



Minor crops: An alternative for the UK fruit industry?

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Disclaimer

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Introduction and Background

I trained as an Agronomist at the University of León (Spain). During my degree, I thoroughly enjoyed all fruit related topics. I also became fascinated by genetics and the advantages of using molecular techniques for crop improvement as tools for marker-assisted selection as well as genetic modification. As an undergraduate, I spent a year at the University of Bologna (Italy) studying plant breeding and oenology and acquired some laboratory experience on maize molecular genetics. In January 2001, I came to the UK on a graduate training scheme to work at Rothamsted Research for three months. During this period I met Ben, my partner, and got a job at East Malling Research (EMR); both have kept me in the UK for longer than originally envisaged!

The establishment of the East Malling and Wye Fruit Experimental Station in Kent in 1913 was driven by local fruit growers. Since then the institute has carried out horticultural research under several funding arrangements and names. As part of HRI (1990 – 2004), we were sponsored by Defra as a Non-Departmental Public Body but, since this arrangement was dissolved, East Malling Research (EMR) has been a company limited by guarantee and a registered charity. We operate as an independent provider of top-class research, development and consultancy, and continue to serve the food chain and various sectors of the land-based industry. Our professional and scientific team cover a wide range of expertise including breeding and molecular genetics, pest and disease biology and management, crop and post-harvest physiology, agronomy, environmental science, food product development and consumer research.

In 2003, after two years working as an apple molecular geneticist, I became increasingly involved in the raspberry breeding programme. This involvement has brought me back to the field and to dealing with plants as a whole rather than studying only their DNA. It has also connected me in a more direct manner with the concerns and realities faced by UK fruit growers. I hope to continue breeding raspberries at East Malling Research for a long time; however the future is far from certain. Funding for horticultural research in the UK has been declining for over two decades and will continue to do so as Defra's research priorities shift from sustainable production systems to the development of economic stewardship of the countryside. The changes in the horticultural sector in general and in fruit growing in particular have been and will continue to be swift. Diversification has become important both to the industry at large and unavoidable to EMR which leads me to the background of my study.

When I started my study in 2006, the top-fruit industry in the UK had seen better times. The orchard area had declined from approximately 35,000 to 15,000ha in 20 years^[1]. Whilst demand has remained at similar levels, fruit imports have increased substantially; non-EU imports almost doubled between 1995 and 2005^[1]. The heavy reliance on a small number of cultivars is partly to blame; 'Cox', 'Bramley' and 'Conference' still amount to thirty seven percent of the total apple and pear growing area, sixty four percent if we exclude cider and perry orchards^[1]. Cost of production, especially labour, has become the most crucial factor in competing with overseas product, as farm-gate value of the product has barely increased since 1985^[1]. Southern hemisphere producers have a clear advantage as they produce with lower costs but they have also invested in modern orchards, new cultivars and promotion of their product. UK growers have not kept up as a whole and the industry has suffered as a consequence. Obviously, there are exceptions and the successful promotion campaign of the 'Bramley' apple is one of them.

In the last couple of years, we have seen some signs of recovery. The revival in cider and perry drinking has driven the specialist orchard area up by twenty one percent^[1]. Growing demand for locally produced fruit has paired up with retailers' will to show 'greener' credentials to increase the shelf space given to UK apples and pears. Other

hopeful signs are the increase of intensive orchards and cultivar diversification; the orchard area dedicated to 'Braeburn' has increased by forty percent since 2004^[1] (9,000t harvested in 2007) and new premium dessert apples such as 'Jazz', 'Cameo' and 'Kanzi' are gaining ground (Shamash 2007). Research investment, however, is at an all-time low: UK top-fruit growers have done better recently but they should consider their long-term investment strategies carefully if the sector is to fully recover.

The soft-fruit sector is at a very different stage in its development. Although the area dedicated to berries decreased from 15,000 to 9,000ha from 1985 to 2005, the value of the crop more than doubled during the same period^[1]. In the last 10 years, the UK soft-fruit growers have embraced change. They have adopted new cultivars, localised fertigation and protected cropping to extend the season and to improve quality and shelf-life of their product.

British Summer Fruits (BSF), which represents 90 of the UK berry growers, leads a very successful PR campaign that together with healthy eating messages and the 'superfood' phenomenon has materialised in an unprecedented increase in demand. Off-season imports have helped maintain year-round product availability and, perhaps counterintuitively, driven demand for UK product. Despite the poor weather in 2007, the British soft fruit sector grew eleven percent in retail sales to a total of 59,000t worth £282 million. I do not need to give numbers; anybody shopping in UK supermarkets in the last five years knows that berries are here to stay. However, the sector faces a number of challenges in the years to come including commoditization, diminishing profit margins and regulatory constraints.

Strawberries are nowadays a commodity. Sales continue to increase (twelve percent in 2007, according to BSF) but at a slower rate than other berries. Their market penetration is relatively high but saturation is a real possibility in the peak of the UK season, especially if the weather is bad. **Raspberries** still have great scope for increase with less than thirty seven percent of consumers buying them and purchase frequency under twice a month in 2006, according to Nicholas Marston (KG growers). However, the marked production peak in early July still needs to be addressed; those planting main-season cultivars might not see a good return for their investment. **Blueberries** are a prime example of just how quickly a product can lose 'niche' value. They went from little-known delicacy to buy-one-get-one-free in less than 18 months, even before UK production had a chance to 'get off the ground'.

The most important challenge for the berry industry is to preserve profit margins in the face of increasing costs that no longer result in price inflation mainly due to fierce inter-retailer competition. Availability and cost of labour - currently it can be as high as sixty percent of total cost of production – will continue to be crucial.

Other constraints for the development of the sector could be water availability and planning restraints on polytunnels; the wet summer of 2007 demonstrated how essential they are for UK production. On the positive side, the emergence of 'premium lines' in most retailers allows certain growers to maintain 'niche' value for their fruit.

The UK stone-fruit sector is comparatively small with financial results varying greatly from year-to-year depending mostly on weather conditions. Plums are still the main crop and the renewed interest in UK grown cherries could be successfully exploited by planting late-fruiting cultivars to extend the currently very short season. Small plantings of other stone fruits such as apricots seem to be increasing slowly (first commercial crop in 2007) but few data are available.

Against this complex background, the original aim of my Nuffield study was to identify the most promising minor or novel crop for the UK fruit grower. On a more personal level, my aim was to gather information to help position EMR's interests and research capability consequently.

Originally, I was looking for the 'new blueberry' and in the last two years, blackberries have established themselves as 'such'. According to BSF data (Barnet 2007), Blackberry sales increased forty four percent last year reaching a record value of £6m. This value, compared to the £60m of raspberry and £216m of strawberry sales, illustrates how low the initial market was but also what a great potential this crops has, as I will discuss later on. However, the industry was aware of this opportunity back in 2006 which left me to reconsider the aims of the study. I realised that a single opportunity would not be enough either for the industry or for EMR. Whether diversification is an alternative for individual growers or just another distraction from their main business is for each grower to decide. It will depend on their business structure and aspirations. However, diversification for the industry as a whole is a real opportunity; for EMR it is a necessity.

This report highlights the minor or novel crops which, I believe, have commercial potential for UK growers and relevance for my employer.

Destinations and methodology

Nuffield has given me the opportunity to visit research institutes, fruit growers and universities around the UK and the US (North Carolina, Arkansas, California, Oregon, Washington State and New York). It took me from cool, wet British Columbia (Canada) to Novi Sad, in Serbia, during one of the hottest and driest summers on record. It has also meant that people with very interesting information, passing through the UK, have found time to visit me and share that knowledge with me. As importantly, it has given me a different perspective when visiting nurseries, farm shops or farmer's markets or doing my weekly shopping. I have been looking for the commercial formulae that allow 'niche' markets to be successful as much as I have been looking for the products to fill these 'niches'.

The first step of my research was to gather ideas from my colleagues at EMR through a 'brainstorming' session. The result was a long list of possible fruit crops of interest with some front-runners. During my travels I encountered many of these fruits and some others and I came back with my personal favourites. I have attempted to classify these crops giving them a score that reflects their relevance for the UK industry, in my opinion. This score is a combination of environmental adaptation to UK conditions and ease of growing (suitability) and commercial potential (opportunity), as illustrated in Table 1. Whilst the first parameter is reasonably objective, the second one is not. I am sure different people would give different scores. Moreover, although this report highlights some of the most 'relevant crops', it deals with them in an uneven manner, depending on the data available to me as well as my personal preferences.

Table 1. Matrix for the assignment of 'relevance scores' to novel and minor crops.

		Opportunity		
		High	Medium	Low
Suitability	Good	1	2	3
	Acceptable	2	3	4
	Marginal	3	4	5

I have not aimed to produce a botanical treatise or an agronomy guide as that information is readily accessible through the internet. I have mentioned, where appropriate, if a fruit is reported to have benefits beyond those conferred by a varied healthy diet. However, I have purposely avoided comparing chemical compositions as the data available from different sources could have been obtained differently. Whilst common sense, anecdotal evidence and a growing body of scientific research supports the health benefits of eating fruit, little is known about the bioavailability and effects of many of the most 'popular' compounds such as anthocyanins and polyphenols.

The substantial increase in fruit consumption as a result of '5-a-day' and similar campaigns has not been matched by the vegetable sector. I believe the main reasons for that are convenience and flavour. Although many consumers will try a product for its perceived health benefits alone, repeated purchase is driven by product satisfaction. As far as fruit is concerned, consumer satisfaction after purchase is much more to do with texture, aroma and shelf-life than with vitamin or polyphenol content. So, without negating any health benefits or their potential as a marketing tool, I have not taken them into consideration when rating the crops in this report.

Table 2. Minor and novel fruit crops of potential interest to UK growers, their uses and suitability score.

Family Binomial name	Common Name(s)	Uses [*]	Brief description and/or comments	Relevance score [†]
Actinidiaceae				
<i>Actinidia arguta</i>	Hardy Kiwi, Kiwi- berry, Kiwai	F	Dioecious vines, grape size green berry.	1
Adoxaceae				
<i>Sambucus</i> spp	Elderberry, elderflower	P	Deciduous shrub or tree. Some traditional medicinal use in Europe and North America.	3
Annonaceae				
<i>Asimina triloba</i>	Common Paw- Paw	F/P	Temperate tree native to North America. Fruit is a large exotically-flavoured berry.	1-2
Cactaceae				
<i>Opuntia</i> spp	Prickly pear, Opuntia, Nopal	F/P/N	Some of these cactus species grow well in temperate conditions. Fruits must be peeled very carefully to avoid the ingestion of spines. Some reported medicinal uses.	3-4
Caprifoliaceae				
<i>Lonicera caerulea</i>	Haskap, Edible Honeysuckle, Honeyberry	F/P	Deciduous shrub. Very early season. Fruit resembles blueberry but very different flavour, almost zesty. Derived traditional products reach high prices in Japan.	2
Cornaceae				
<i>Cornus mas</i>	Cornelian cherry	P	Temperate-Mediterranean deciduous shrub or small tree. Added ornamental value. Produces small red berries that are very astringent when under-ripe. Derived traditional products reach high prices in the Balkans.	3
Ebenaceae				
<i>Diospyros kaki</i>	Persimmon, Sharon fruit	F	Deciduous tree, sufficient winter hardiness for UK although it will fruit properly only in hot summers; might increase interest in the future. Already sold in the UK.	4
Elaeagnaceae				
<i>Hippophae rhamnoides</i>	Sea buckthorn, Sea berry	P/N	Dioecious shrub or small tree. Used in Chinese medicine. Problematic harvesting.	2

Table 2 (continuation)

Family Binomial name	Common Name(s)	Uses *	Brief description and/or comments	Relevance score [†]
Ericaceae				
<i>Vaccinium</i> spp	Blueberries	F/P	Encompasses several cultivated species. Tremendous demand increase in last 5 years. Although restricted to acidic soils or containers, UK production continues to grow. It could be restricted by high volumes produced at lower cost within the EU.	1-2
Other <i>Vaccinium</i> spp	Cranberry, Bilberry, Lingonberry Huckleberry	F/P	Similar in requirements to blueberries. Limited demand that is unlikely to grow substantially. They are more interesting as nursery plants as they combine ornamental and edible attributes. Trehane (2004) is a good reference for those interested in this botanical family.	4
Grossulariaceae				
<i>Ribes</i> spp and hybrids	Blackcurrant, Redcurrant, Gooseberry, Jostaberry	F/P	Deciduous shrubs generally well adapted to UK conditions, except cultivars with very high chilling requirements. Many traditional derived products could be promoted. Some hybrids (Jostaberries) are palatable fresh and USDA repository at Corvallis is considering naming a couple of promising ones.	3
Lythraceae				
<i>Punica granatum</i>	Pomegranate	F/P/N	Best suited to hot climates where it is produced at low cost; good shelf-life.	4-5
Moraceae				
<i>Ficus carica</i>	Fig	F/P	Mediterranean tree, potential for picking closer to maturity and improve flavour. New cultivars (eg 'Violetta') are fairly well suited to UK and will crop more reliably	3-4
<i>Morus nigra</i> , <i>M. alba</i> , <i>M. rubra</i>	Black, White and Red Mulberries	P	Well adapted trees/shrubs with a very long juvenile period. Very labour intensive to harvest and process.	4
Rosaceae				
<i>Amelanchier</i> spp	Saskatoon, Juneberry	F/P	Tree or large bush. Fruit resemble a blueberry. Very winter hardy. Derived traditional products reach high prices in areas of Canada.	3
<i>Aronia melanocarpa</i>	Aronia, Chokeberry	P	Tree or large bush. It can be grown as a hedge for mechanical harvest. Interesting as a natural colorant for juices, smoothies and dairy products. Large plantings in Eastern Europe and US, could trade as a commodity very quickly.	4
<i>Chaenomeles japonica</i>	Japanese quince	P/F	Ornamental tree or bush. The fruit of some cultivars is pleasantly 'lemon-flavoured'.	4
<i>Cydonia oblonga</i>	Quince	P/F	Traditional crop ready for a revival.	2-3
<i>Mespilus germanica</i>	Medlar	P/F	Traditional crop ready for a revival.	2-3
<i>Prunus armeniaca</i>	Apricot	F/P	Mediterranean tree, potential for picking closer to maturity and improve flavour.	3-4

Table 2 (continuation)

Family Binomial name	Common Name(s)	Uses *	Brief description and/or comments	Relevance score [†]
<i>Prunus maritima</i>	Beach plum	P	Deciduous shrub or small tree native to US Eastern coastal regions. Similar to damson and Kea plum. Derived traditional products reach high prices in the US.	3
<i>Prunus persica</i>	Peach/Nectarine	F/P	Mediterranean tree, potential for picking closer to maturity and improve flavour.	3-4
<i>Pyrus pyrifolia</i> and <i>P. bretschneideri</i>	Asian pear, Nashi & Chinese white pear	F/P	Cultivation is similar to that of the European pear. Very good texture but usually bland. The hybridise with European pear opening opportunities for breeding more aromatics cultivars.	3
<i>Rubus occidentalis</i> , <i>R. leucodermis</i>	Blackcap, Black raspberry	F/P/N	Deciduous trailing shrub, black round fruits very similar to red raspberries.	2
<i>Rubus</i> spp	Blackberries	F/P	Deciduous shrub, black round fruits; unlike raspberries they retain the receptacle when picked.	1
Other <i>Rubus</i> spp and hybrids	Boysenberry, Tayberry, Loganberry, Cloudberry, etc	F/P	In general, very aromatic with unique flavours. Most will grow well in UK conditions but shelf-life is normally poor. Interesting for small processing operations or PYO.	3
Solanaceae				
<i>Lycium barbarum</i>	Wolfberry, Goji berry	P/N	Deciduous shrub, small orange-red berries.	2
<i>Physalis peruviana</i>	Physalis, Cape gooseberry, Ground-cherry	F/P	Perennial plant in tropical conditions. It can be grown as an annual crop outdoors in UK. Grape-sized golden berry in dry husk.	2
Vitaceae				
<i>Vitis vinifera</i>	Wine grapes	P	Dioecious or hermaphrodite vines. Great potential but climatic adaptation not optimum yet. Trialling and testing new cultivars (e.g. 'Albariño', 'Treixadura', or 'Godello' from Northern Spain) could improve quality and diversify offer.	2

* Common uses of the fruit: Fresh consumption (F), Processing (P) and/or Potential Nutraceutical interest (N). Characters in bold denote the use of most commercial interest.

[†] As per Table 1.

Findings

All crops taken into consideration for this report are summarised in Table 2. I have organised my findings into two main sections. The first part deals with novel or minor crops for the UK: some detail is given about the five crops I believe to have the most promise, namely blackberry, black raspberry, hardy kiwi, paw-paw and haskap. Other crops are also briefly discussed. The second part of this section deals with three crops (beach plum, cornelian cherry and saskatoon) that could be grown in the UK but that I find more interesting as examples of successful marketing of traditional product and the opportunities this suggests to me.

Novel Crops:

Blackberry (*Rubus fruticosus*, *R. ursinus*, *R. argutus* and hybrids)

Blackberries are hardly a novel crop; they have been harvested from the wild across Europe and the Americas for hundreds if not thousands of years. Early breeding efforts concentrated in increasing fruit size and yield but the poor flavour of many of these cultivars has limited the expansion of the crop. However, three factors have come together to change this situation: the availability of improved cultivars, the 'superfoods' boom and, for the future, the introduction of primocane fruiting cultivars.

- Several breeding programmes have developed and continue to work on cultivars with much better flavour; those remembering the 'aromas' of wild blackberries need not despair.
- The interest in 'superfoods', that has benefited all berries, has increased consumer demand for blackberries by about three hundred percent in three years according to Adrian Wallbridge (The Summerfruit Company).
- The advent of primocane fruiting cultivars has not yet affected the market but could have a tremendous impact in the next 10 to 15 years. Traditional cultivars fruit on the previous year's cane, as do main season raspberries. The introduction in breeding programmes of germplasm that fruits later in the season on the tips of the same year canes (in the same way that autumn fruiting raspberries do) offers enormous possibilities for season extension and manipulation. At the moment, primocane cultivars (Prime-Jim™ & Prime-Jan™) have been released only to the US amateur market, but we can expect commercial ones to become available in the UK in next few years.

Whilst in the US, I visited three world-leading *Rubus* breeding programmes: at University of Arkansas, Driscolls (California) and the USDA's Northwest Center for Small Fruit Research (Oregon). All three reported an increased interest in blackberries, all three have exciting new cultivars either released and/or in the pipeline.

Several cultivars developed by Prof. John Clark at University of Arkansas ('Arapahoe', 'Navaho', 'Apache' and 'Ouachita') are now available to UK growers and they represent a significant improvement on the flavour of cultivars such as 'Loch Ness' and 'Chester'. However, the most exciting blackberry flavours I came across are those concocted by Dr Chad Finn in Oregon. His breeding programme revolves around the trailing western blackberry (*R. ursinus*) and cultivars such as 'Kotata', 'Black Pearl', 'Obsidian' and 'Black Diamond' are the result. 'Black Diamond' and several of his advanced selections such as ORUS1523-4 (to be named soon) and ORUS1793-1 are a joy to eat and I hope they will be available in the UK in future.



Figure 1. Blackberry 'Obsidian'



Figure 2. Blackberry selection 'ORUS1793-1' USDA breeding programme in Oregon (USA)

Black Raspberry (*Rubus leucodermis* and *R. occidentalis*)

This shrub bears many similarities to its close relative the red raspberry (*R. idaeus*) but the shoots are spinier than those of most red raspberry cultivars, they have a tendency towards trailing habit and do not usually sucker. The fruit is round, black and relatively small (up to 2.5g). They can be quite seedy but their low acidity and very aromatic, 'wild' flavour make them a great eating experience.

Black raspberries have the potential to be highly profitable both for processing and for the fresh market in the UK. Most of the US production is mechanically harvested in Oregon for processing with small volumes of fresh berries from other areas going to local or high-value markets such as New York City. They are a high value crop with a farm gate value up to \$12,000 per acre in peak production seasons. However, establishment costs are high and it can take over two years to recover the capital investment (Weber 2006). Plantation life will vary greatly depending on pest and disease status. Productivity is considerably lower than that of the red raspberry partly due to pest susceptibility, although that might not be the case in the UK where different aphid species colonise raspberries.

Black raspberries are well known for their high content of anthocyanins (natural pigments used as dyes and antioxidants) as well as ellagic acid. There is a great deal of interest in the potential nutraceutical uses of this fruit. Ongoing research at Ohio State University using black raspberry extracts to determine the benefit for cancer treatment in mammalian test systems has lead to the first clinical trials on patients with digestive tract cancer with encouraging preliminary results (Wagner 2001).

After years of obscurity, research on this crop seems to be recovering at Cornell University (NY) and USDA-Corvallis where wild black raspberry germplasm is being collected, characterised and incorporated into the breeding programmes. Breeding efforts concentrate on improving pest and disease tolerance and increasing fruit size as well as producing spine-free and primocane fruiting types. We can expect improved cultivars to be released in the next 5 to 10 years. Current cultivars include 'Munger', 'Jewel', 'New Logan' and 'Mac Black'. I was pleasantly surprised by this fruit when I first tried it in Oregon and, by the time I got to Cornell (NY), I was a convert.



Figure 3. Black raspberry 'Munger'.

The main restraints for the UK grower would be the lack of easily available plant material^[2] and the high susceptibility to *Verticillium* wilt but neither is insurmountable. Plant imports from the US are difficult to arrange but not impossible moreover some cultivars can be obtained from EU nurseries and introduced under plant passport regulations. The easiest way to avoid soil pathogens would be to grow them in pots. Alternatively, finding inoculum-free soils can be difficult (*Verticillium* is a persistent pathogen with many hosts) but pre-planting soil treatments with chloropicrin are reasonably effective.

Hardy Kiwi (*Actinidia arguta*)

This plant is a close relative of the standard ‘fuzzy’ kiwi (*A. deliciosa*) and the rarer golden kiwi (*A. chinensis*) and its cultivation in the UK should not present major difficulties as it thrives in the milder areas of the Pacific Northwest (PNW) of the US and British Columbia (Moulton 2006). The fruits are oval with a smooth brownish or reddish green skin and green flesh. They are the size of a large cherry (5-12g) and are eaten with the skin on. They are sweet and aromatic; the flavour resembles that of the golden kiwi and many prefer it to the standard green ones. They are grown much like standard ‘fuzzy’ kiwis and the vines tolerate low winter temperatures (down to -25°C) without damage.

The vines are vigorous and require intensive pruning and training in trellises to obtain optimum yields around 23t/ha^[3]. Male pollinators such as ‘Meader’ are also required. In Canada and the PNW, hardy kiwi is fairly susceptible to soil pathogens such as *Verticillium* but otherwise remains pest and disease free during the growing season^[3] and I would expect the same to be true in the UK making them interesting for organic production. Establishment costs in Canada are about \$15,000 per ha and it is estimated that the recovery of this investment occurs after two harvests^[3]. The fruit should be picked while hard (soluble solids should be around eight percent) and put in cold storage. They can be ripened either in storage or on the market shelf (Moulton 2006).

The most commonly grown cultivar, ‘Ananasnaya’ (Anna), is very productive and tends to be harvested in early to mid September in the PNW although fruit would not reach full maturity until mid October. Earlier-ripening cultivars are needed for the fruit to be consumed without storage. Other high yielding cultivars include ‘Dumbarton Oaks’ and ‘Geneva’. The self-pollinating cultivar ‘Issai’ is highly rated for its superior flavour but fruits are small. ‘Michigan’ with large (up to 12g) elongated fruits is a promising addition but more yield data are needed^[3].

This is one of the most promising of the novel crops in this report. Market response in Canada has been good and premium prices have been paid by wholesalers and grocery stores^[3].



Figure 4. Hardy kiwi ‘Ananasnaya’

It was retailed for the first time by Waitrose in 2007 and I hope to see it again in 2008. Plants are available from several suppliers^[2] in the UK as well as Holland. EMR is in the process of establishing a 0.2 ha plot and I would expect to see some commercial size plantings across the country in the next few years.

Paw-Paw (*Asimina triloba*)

This deciduous tree is also known as Papaw, Poor Man's Banana or Hoosier Banana and should not be confused with the tropical papaya (*Carica papaya*) sometimes also known as pawpaw. The common paw-paw is native to the temperate woodlands of the Eastern US and thrives in a humid continental climate. It prefers neutral or acid soils, requires a minimum of 400 hours of winter chill to break buds and around 160 frost-free days for the fruit to reach maturity^[4] although this varies between cultivars. Paw-paws have been reported to be sensitive to low humidities, dry winds and cool maritime summers. However they have been successfully grown in parts of California and the Pacific Northwest^[4] and can be found in some UK gardens. They are winter hardy and can be grown on their own roots or, preferably, grafted on seedlings.

The paw-paw is the largest edible fruit native to America^[4] and the only temperate member of the Custard Apple family (Annonaceae), which includes many tropical and subtropical fruits such as guanabanas, cherimoyas, sugar apples and atemoyas. The paw-paw bears a striking similarity in sweetness, aroma, consistency and flavour to these fruits^[5]. Individual fruits are oval or elongated, measure 7-15cm in length and weigh between 140 and 400g. They are normally produced in clusters of 3 or 4 fruits.

The ripe fruits have melting yellow flesh and thin skin with many large dark seeds in the middle. At their best, paw-paws have a complex, tropical flavour completely surprising in a temperate fruit. Once ripe, they are perishable at room temperature (2-3 days) but can be kept much longer if refrigerated.

Paw-paw trees are mostly free of pest and disease in their natural habitat and could be of interest for organic production in the US and elsewhere. Cultivation in commercial orchards is just beginning in the US as gourmet fruit markets and restaurants expand the demand. Although many people enjoy this fruit, allergic reactions have been reported.

In addition to the promotion of a novel product, the main constraints for commercial cultivation in the UK would be the length of the season and pollination problems. Trials would be needed to identify the cultivars best suited to UK conditions. Pollination issues could be more problematic. Paw-paws require cross-pollination: although the flowers are perfect, male and female parts mature at different time; moreover they are self-incompatible so a different cultivar is needed for pollination. Unfortunately, bees are not very interested in these flowers and other insects do not appear to be very efficient in natural or garden conditions so some research might be needed in this area. Cultivars of interest include 'Overlesse' (excellent flavour, large fruited and moderately early) and 'Sunflower' (self-fertile but with smaller fruit and later season) as well as 'Prolific', 'Mitchell', 'Sweet Alice' and 'Taylor'.

The fruit could be marketed for fresh sales and, possibly, as a flavouring in juices and dairy products^[6]. I think it could have great potential in the UK as a source of low food-miles exotic flavour. Plant material is available in some UK^[2] and EU nurseries.



Figure 5. Paw-paw 'Sunflower'. Image courtesy of Mr. Clive Simms

Haskap (*Lonicera caerulea*)

Also known as Blue Honeysuckle or Edible Honeysuckle, Haskaps are one of the many species of the honeysuckle family. They have been widely harvested in regions of China and northern Eurasia from ancient times. They are the base of many traditional delicacies in Hokkaido (northern island of the Japanese archipelago) where wild-growing plants provided one of the few fruits available to the Aniu people. They appreciated their taste and also recognized their high nutritional value. In 1967, the Japanese began a programme to domesticate this fruit^[7].

Haskap belongs in the subspecies *L. caerulea* ssp. *emphylocalyx*. Russian scientists have developed many cultivars mainly from the Russian subspp. *edulis* and *kamtschatica*, which are well adapted to the severely cold regions of Russia, but not to more moderate climates. A few of these are currently being marketed in North America as "honeyberries" and should not be confused with the superior genotypes originated from Japanese germplasm^[8].

Prof. Maxine Thompson introduced Japanese selections to the US in 2000 and she is responsible for an outstanding breeding programme in Corvallis that is an inspiration to any under-funded plant breeder. More recently, breeding work is also carried out by Dr Bob Bors at the University of Saskatchewan in Canada.

Haskap plants are long-lived, deciduous shrubs that grow to about 1.8-2m high. They resemble high-bush blueberries in growth habit and size. They are winter-hardy and very early blooming (March to early April in Oregon) and the flower can withstand light to

medium frost without damage. Plants are self-incompatible so it is necessary to plant two different cultivars for cross-pollination, generally carried out by bumble bees^[7].

Fruits mature very early, before or at the same time as early strawberry cultivars. Most cultivars and selections ripen in May and early June. When I visited Prof. Thompson, in the 3rd week of June 2007, we harvested her latest selection. Although for the fresh market multiple harvests would be needed, on some bushes the first fruits to mature remain on the bush until all others are ripe enough; this could allow a single mechanical harvest^[7]. Moreover, the berries shake very easily from the bush making them ideal for that process^[8] and blackcurrant or raspberry harvesting machines could be used.

Fruits are similar to blueberries in colour and size although they tend to be more elongated, varying from oval or oblong to cylindrical, with seeds that are small and not noticeable. Fruit size ranges from 0.5 - 2.0g and texture varies greatly between cultivars; some selections are firm enough to be stored for 2 weeks^[7].

The appearance of bush and berry are misleading when it comes to flavour. They are more acidic than blueberries and their aroma is much more intense making them ideal for processing. Some selections are very pleasant to eat fresh. I was astounded by the 'wildness' of flavour in these little berries and intrigued by the possibilities offered by such an early season. It appears reasonably free of disease whilst birds are the biggest pest.

To my knowledge, UK suppliers only provide material from the Russian types^[2]. However, some of the seedlings from Prof. Thompson's breeding programme are currently being grown in the UK and EMR is likely to introduce some more next year. Watch this space!



Figure 6. Late ripening Haskap selection (USDA – Corvallis)

Other crops of interest:Sea-buckthorn (*Hippophae rhamnoides*)

Also known as sandthorn or seaberry, this deciduous spiny shrub or small tree is widely spread across China, Russia, Finland, Central Asia, Pakistan and India and has been introduced to western Europe and North America.

The fruit are yellow or orange berries rich in vitamins C and E, carotenoids, polyphenols and essential amino-acids. The oils and other fruit extracts have been used in traditional Chinese medicine for centuries. Its wide adaptation, fast growth and strong nitrogen-fixing properties make it a good choice for marginal areas where it can have a beneficial effect on wildlife.

A natural sea buckthorn habitat can yield from 750 to 1,500kg/ha of berries, shelterbelt plantings 4-5t/ha and orchards up to 12t/ha (Ahah pers. comm.). It is winter hardy and vigorous and grows easily in coastal areas of the UK. It can also be spotted growing densely in the roadsides of Crawley (West Sussex).

Many products derived from the sea buckthorn berries are commercialised in Germany such as liquors, jellies and jams and even cosmetics. However, it is the well reported medicinal properties of the oils and plant extracts (Zeb 2004, 2006, Wang 2006) that could make this crop worth harvesting, currently an extremely labour intensive and arduous task. Special mechanical harvesters were developed in East Germany (Gilbert et al 2003) that remove and feed entire branches into the machine where the fruit is 'shaken' off the woody stem, but they have not been used elsewhere to my knowledge.

Several UK suppliers stock a range of cultivars^[2].

Cape Gooseberry (*Physalis peruviana*)

This fruit, lately ubiquitous in buffet lunches and fashionable desserts, is a member of the Solanaceae and therefore distantly related to tomatoes, peppers and the nightshades. Other species of physalis are grown as ornamentals in many countries or fought as invasive weeds.

All the fruit currently sold in the UK comes from Colombia where it can grow as a perennial, but it was grown in English gardens as early as 1774. Under temperate conditions, it is best grown as an annual crop in much the same way as tomatoes. The plants are easily grown in pots and adapt well to greenhouse culture. They could also be advanced under glass and planted outdoors for the frost-free period.

After the flower falls, the calyx expands, forming the characteristic lantern-like husk that encloses the fruit. Trials carried out in Portugal identified the need for pruning and the reduction in fruit quality in high humidity as the husk loses its appeal (Oliveira pers. comm.). It can be eaten fresh when ripe and it makes an interesting ingredient in salads and cooked dishes. High pectin content makes cape gooseberry a good preserve and jam product. It can also be used in desserts or dried.

Commercial growing would be relatively labour-intensive but could be part of a diversified operation supplying the hospitality sector with local product. Plants are available in the UK from several nurseries^[2].

Goji berry (*Lycium barbarum*)

This bush from the Solanaceae family has been increasingly mentioned as a 'superfood' or exotic functional food since 2005. Although it is also known as Chinese wolfberry, Tibetan goji or Himalayan goji, this plant probably originated in southeastern Europe and it is now grown all over the world.

Gojis have been naturalized as an ornamental and semi-edible plant in the UK for nearly 300 years. The UK Food Standards Agency (FSA) ruled in June 2007 that there was significant history of the fruit being consumed in Europe before 1997 and therefore removed it from the Novel Foods list. It is now legal to sell the goji berry in the UK as a food.

Gojis have long played important roles in traditional Chinese medicine where they are believed to enhance immune system function, improve eyesight, protect the liver, boost sperm production and improve circulation, among other effects (Gross et al 2006). Preliminary reports on the health benefit of goji berries that mention anti-cancer properties amongst others are being carefully scrutinized in the US by the Food and Drug Administration (FDA).

I have never tried these berries fresh and I was not too excited about the juice. I find the dried fruit extremely disappointing and not pleasant to eat unless they are thickly coated in dark chocolate. However, there might be a market for UK gojis and several nurseries have plants available^[2].



Figure 7. Sea buckthorn growing in Crawley. Image courtesy of Mr. Asad Ahah



Figure 8. Goji berries in dark chocolate retailed in the US

Traditional Crops:

This section is dedicated to three crops that exploit the value of traditional products in different countries: cornelian cherry in Serbia, saskatoon in Canada and beach plum in the US. All three could be grown in the UK as novel crops following some cultivar trials and a market development campaign, but I want to draw attention to them for a different reason; they make interesting case studies of the economical potential of traditional products.

Cornelian cherry (*Cornus mas*)

The Cornelian cherry, a close relative of the dogwood, is a shrub or small tree from central Europe that can easily grow in most soils and positions. The flowers emerge from bare stems in late winter to early spring and it has a high ornamental value. The berries have traditionally been harvested from forests across the Balkans and central Europe.

Although the fully ripe fruit of some bushes can be eaten raw, in most cases it is far too astringent and is transformed into jams and jellies. It can also be preserved in brine, like olives. Work carried out at the University of Novi Sad, mainly through selection of elite wild germplasm (Ognjanov *et al.* 2004), is supporting the revival of this crop in Serbia where a few small orchards are being planted as an alternative to wild harvest.

Cornelian cherry products are considered a speciality and are not always easy to source. Prices at gift shops and airports are high by UK standards and much more so for Serbia.



Figure 9. Cornelian cherry jelly (as retailed in Serbia) and wild fruit sample

Saskatoon (*Amelanchier alnifolia*)

Also known as juneberry, serviceberry or shadberry, these berries grow on tall bushes in northwest Canada. They resemble blueberries although they are not related and their flavour is quite different: not quite as sweet and with a slight nutty hint to them.

The fruit can be eaten fresh but they are more commonly processed into pies (a delicacy in Saskatchewan), jams, sauces and even cider. They are very popular in areas of Canada not least because of their sensational nutritional characteristics.

Commercial production dates from the 1960s and it has been intensely promoted by the Saskatchewan Fruit Growers Association^[10] and has now extended to other areas of Canada^[11]. Mr Jarvis Blushke from Blue Sky Farm in Saskatchewan would like to see production move into Europe in the near future and he is a willing contact for those interested.



Figure 10. Saskatoon berry 'JB30'. Image courtesy of Mr Jarvis Blushke

Beach Plum (*Prunus maritima*)

This shrub is native to coastal dunes of the North-eastern US. The fruit resembles damsons and it has been collected from the wild for making preserves and jelly since colonial times. In 2001, native stands supported a cottage industry in the Northeast US and researchers at Cornell University set up a project to bring it into commercial production^[9].

The goal of the 'beach plum project' was to develop an integrated system for a sustainable beach plum industry (fruit production and elaboration of added value products) as well as developing niche markets for these products. This ambitious project was funded by the USDA through the Sustainable Agriculture Research and Education (SARE) Program amongst other organizations and it has required the involvement and coordination of growers, processors and retailers. Their internet site is really interesting^[9] and Dr Whitlow a very good source of information and ideas.

The promotion side of the project involved New York City chefs and other end users and it has produced some very illuminating consumer research^[9]. They found that the 'niche' market opportunity and price return could only be maintained by avoiding production volumes that would attract industrial processors and large retailers. Therefore, joint research and promotion but individual labelling and presentation of the product seem to be the keys for success. Currently, several grower associations are involved in small-batch production and the Cornell University Orchard harvests sufficient fruit from their germplasm collection to produce over 350kg of delicious jam per season.

UK traditional products:

Saskatoons, Cornelian cherries, beach plums and haskaps are all raw ingredients for 'niche' products in the countries where they have been historically consumed. The Canadian, Serbian, US and Japanese markets are different in many respects but they have all been able to accommodate traditional speciality products at the high end of the price range.

The UK food market is highly developed. In the last ten years, the proliferation of celebrity chefs combined with healthy eating campaigns set the scene for the emergence of a 'foodie' culture. A larger proportion of consumers are now prepared to pay more for flavour, provenance or heritage as demonstrated by the proliferation of premium ranges in all multiples. Perhaps it is time to take advantage of this trend and breathe new life into old classics. I would like to see more gooseberry, rhubarb and damson products in mainstream retailers and more small brands commercialising local specialities. Some processors already have very successful products along these lines. I understand that Tiptree's mulberry conserve is very popular and I have recently come across a small processor in Cornwall making, amongst others, Kea plum jelly.

Quince (*Cydonia oblonga*) and Medlar (*Mespilus germanica*) would benefit from a well co-ordinated 'revival' campaign. They are both well adapted to the UK and have been grown here for hundreds of years; medlars were mentioned by Chaucer and Shakespeare. They are both very tasty and, because they stay on the tree for a long time, require little storage before processing.

Quince fruits are hard and astringent but incredibly aromatic and some modern cultivars are reported to be palatable raw.

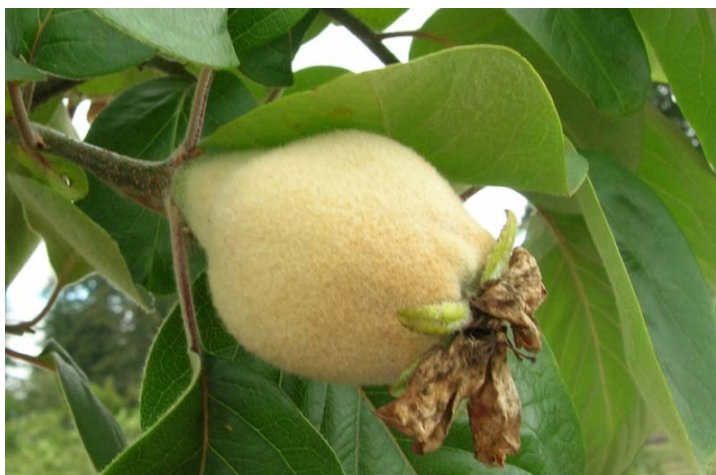


Figure 11. Quince 'Seker Gevrek' growing in Corvallis (Oregon – US)



Medlars are acid and hard until they are softened (bletted) by frost or in storage if kept for long enough. When they are ready to eat, the skin wrinkles and turns dark brown, and the pulp reduces to a consistency and flavour reminiscent of apple sauce. They used to be eaten at Christmas and afterwards, when all other fruit was finished; a perfect low carbon foot-print crop.

Figure 11. Medlar 'Rašna' growing in the Novi Sad region (Serbia)

Conclusions:

💡 **This is a good time for the UK market to accept novel fruit crops.**

We can benefit from increased interest in healthy eating. Also, consumers have become more adventurous with fruit and they appreciate a wider choice of fresh produce.

💡 **Hardy kiwis, Haskaps, Black raspberries and Paw-paws are real alternatives.**

I believe they all hold real possibilities for the UK fruit industry. Each has unique selling points and any one of them could join blueberries and blackberries as part of main stream commercial UK production provided the industry seizes the opportunity they offer and is prepared to invest in their development.

💡 **Other novel/minor crops could find profitable 'niche' markets.**

Product diversification is not the only way but can be a very successful business strategy. Fruits such as sea-buckthorn, goji, or certain Mediterranean crops like apricots and figs (with a bit of help from climate change), can have a place in UK production and will offer some growers excellent opportunities.

💡 **Provenance and traceability influence consumer and retailer decisions.**

'Food miles' was an unknown term a few years ago. Nowadays retailers have started labelling air-freighted food. In the future, carbon foot-print labels will be used to assess the environmental credentials of our food. Growing fruit nearer the consumer under a sustainable production system will allow UK growers to capitalise on 'green-purchase'.

💡 **Tradition is a valuable asset in marketing high added-value products.**

Historically important crops currently out of fashion could be ideal candidates for 'niche' market development. It is being done already and could and, in my opinion, should be expanded.

💡 **Novel food regulations can be a hurdle but need not deter investment.**

A novel food is defined as a food or food ingredient which does not have a significant history of consumption within the EU before May 1997. All novel foods are subject to a pre-market safety assessment under the novel foods regulation (EC) 258/97. In the UK the ACNFP (FSA) carries out all novel food assessments and they can take up to two years. However, a simplified application can be made where the new product can be considered similar enough to an existing one. Moreover, the ever-expanding EU provides further countries where the product could have been consumed before 1997. For example, in 2004 the FSA blocked the sale of Saskatoon berry products not considering them equivalent to blueberries. Their decision was overturned by the EU as Saskatoons have been consumed in Finland much earlier than 1997.

💡 **Quality, Continuity and Communication are key sustainable businesses.**

Continuity of supply is probably the biggest challenge for fresh fruit producers. Seasonality is part of the very nature of their business but many actions can be taken to reduce the problems associated with it. Commodity products use imports and season extension to reduce seasonality to a minimum. For 'niche' products the most obvious strategy is turning seasonality into a marketing tool.

To capitalise on 'niche' market opportunities, no compromises are admissible in either quality of the product or communication within the supply chain.

Recommendations

Combine efforts to secure funding for rigorous trialling of new germplasm.

The value of independent cultivar trials is well known to the fruit industry. This will be particularly important when dealing with completely new crops where little local experience is available.

Compile information and contacts into a user-friendly resource.

A wealth of information can be sourced from the internet, books, leaflets, reports or simply by contacting the right person. The next step involves filtering, analysing and compiling this information and transforming it into guidelines and best practice guides. As importantly, a platform is needed to put and keep in contact all the stakeholders involved or interested in the introduction, promotion and development of novel fruit crops so that propagators, growers, processors and retailers can best work together.

Identify new crop(s) of interest to specific businesses.

This could be a new investment to diversify current operations or a complementary crop to fit in the current business structure, for example to increase the use of mechanical harvesters. Particular thought must be given to the commercialisation routes for the product, even if no fruit is expected for several years.

Carry out a realistic sensitivity analysis.

A full breakdown of the diversification cost is required. It is all too easy to 'hide' costs by absorbing them into an ongoing business. Financial conclusions reached in that manner are often misleading and do not hold true when increasing the size of the new operation. Use conservative yield estimates when calculating the all-important 'break-even' price for the new product and allow for management and labour learning curves.

Research your market opportunities carefully.

Retail prices for fresh product can be very attractive but labour costs constantly drive profit margin down; adding value to 'second class' or mechanically-harvested fruit by processing could be a more profitable option.

Developing an effective commercialisation chain.

Find out about small processors to interest them in the new product. Ensure up-to-date information about the availability of your product reaches customers in advance and during the season. A good relationship with local retailers, a successful farmers market in your area or your own farm-shop could make all the difference to the success of a novel product.

Invest in the presentation of the product.

Careful handling of fresh fruit to optimise shelf-life is a must. Using 'environmentally-friendly' packaging and 'low food-miles' labels can attract a premium sector of the market. 'Niche' markets are about buying 'ideas' and 'experiences' as well as food; this could include labels with information about the origins of the plant, traditional uses, etc.

Ensure excellent product quality and flavour.

Introducing a new food product in the current market will entail not only interesting the customer but ensuring their satisfaction and enjoyment. In the long term, consumers will buy food because of its eating quality. Health benefits and other considerations are important but not the number 1 factor, particularly for the most discerning consumers.

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