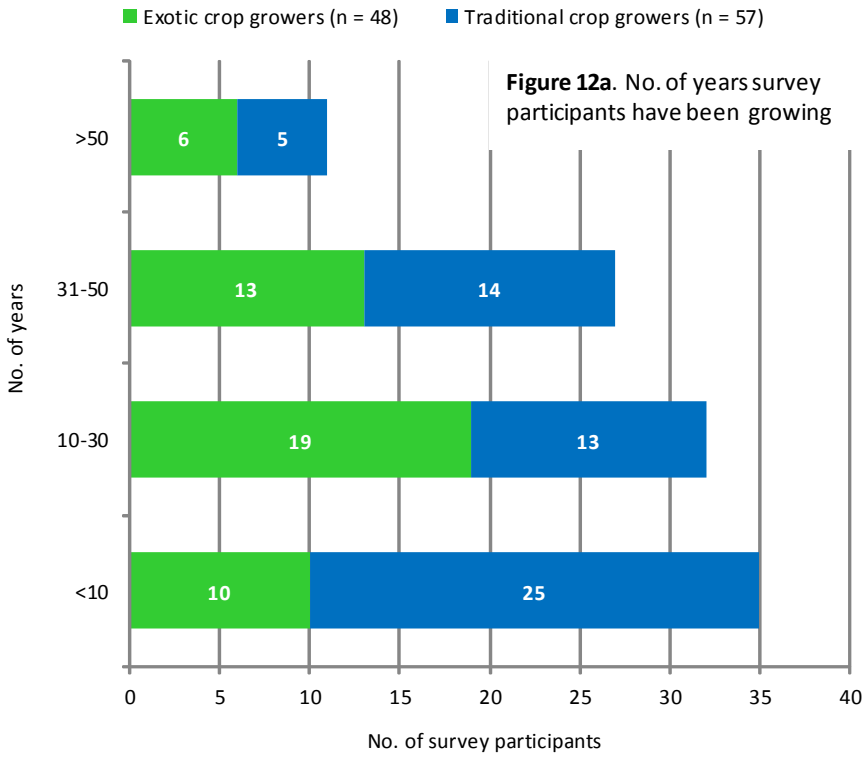
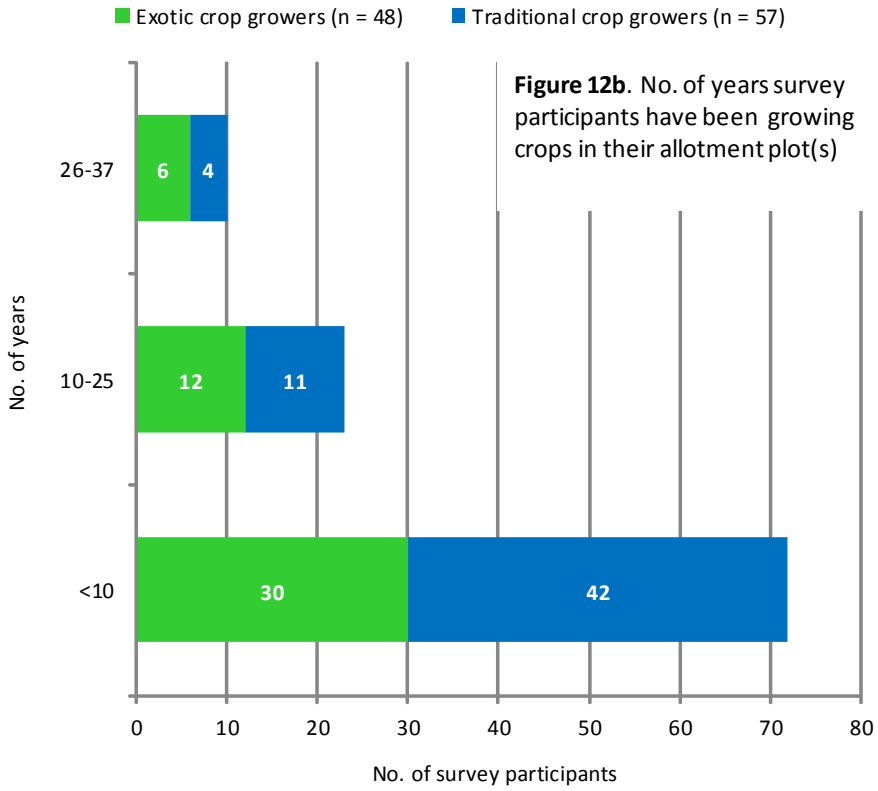


Figure 12a. No. of years survey participants have been growing



Figures 12a and b. The length of time survey participants have been growing crops and how many years they have been growing crops in their allotment plot(s).

Figure 12b shows that while many allotment plot-holders have been growing their own crops for many years, relatively few (c. 31%) have been growing them in the survey allotment plots for more than ten years and the maximum number of years they have been grown in these plots is 37. Critically, of the 33 participants who have grown crops in the same plots for over ten years, less than half (14) grow all or some of the same varieties each year and save their own seeds (six of whom grow some exotic crops). Again, the importance of ensuring that the non-commercial crops that have been grown in the same plots for more than 10 years (and particularly those that have been grown in the same plots for more than 25 years) are passed on to other growers when these plot-holders move on or give up cultivating their crops cannot be over-emphasized. This will be critical to sustain the full range of crops and the wealth of diversity that they contain for future use. Not only that, but along with the crops comes the vital knowledge of the grower; without that knowledge, continued cultivation of the crops may not be successful. It is however encouraging to see that a significant number of plot-holders (62) have started growing crops in their allotment plot(s) within the last ten years. Of these, more than half (11 growers of exotic and traditional crops and 24 who only grow traditional crops) grow all or some of the same varieties each year and save their own seeds. Let us hope that they continue to cultivate their plots for many years and that this is not just a short-term surge in interest in growing crops in allotments. The number of years that growers have cultivated their allotment plots may of course be affected by plot availability and occasionally by the loss of allotment sites altogether due to urban development. The long-term stability of allotment sites and long-term availability of plots to growers are vital to ensure the ongoing maintenance of the amazing breadth of crop genetic diversity and local knowledge that these unique pockets of land support.

Preserving diversity: characterization and conservation

Crops collected in the project

A key objective of the Sowing New Seeds project was to collect seeds/vegetative material of non-traditional crops and safeguard this material for future generations by incorporating it into the Heritage Seed Library at Garden Organic, as well as to promote their cultivation through the provision of seeds and information about these crops.

Seeds, tubers and cuttings from non-traditional crops were collected from January 2010 to August 2013. During this time, 305 samples were collected from six crop groups (Figure 13).

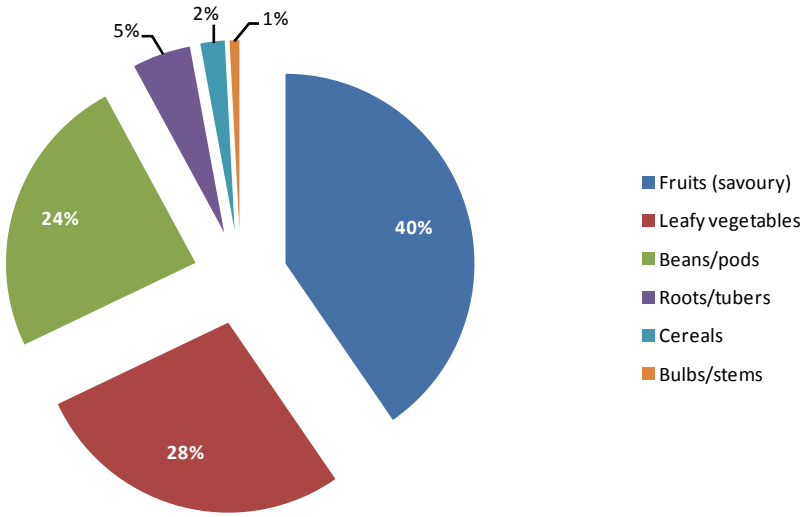


Figure 13. Percentages of samples from six crop groups collected in the Sowing New Seeds project

The most common types of crops collected were savoury fruits, leafy vegetables and beans/pods. The largest group was savoury fruits, representing 40% of accessions collected. At least two thirds of this group were cucurbit crops and the remainder were mainly solanaceous crops. The cucurbits presented perhaps the most interesting diversity of crops including: dudi (*Lagenaria siceraria*), a large gourd used throughout the Indian community, sharks fin melon (*Cucurbita ficifolia*) a squash used by the Chinese in soups, smooth luffa (*Luffa cylindrica*), karella or bitter gourd (*Momordica charantia*), chayote or cho cho (*Sechium edule*).

Leafy vegetables were abundant in the collection (28%). Half of these were amaranths (*Amaranthus* species) originating from Jamaica, Bangladesh, India, China and India. The Caribbean name, calalloo is the most common term for amaranths but there are many other names such as dugi, dhata and lalshank. Amaranths are particularly popular within the collection because it is very easy to save seed from them. The remainder of the leafy crops was dominated by leafy brassicas, including mustards (*Brassica juncea*) from Vietnam, China and India, and African kale (*Brassica oleracea var Acephala*) from Zimbabwe. The African kale is an interesting crop as it is grown as a perennial leafy crop and propagated from stem cuttings.

Beans and pods were the third major group representing 24% of the collection. Lablab (*Dolichos lablab*) beans from India, Bangladesh and China (under the names of sim, papri, valoor and liva) were popular. In common they all had slightly flattened, crescent shaped pods, with a characteristic rough-edged seam. There were also several forms of French beans (*Phaseolus vulgaris*) from Jamaican communities that use the beans in their dried state. These were often termed 'red peas' and used in the traditional dish of 'rice and peas'. There were many crops collected in other the categories. Roots and tubers included a yacon plant (*Smallanthus sonchifolius*) and oca (*Oxalis tuberosum*). The cereals included a variety of white maize found on an allotment in Birmingham that can flower in this country.

Given the large number of varieties collected, it was not possible to characterize every single crop donated to the collection. A selection of around 100 crops was cultivated and observational notes recorded. From these, 20 crops were selected and seeds multiplied for conservation in the Heritage Seed Library and inclusion in the HSL catalogue. The aim of this was to increase the scope of public access to multicultural varieties that can be grown in the UK climate. Within the larger collection, both home-saved and commercial seed was received. However, only seed that had been home- saved was included in the HSL catalogue.

Crop trials

In order to characterize the crops collected, trials were carried out in 2010 and 2011, following which seed was multiplied in 2012. During the trials, key dates of emergence, flowering and fruiting were recorded. Yields were recorded where possible, but in many cases this was not possible due to the limited initial quantities of seed received. In such cases, all of the plants grown had to be used for seed multiplication to ensure preservation of the seed stock, so yields could not be measured. Growing plants for seed multiplication has different aims to growing for yield and with most crops it is not possible to do both. A summary of key results from the crop trials is presented here, with a more detailed, crop by crop account given in the annex.

Calalloo grown for a crop trial

Leafy crops

Amaranth or calalloo (*Amaranthus* species) was a very popular crop amongst the collection, with 21 different types collected from Jamaica (two distinct types), China, Guyana, India (four distinct types), Vietnam, Nigeria and Bangladesh, as well as several other samples. Some of the best performing varieties were a large-leafed Jamaican variety collected from Don Howe in Nottingham and a scarlet red variety termed 'Bangladeshi dhata'. Most types would grow outside during the summer and could be sown directly any time after May. Flowering could occur any time from mid-July but had occurred in all varieties by mid-August. Most would attain a height of around 1.3 m by the end of the season.

Mustard leaves (*Brassica juncea*) were also a popular crop. Most were the Indian or Bangladeshi type with a rough, serrated, blue-green leaf that needed cooking. These were quite frost hardy and survived winters down to –5°C. This type of leaf is often termed 'saag'—a generic Indian name for 'leaf'—so can refer to other leafy crops such as spinach. The Vietnamese type was a paler green with smoother leaves that could be eaten raw or stir-fried. Early sowings made before June would flower within two months of sowing, but later sowings would be much more productive and often last well into the winter, withstanding milder frosts.

African kale (*Brassica oleracea*) was an interesting leaf crop that went under several names: 'chomolia', 'covo' or 'rugare'. All of the accessions collected came from Zimbabwe. The plants will grow for a long period without flowering, so can be treated as a short term perennial. Plants are very productive during this period, forming a plant 1.3 m high from which regular harvests can be taken. Chomolia took 18 months to flower, producing white flowers, whereas covo and rugare produced very few flowers. As the plants rarely produce seeds, the plants are

propagated using semi-ripe or heel cuttings. Cuttings take readily and are often put straight into the ground without rooting them in a pot first.

Savoury fruits

This group comprised mainly a range of interesting species of cucurbits. One of the most popular among Indian and Bangladeshi communities was the 'dudi' or 'kodu' (*Lagenaria siceraria*). This is a large green gourd that could be grown either outside in the summer or in a poly-tunnel. 'Tower Hamlets' was the earliest flowering variety, flowering by mid-July and setting fruits two weeks later. The plant is a vigorous climber with large lobed leaves and one plant will easily fill a 20 m poly-tunnel with foliage if left untamed. The plants are noted for their large white flowers which in their native countries of origin, are pollinated by moths[21]. In order to reliably save seed from this plant in the UK, the plant must be grown in a poly-tunnel and hand pollinated between 19:00 and 09:00 when the flowers are open.

Two varieties of sharks fin melon (*Cucurbita ficifolia*) were collected. This was an extremely vigorously growing cucurbit vine with a sprawling habit. Around 3–4 weeks after transplanting, it would send out long shoots that would easily grow at least 3 m long. Flowering and fruiting would occur from mid-August, with mature fruits ready in mid-September. Each plant typically produced at least four full-sized fruits producing a yield of 15 kg. Once mature, the fruits would store for a least a year.

Luffa is a popular crop which is sold young as 'turia' in Asian shops. There are two types: the angled luffa (*Luffa acutangula*) and the smooth luffa (*Luffa cylindrica*). Of the two, the smooth luffa grew more vigorously and cropped from the end of August onwards. If not harvested for food when immature, the mature luffas would weigh 1–2 kg each. The angled luffa was far less vigorous and had a tendency to produce only male flowers for most of the season.

Perhaps the most unusual of the cucurbits collected was the 'chayote' or 'chocho' (*Sechium edule*). This could not be collected as seed as the entire fruit has to be planted. Only the spiny variety will flower and produce in the UK. In 2012, a chayote obtained from parent material that had produced good yields in the UK over a number of generations was grown at Ryton Gardens. Perhaps owing to the poor weather and low light levels in 2012, this plant did not flower until September and fruit set was poor, only eventually resulting in one fruit. However, the following season had better growing conditions and the same plant produced eight fruits, each weighing around 500 g.

Legume crops

The two main legume crops grown for their beans were 'lablab' *(Dolichos lablab*) and 'yard long beans' (*Vigna sesquipedalis*). Fenugreek (*Trigonella foenum-graecum* and *Trigonella corniculata*) is also a legume cultivated for its leaf production.

A number of different types of lablab beans are consumed by the Indian community under the names of 'papri', 'liva' and 'valor'. Of the lablab beans that were characterized, three that performed particularly well were 'Yings Chinese lablab', 'dwarf papri' and 'Bangladeshi papri'. Yings, a vigorous climber, was very early to flower, yielding from the second week of July onwards and cropping until the first frost in October. It produced a flat, sickle-shaped pod with lime green colouring and pink margins, so could serve well both as an ornamental as well as an edible plant. The dwarf papri, as the name suggests, was low growing and upright in habit with white flowers and small curved flat pods. Bangladeshi papri, also climbing, was early to flower, cropping from mid-July to October, producing a smaller dark green pod.

Yard long beans are a hot crop often grown in the dry season in the tropics owing to their ability to tolerate low rainfall. Of the types grown, the commercial variety 'Kings Yard Long Green' grew the best, cropping favourably in 2010, 2012, and 2013, although the cold wet summer of 2011, it yielded nothing at all.

Fenugreek or 'methi' was grown extensively as a leaf crop throughout the Indian community. The most common type (*T. foenum-graecum*) was grown using seed from spice packets. This was fast growing, producing a crop within 6–8 weeks of sowing, but only producing a single cut. The other type (*T. corniculata*) was far less common and could be distinguished by having much smaller seeds, rounder leaves and yellow (rather than cream) flowers. It regenerates more rapidly after being cut than the common type and is often used for flavouring when half-dried, when it is stronger tasting.

Cereals

The most notable cereal crop included in the collection was white maize (*Zea mays*). This maize crop is far more dry and starchy than sweetcorn consumed in the UK and is ground to make porridge or roasted. As the fresh cobs do not store well, there is little scope for importing them; therefore, fresh white maize is not readily available in the UK. Many African and Caribbean people try to grow white maize in this country but find that it does not flower in the long days of the UK summer. However, a few varieties are not sensitive to day length and can be grown in the UK climate. One such variety was found on an allotment in Birmingham. It grew very tall, up to 2.5 m and first flowered at the end of July. Harvest was very late, with cobs not being ready until October. Although some cobs looked immature, when the time came to strip silks off, kernels were revealed to be full and fertile. They generally produced two or three cobs per plant.

Roots and tubers

Various roots and tubers were grown and characterized for interest, but as most of them were obtained from commercial sources, they were not included in the HSL collection.

Sweet potato (*Ipomoea batatas*) has recently become a popular crop to consume in the UK, but is challenging to grow in this country because plants require a longer growing season to mature than the frost-free period from May–September. It is a member of the Convolvulaceae family and closely resembles bindweed in appearance. Many growers find that leaf production is abundant with little tuber growth beneath. Four varieties of

[21] In the 3rd year of growing this crop at Ryton Gardens, a native moth, the Beautiful Golden Y, was noted visiting the flowers and some non-hand pollinated fruit contained seed.

sweet potato are now available commercially that were grown at Ryton Gardens: 'Beauregarde Improved', 'T65', 'O'Henry' and 'Georgia Jet'. Of these, Beauregarde Improved and O'Henry were found to be the best yielding and have the best flavour. Beauregarde Improved is a pink skinned variety with orange flesh whilst O'Henry is yellow skinned with white flesh. Keeping the soil warm seemed to be an important factor—one grower who had created a hot bed using horse manure produced very respectable yields.

Oca (*Oxalis tuberosum*) tubers were also cultivated and produced a dependable but small yield. This South American plant is closely related to the wood sorrel (*Oxalis acetosella*) but forms brightly coloured red, yellow and purple tubers with a lemony/nutty taste. The plants are very late to initiate tubers so needed to be left until late September or October before harvesting.

Yacon (*Smallanthus sonchifolius*) was a plant that attracted much interest. The tall sunflower-like plants generated a mass of swollen roots. These were harvested in late September and left to ripen, then consumed raw as a dessert. The flavour was described as "similar to a nutty pear". New plants were generated by dividing new suckers growing from the base of the plant.

Varieties of taro were also characterized. These were variants of the species *Colocasia esculenta* and are known under a number of different names, including: 'eddoe', 'cocoyam', 'dasheen' (Afro-Caribbean names) and 'arbi' or 'mukki' (Indian and Bangladeshi names). Most of these were obtained from Asian grocery shops and planted to obtain full sizes plants. As the species normally grows in the humid tropics, it can only be grown indoors. In this country it is mainly grown for the leaves, which the Indian communities use in a dish called 'patra'.

Next steps: *in situ* and *ex situ* conservation

There are two approaches to conserving biodiversity (including crop diversity)—*in situ* conservation, which is the maintenance of diversity in its native environment—which in the sense of crop conservation refers to the location in which a crop is cultivated—and *ex situ* conservation, which is the maintenance of diversity at a remote location away from its native environment. *In situ* conservation of crop diversity is the cultivation of crop varieties in locations where they are subjected to repeated cycles of selection, seed-saving and replanting. As already noted, over time these varieties will adapt to local environmental conditions and grower selection for desirable consumer traits (e.g., taste, colour, size, texture) and diversify due to the use of self-saved seed. Compared with modern, highly bred commercial cultivars, such crop populations are genetically diverse and important for food security due to their known success in particular locations, greater resistance to unexpected environmental conditions (e.g., drought, flood or extreme temperatures) and/or new strains of pests and diseases, longer harvesting season, and their potential to contribute to crop improvement programmes.

Ex situ conservation of crop diversity is the maintenance of crop varieties in special facilities known as gene banks. For most crops cultivated in the UK and other temperate climates, it is possible to store seed samples for long periods in a partially dried state, either for relatively short periods at room temperature or for many years at subzero temperatures. As long as the gene bank facility is well-managed, this *ex situ* conservation method means that samples of the crop diversity are safely conserved for future use, either directly as new plantings of the crop or indirectly in breeding programmes for crop improvement. From time to time, plant populations stored using this method have to be regenerated (i.e., seed is germinated and plants grown on to produce more seed) because seeds naturally lose viability over time and germination rates reduce.

Some crops cannot be stored in the form of seed samples, either because the seeds will not withstand drying and long-term storage at low temperatures or the species has to be clonally (i.e., vegetatively) propagated because viable seeds are difficult to produce, the seeds are sterile, or offspring are too genetically diverse. Many crops that come from tropical and subtropical regions fall into the category of so-called 'recalcitrant' seeded species because the seeds are fleshy, highly moist and accustomed to high temperatures. Examples include cocoa (*Theobroma cacao*), pawpaw (*Carica papayer*), avocado (*Persea americana*), coconut (*Cocos nucifera*) and mango (*Mangifera indica*). Most of the seeds collected in the Sowing New Seeds project were orthodox, but the chayote (*Sechium edule*) exhibited recalcitrant behaviour. This seed cannot be dried as it has to be stored within the fleshy fruit to remain viable. Crops that have to be clonally propagated include banana (*Musa* and *Ensete* spp.), cassava (*Manihot esculenta*), garlic (*Allium sativum*), pear (*Pyrus communis*), potato (*Solanum tuberosum*), sweet potato (*Ipomoea batatas*) and yam (*Dioscorea* spp.). These crops that cannot be conserved as seed samples and are conserved as whole plant populations in field gene banks (i.e., outside plots or glasshouses at gene bank facilities) or using *in vitro* techniques (i.e., as plantlets in sterile conditions in flasks).

In situ and *ex situ* conservation approaches should not be used in isolation but in a complementary manner. *In situ* conservation is essential to conserve the continuous process of adaptation and diversification in crops due to artificial selection by growers. However, populations of highly locally adapted crop varieties may be lost due to unexpected weather events or pest and disease attacks, as well as from competition from modern cultivars or the loss of the individuals who cultivate them. Without backup seed samples in *ex situ* facilities, this diversity may be lost altogether. At the same time, *ex situ* conservation of crop populations should not be relied on as the sole option because they are not subject to the artificial selection pressures of *in situ* maintained populations and therefore remain static in their genetic make-up. While the conservation of such samples of diversity is important to preserve as wide a range of diversity as possible and to facilitate access to samples for use in crop improvement programmes, *ex situ* conserved material may be subject to loss of viability, selection for unwanted characteristics in the field or greenhouse during ongoing maintenance or regeneration, or at worst losses due to accidents or unexpected disasters. Therefore, the two approaches are used in tandem to effectively and safely conserve maximum diversity.

In situ conservation of crop diversity is not only important to conserve the widest pool of diversity of genetic resources (i.e., the biological resources that humans rely on for survival) to ensure that this diversity is maintained for the general benefit of humankind, but is also the means by which the maintainers themselves obtain the various benefits of growing the crops, whether that is for basic nutrition, monetary return, cultural reasons or some form of life enrichment. This report has highlighted the importance of allotment plot-holders as maintainers, or conservators of both traditional and exotic crops. Many allotments sites have been established for several decades and there is a long-standing tradition of swapping and sharing seed amongst growers. Furthermore, the increase in uptake of allotments by the younger generation is positive for *in situ* crop conservation as the varieties grown by the older generation are more likely to be passed on to the next generation.

The promotion of (and increase in) locally adapted crop population maintenance *in situ* at allotment sites will therefore have many long-term benefits, both for the growers themselves and for future generations. Undoubtedly there is a continuous and overwhelming demand for allotment plots so there is no shortage of potential *in situ* conservators of crop diversity at allotment sites. As this report has shown, many allotment gardeners already save their own seed and cultivate the same varieties from one year to the next, and have been doing so for many years. The more growers who save and swap seeds—particularly of locally adapted varieties (whether traditional or exotic)—the greater the diversity available for future direct and indirect use, and ultimately for food security. However, the long-term security of allotment sites is also critical for crop diversity conservation. The loss of even one site may mean the loss of unique locally adapted genetic diversity and food insecurity for a proportion of the local population. Therefore, local councils have a duty of care to protect allotment sites from development for

the benefit of the local populous and more generally to conserve biological resources for the benefit of humankind.

There is a long history of the conservation of crop diversity *ex situ* and hundreds of plant gene banks exist worldwide in which millions upon millions of samples of crop populations are conserved, mainly in the form of seed samples, but also in field gene banks and *in vitro*. However, the full range of *in situ* conserved crop diversity is not represented in *ex situ* collections because i) it is practically impossible to identify and document the myriad of crop varieties in cultivation, and ii) even if this were possible, there are insufficient resources available to collect and maintain such a huge range of diversity in the *ex situ* facilities that are available. However, the UK's major seed banks are working together to obtain resources to continue to develop an inventory of the nation's non-commercial crop diversity, including diversity maintained in allotment plots. It is clear that the cultivation of exotic crops and exotic varieties is important to a large proportion of the UK's population. Not only that but this diversity is an important component of the nation's cultural heritage and biological resources base. Exotic crops and varieties should therefore be included in any future collection and *ex situ* conservation endeavours.

Garden Organic's Heritage Seed Library

Garden Organic's HSL is one of the UK's most important seed bank facilities and only one of a handful of seed banks globally that is maintained by the NGO sector. Its speciality in the conservation of rare and/or unusual crop varieties that are not commercially available is a vital part of the UK's genetic resources conservation efforts. With the inception of the Sowing New Seeds project, Garden Organic has provided an opportunity for exploring and researching the diversity of exotic crops in one region of the UK, as well as a platform for sharing knowledge of, educating people about, and promoting the importance of these crops, both for our heritage and for food security. A range of crop samples collected under the umbrella of this project have been safely stored in the HSL and some material propagated and grown on for the purposes of identification and characterization (i.e., the process of scientific naming and recording of the crop's characters), as well as to provide details of cultivation requirements for the benefit of those who wish to grow them in the future. The HSL and its Seed Guardians (volunteer growers who are responsible for maintaining specific varieties) will be important for the *ex situ* conservation of exotic crops as they have been for many years for the conservation of traditional crops. However, it must be emphasized that *ex situ* conservation should be viewed as backup for *in situ* crop maintenance and not as an alternative.

The benefits of non-traditional crops now and in the future

Self-grown crops and food security

The importance of self-grown food crops (both exotic and traditional) for food security has already been highlighted in parts of this report. While the focus has been on crops grown at allotment sites, some of the same benefits of self-grown crops in allotment plots also apply to those grown in home and community gardens. In particular, crops that are grown from self-saved seed over a number of years will provide the greatest return to growers and to society in general. Repeated cycles of selection, seed-saving and cultivation over a number of years in a particular locality will result in a crop becoming acclimatized and adapted to local environmental conditions and over time it will gradually become more distinct from the original crop that was first introduced. These changes may visually appear to be very subtle but in terms of genetic makeup of the species they might be substantial. At a time when we are facing the potentially devastating impacts of climate change on food production, the diversity of such crops is likely to be ever more important as a buffer against crop failures and ultimately as insurance against food insecurity. A further consideration is that they are generally grown in low input, sustainable cultivation systems; therefore, there are both environmental and cost benefits associated with their cultivation.

The grower benefits of small-scale cultivation of food crops are multi-fold. Growers benefit from reduced living costs (as they have to buy less from food outlets), the ability to save their own seed (cutting out the cost of buying fresh seed for each new growing season), the option to choose which cultivation methods to use (in particular, the option to grow organically), and the ability to select seed from plants that exhibit the characteristics that are of interest to them for culinary use. There is also likely to be less wastage as growers can harvest produce according to demand. For those growers cultivating crops year on year from self-saved seeds, they benefit from the security of knowing that the crops are less likely to fail in adverse weather conditions or due to pest and disease attacks, and a reduction in gluts due to a wider cropping window. Unemployment, poverty, food inflation, currency devaluations[xxxvii] and an acute skills shortage in the horticultural industry[xxxviii] have been identified as threats to food security in the UK. Partial self-sufficiency through self- or community-grown food crops is essential to help mitigate these threats.

Local adaptation in crops through the process of selection, seed-saving and replanting from one season to the next is not only important to sustain a productive crop for the growers' own use, but is also of interest to plant breeders as a source of genetic variation to improve existing crop varieties. Modern commercial crop varieties are bred to be very uniform so they are not only susceptible to pests, diseases and adverse weather conditions, but they will not provide a wide pool of genetic variation for future breeding and crop improvement. Thus, the ongoing cultivation of self-grown locally adapted crops has the dual role of contributing to local food security and potentially to global food security as well.

Socio-economic benefits of non-traditional crops

The advantages of self-grown crops highlighted in the previous section are applicable whether small-scale growers cultivate traditional or non-traditional (exotic) food crops. However, there are some additional factors related to the cultivation of exotic crops that have important socio-economic benefits. The cultivation of non-traditional crops in the UK is integral to and has an important role in supporting cultural diversity. Many exotic crops that have arrived in the UK in recent years have been brought here by the immigrant population and these foods are a critical component of their cultural identity and way of life. Growers of exotic crops may have cultivated the crop overseas before moving to the UK or the crops may have been grown by their ancestors. In addition to being able to eat a cuisine that they are accustomed to, these growers also benefit from the security of being familiar with the cultivation requirements of the crop. Less dependence on speciality produce bought from food outlets means that non-indigenous ethnic groups are more independent and self-sufficient, giving them a greater sense of security within UK society.

The increased diversity that the cultivation of exotic crops brings to the UK provides greater options for all our diets and nutritional needs, as well as for commercial growers and farmers to diversify and to reap the economic benefits. In particular, growers interested in small-scale commercial production or simply in some *ad hoc* local sales of produce may benefit from a crop that is unique and could attract a niche market. Furthermore, the broadening of the UK's food genetic resources may also be valuable as a source of new diversity for use in plant breeding programmes for crop improvement and thus for wider food security beyond that of local consumers.

A further benefit is to human health and wellbeing, both through the nutrition provided by exotic crops and through the exercise and general sense of well-being gained through their cultivation. Many minority ethnic communities are reported to have worse health than the white British, the worst affected groups being Bangladeshi, Pakistani and Black Caribbean[xxxix]. Further, health is reported to be worse for those born in the UK than first generation migrants. These health problems are attributed to a number of reasons including adapting to a western lifestyle and diet. Therefore, there is the need to promote the cultivation and consumption of fresh produce within these cultural groups with all the benefits this brings (outdoors in green space, exercise, increased consumption of fresh produce). Growing crops familiar to them is more likely to increase participation in such activities. Furthermore, many of the exotic crops cultivated in the UK have specific health benefits that have been recognized for many years but are in danger of being lost. For example, fenugreek can stabilize blood sugar levels in type 2 diabetics[xl].

Many non traditional crops such as fenugreek have health benefits

What is the future for non-traditional crops in the UK?

As highlighted in the introduction to this report, most of the UK's food crops have been brought into cultivation, domesticated and developed in other regions of the world. The introduction of new food crops has intensified in recent years along with an increase in non-indigenous ethnic groups settling in the UK, combined with the curiosity of many UK nationals in trying new types of cuisine and an interest in a more varied diet. As shown in this report, there is an amazing wealth of exotic crop diversity being cultivated on a local scale in allotments in the Midlands and undoubtedly this will be reflected in other areas of the UK as well, particularly in ethnically diverse areas. While these exotic crops are strongly associated with the ethnic origins of the growers, results of the Sowing New Seeds allotment survey have shown that their cultivation is not restricted to minority groups and has spread from one ethnic group to another such is the interest amongst growers in trying something new.

It is difficult to predict what the future is for non-traditional crops in the UK but while it is likely that we have reached a peak in the introduction of different crop taxa, exotic crop varieties will undoubtedly continue to be introduced from overseas. What will be interesting is to monitor trends in the wider commercial cultivation of exotic crops in the UK. Their successful cultivation in UK soil will lead to less dependence on importing produce from overseas, a reduction in our carbon footprint[22], and the availability of fresher produce. While the UK produces a large proportion of vegetables consumed by the nation (55% in 2007[xli]), we have a strong dependence on two other countries (Spain and the Netherlands) for our supply of fresh vegetables. Any major crop failures in the UK and/or these major import countries could render the UK vulnerable to a food shortage and an increase in the cost of some staple elements of our diet. The situation regarding fruit crops is probably less critical since the UK produces a very small proportion of that consumed by the nation (7% in 2007[xlii]) and we source fresh fruits from a wider range of countries than we do fresh vegetables. Nonetheless, greater use of our national capacity for producing a broad range of vegetables and fruits (including exotic species and varieties) is likely to improve food security and bring benefits for the national economy, the environment and consumers.

Further, what will our changing climate bring? We are already experiencing some extreme and unusual weather events and patterns, including colder or wetter winters, hotter or wetter summers, as well as some severe flooding and extended periods of drought. These changing climatic conditions have not only caused injury, death and destruction but they have had a lasting impact on farmers and on the agricultural sector in general. Will exotic crops provide a partial solution to these problems? Perhaps in 50 or 100 years time there will be crops that can be widely cultivated in the UK that are currently not suitable to grow in our climate.

What is certain is that the trend in 'growing your own' will remain strong in the coming years and may possibly even increase. Particularly in the current economic climate, people are looking for ways of cutting their expenditure through sheer necessity if not for future financial security. Gardening is always said to be the second most popular hobby in the UK. The enjoyment and satisfaction we gain from growing our own food crops cannot be matched by any other activity and there will always be keen growers who wish to try out something new.

[22] Only if the environmental impacts of inputs are less than those of importing the same crops.

Conclusions and recommendations

The introduction of exotic food plant species or varieties to the UK has been a continual process over centuries but has accelerated in the last 50 years in conjunction with Britain becoming a more multicultural society. Today, non-traditional crops are frequently grown in home gardens, allotments and community gardens and their cultivation is often intimately linked with the ethnic origins of the growers. Some non-traditional crops have entered into commerce, reflecting not only the cosmopolitan nature of the UK population, but also a general and widespread interest in a diverse range of food genres.

The Sowing New Seeds project has documented and characterized many of the non-traditional crops cultivated on allotments in the Midlands and the results of this work have revealed a substantial and previously undocumented crop diversity resource. Many of the home-saved seed accessions collected in the project proved to be well adapted to UK conditions and represent an important source of genetic material. Efforts should be made to conserve these accessions, both *in situ* and *ex situ*. The HSL and its Seed Guardians will be important for the *ex situ* conservation of exotic crops as they have been for many years for the conservation of traditional crops. However, these should be duplicated in other UK gene banks to ensure their safety.

Many of the exotic crops and varieties cultivated successfully in the UK are likely to be those that have been subjected to multiple rounds of selection and seed saving over a number of years, enabling them to acclimatize to our temperate climate. As a consequence, they are often maintained by the older generation and unless people are willing or given the opportunity to become a guardian of these crops and the associated varieties, they are under threat of extinction once the original maintainer dies. Furthermore, along with the extinction of the crop and varieties, there is a critical loss of experience and knowledge.

To ensure the continued *in situ* conservation of these crops, maintainers should be encouraged and supported to continue to cultivate them and save their seed. Passing crops on to other growers will not only increase the security of their conservation, it will maintain a wide range of crop diversity that is adapted to local environmental conditions and to the growers' own preferences. The Sowing New Seeds project has revealed that seed saving is already practiced extensively by allotment-holders in the Midlands. However, while seed swap events and networks already exist there is capacity to hold more of these events.

In situ conservation of crop diversity is not only important to conserve the diversity of genetic resources, but is also the means by which the maintainers themselves obtain the multitude of benefits of growing the crops, whether for nutrition and health, monetary return, cultural reasons, general well-being or some other form of life enrichment. The promotion of (and increase in) locally adapted crop population maintenance *in situ* at allotment sites will therefore have many long-term benefits, both for the growers themselves and for future generations.

This report has highlighted the importance of allotment plot-holders as conservators of both traditional and exotic crops. Many allotments sites have been established for several decades and there is a long-standing tradition of swapping and sharing seed amongst growers. Furthermore, the increase in uptake of allotments by the younger generation is positive for *in situ* crop conservation as the varieties grown by the older generation are more likely to be passed on to the next generation. Therefore, the long-term security of allotment sites is vital. The loss of even one site may mean the loss of unique locally adapted genetic diversity and food insecurity for a proportion of the local population. Therefore, local councils have a duty of care to protect allotment sites from development for the benefit of the local populous and more generally to conserve biological resources for the benefit of humankind.

We hope that this report and the activities of the Sowing New Seeds project have provided an incentive for growers and non-growers alike to try cultivating some exotic crops, saving their own seed and thus making a valuable contribution to the UK's food genetic resources base and ultimately to food security. Importantly, these exotic crops are inherently linked with cultural diversity and are therefore a vital part of the UK's multicultural society and heritage—a constituent that must be nurtured and protected for the benefit of future generations.

References

[i] Morton, F.J. (1987) Kiwifruit. In: Morton, F.J., *Fruits of Warm Climates*. Miami, Florida. Pp. 293–300. Available online: www.hort.purdue.edu/newcrop/morton/index.html [Accessed 16 February 2014]

[ii] Thirsk, J. (1997) *Alternative Agriculture: A History from the Black Death to the Present Day.* Oxford University Press. 371 pp.

[iii] Hockridge (no date) *Farm Local; Eat Global • Growing Exotic Vegetables in the UK: A Potential Vehicle for Utilizing an Underdeveloped Market and Promoting Agriculture in the UK.* Nuffield Farming Scholarships Trust. The 2006 Bob Matson Young Award. Available online: www.nuffieldinternational.org/rep_pdf/1255360825Emma_Hockridge_Nuffield_Report.pdf [Accessed 27 June 2013]

[iv] Perez-Vazquez, A., Anderson, S. and Rogers, A.W. (2005) Assessing benefits from allotments as a component of urban agriculture in England. In: Mougeot, L.J.A. (ed.), *Agropolis: the Social, Political and Environmental Dimensions of Urban Agriculture*. Earthscan, IDRC. Pp. 240•263.

[v] Purdue, D.A. (2000) Backyard biodiversity: seed tribes in the west of England. *Science as Culture* 9(2), 141•166.

[vi] Huxley, R. (2003) *A Review of the UK Food Market*. Cornwall Agricultural Council and Cornwall Taste of the West. Available online: www.objectiveone.com/ob1/pdfs/uk_food_market_review.pdf [Accessed 27 June 2013]

[vii] Jupe, S. (2013) *Vegetable Yearbook and Buyers Guide 2013*. ACT Publishing, Kent, UK. Available online: www.actpub.co.uk/year-books/ [Accessed 24 February 2014]

[viii] Lindgreen, A. and Hingley, M.K. (2009) *The New Cultures of Food: Marketing Opportunities from Ethnic, Religious and Cultural Diversity.* Gower Publishing Ltd.

[ix] Hockridge (no date) *Farm Local; Eat Global • Growing Exotic Vegetables in the UK: A Potential Vehicle for Utilizing an Underdeveloped Market and Promoting Agriculture in the UK.* Nuffield Farming Scholarships Trust. The 2006 Bob Matson Young Award. Available online: www.nuffieldinternational.org/rep_pdf/1255360825Emma_Hockridge_Nuffield_Report.pdf [Accessed 27 June 2013]

[x] Hockridge (no date) *Farm Local; Eat Global • Growing Exotic Vegetables in the UK: A Potential Vehicle for Utilizing an Underdeveloped Market and Promoting Agriculture in the UK.* Nuffield Farming Scholarships Trust. The 2006 Bob Matson Young Award. Available online: www.nuffieldinternational.org/rep_pdf/1255360825Emma_Hockridge_Nuffield_Report.pdf [Accessed 27 June 2013]

[xi] Mintel (2002) Exotic Fruit and Vegetables – UK May 2002

[xii] Huxley, R. (2003) A review of the UK food market. Cornwall Agricultural Council and Cornwall Taste of the West. Available online: www.objectiveone.com/ob1/pdfs/uk_food_market_review.pdf [Accessed 27 June 2013]

[xiii] Church, S., Gilbert, P. and Khokhar, S. (2005) *Synthesis Report No 3: Ethnic Groups and Foods in Europe*. EuroFir

[xiv] Huxley, R. (2003) A review of the UK food market. Cornwall Agricultural Council and Cornwall Taste of the West. Available online: www.objectiveone.com/ob1/pdfs/uk_food_market_review.pdf [Accessed 27 June 2013]

[xv] Morgan, K. and Morely, A. (2002) *Relocalizing the Food Chain: the Role of Creative Procurement*. Available online: http://orgprints.org/

[xvi] Maracchi, G., Sirotenko, O. and Bindi, M. (2005) Impacts of present and future climate variability on agriculture and forestry in the temperate regions: Europe. In: Salinger, J., Sivakumar, M.V.K. and Motha, R.P., *Increasing Climate Variability and Change: Reducing the Vulnerability of Agriculture and Forestry*. Springer, The Netherlands. Pp. 117-135

[xvii] Van der Veken, S., Hermy, M., Vellend, M., Knapen, A. and Verheyen, K. (2008) Garden plants get a head start on climate change. *Frontiers in Ecology and the Environment* 6, 212–216.

[xviii] NSALG (2013) *The National Allotment Society* [Online]. National Society of Allotment and Leisure Gardeners Ltd. www.nsalg.org.uk/ [Accessed 27 June 2013]

[xix] NSALG (2013) NSALG (2013) *The National Allotment Society* [Online]. National Society of Allotment and Leisure Gardeners Ltd. www.nsalg.org.uk/ [Accessed 27 June 2013]

[xx] NSALG (2013) NSALG (2013) *The National Allotment Society* [Online]. National Society of Allotment and Leisure Gardeners Ltd. www.nsalg.org.uk/ [Accessed 27 June 2013]

[xxi] Way, T. (2008) *Allotments*. Shire Publications Ltd.

[xxii] DCLG (2007) *Allotments: A Plotholder's Guide* • New edition. Allotments Regenerative Initiative Available online: http://ari.farmgarden.org.uk/documents/Other_ARI_publications/plotholdersguide.pdf [Accessed 27 June 2013]

[xxiii] Crouch, D. (1997) *English Allotments Survey: Report of the Joint Survey of Allotments in England*. National Society of Allotment and Leisure Gardeners and Anglia Polytechnic University.

[xxiv] Campbell, M. and Campbell, I. (2011) *Allotment Waiting Lists in England 2011.* Transition Town West Kirby in conjunction with the National Society of Allotment and Leisure Gardeners. Available online at: www.transitiontownwestkirby.org.uk/files/ttwk_nsalg_survey_2011.pdf [Accessed 1st April 2013]

[xxv] Pretty, J. (2002) *Agri-Culture: Reconnecting People, Land and Nature*. Earthscan, London.

[xxvi] Birmingham City Council (no date) *Allotments* [Online]. www.birmingham.gov.uk/greenfingers [Accessed 01 April 2013]

[xxvii] Birmingham City Council (2006) *Birmingham Parks and Open Spaces Strategy.*

[xxviii] Stagg (pers. comm.) cited in Dobbie, S.L. (2010) *Sowing New Seeds: a Vegetable Survey of Birmingham Allotments*. M.Sc. Thesis, University of Birmingham.

[xxix] Coleman, G. (2010) *Allotments Boost for Birmingham* [Online]. http://birminghamnewsroom.com/?p=10918 [Accessed 27 June 2013]

[xxx] Communities and Local Government (2010) *Sustainable Communities Act 2007: Report of the Discussion Panel Held on 21 January 2010.* Communities and Local Government Publications.

[xxxi] ONS (2012) *2011 Census, Key Statistics for Local Authorities in England and Wales.* Available online: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-286262 [Accessed 01 April 2013]

[xxxii] Hope, N. and Ellis, V. (2009) *Can You Dig It? Meeting Community Demand for Allotments*. New Local Government Network. Available online: www.nlgn.org.uk/public/wp-content/uploads/can-you-dig-it.pdf [Accessed 27 June 2013]

[xxxiii] Birmingham City Council (2006) *Birmingham Parks and Open Spaces Strategy.*

[xxxiv] BEN (2005) *Ethnic Communities and Green Spaces: Guidance for Green Space Managers*. Black Environmental Network Publications.

[xxxv] PGDS (2012) Stoney Road Allotments, Coventry, England. *Parks & Gardens UK* [Online]. Parks and Gardens Data Services Ltd. www.parksandgardens.org/places-and-people/site/4260/history [Accessed 01 May 2014]

[xxxvi] STAA (no date) *St. Ann's Allotments* [Online]. STAA Ltd. www.staa-allotments.org.uk/heritage/history.htm [Accessed 01 May 2014]

[xxxvii] Defra (2010) *UK Food Security Assessment: Detailed Analysis*. Department for Food, Environment and Rural Affairs. Available online: http://archive.defra.gov.uk/foodfarm/food/pdf/food-assess100105.pdf [Accessed 27 June 2013]

[xxxviii] RHS (no date) *Horticulture Matters. The growing crisis in UK horticulture that is threatening our economy, environment and food security.* Royal Horticultural Society and partners. Available online: www.rhs.org.uk/Media/PDFs/News/1016-RHS-Hort-Careers-Brochure-AW-low-res-spreads [Accessed 24 February 2014]

[xxxix] Department of Health (2010) *Healthy Lives, Healthy People: Our strategy for public health in England.* , HM Government. Available online: www.gov.uk/government/publications/the-public-health-white-paper-2010 [Accessed 24 February 2014]

[xl] **Kassaian, N.**, **Azadbakht, L.**, **Forghani, B.** and **Amini, M.** (2009) Effect of fenugreek seeds on blood glucose and lipid profiles in type 2 diabetic patients. *International Journal for Vitamin and Nutrition Research* 79(1), 34–9. doi: 10.1024/0300-9831.79.1.34.

[xli] Defra (2010) *UK Food Security Assessment: Detailed Analysis*. Department for Food, Environment and Rural Affairs. Available online: http://archive.defra.gov.uk/foodfarm/food/pdf/food-assess100105.pdf [Accessed 27 June 2013]

[xlii] Defra (2010) *UK Food Security Assessment: Detailed Analysis*. Department for Food, Environment and Rural Affairs. Available online: http://archive.defra.gov.uk/foodfarm/food/pdf/food-assess100105.pdf [Accessed 27 June 2013]