

Farmers Club Bursary Report

Ethnic field vegetable production suitable for the UK climate to meet current demand from ethnic markets: Using Chinese Yam (*Dioscorea oppositifolia*) as a case study

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I have been interested in agricultural farm diversification since my time at De Montfort University researching non-food crops. Subsequently while at Moulton College I have had discussions with the farming community in the East Midlands on their ideas on the future of agriculture and part of these talks have highlighted the opportunity for ethnic foods to be produced on British farms. Farmers currently cultivating traditional field vegetables would welcome the opportunity to cultivate high value crops that can be produced with similar cultivation methods. However, most ethnic vegetables are grown in Asia, then shipped/flown over to the UK to be sold for use in ethnic cuisine. In addition to the needs for and opportunities in crop diversification, the cultivation of ethnic foods also has implications for 'food security'. Food security has been the buzzword amongst politicians, journalists, in addition to many scientists trying to market their research interests as being of importance to the future. However, food security is not just about ensuring grain silos are adequately filled, it is also about ensuring that we have the quality of food when supply chains become vulnerable to global pressures. In Britain we love world cuisine and to ensure we can eat authentic regional food, we need the basic building blocks, of fresh fruit, vegetables and herbs. For Caribbean, African, Indian and Oriental cuisine this means that many of the fresh produce are shipped/flown in at great expense from around the globe. This current situation is not good for British farmers, our food mileage, or for ensuring our food security. So if there is a market for new crops, why are British farmers not growing all these weird and wonderful high value crops? Well there are a number of challenges including the construction of distribution networks. These vegetables are not usually the kind on sale in British supermarkets and there is a lack of available information, knowledge and skill on how to grow these crops on a commercial scale in the UK, with the added problem that the key texts are in foreign languages. The challenge of altering production methods to take account of the new crop is significant, but I imagine that a farmer currently growing cabbages could turn his hand to growing Chinese Cabbages quite easily, should a distribution network and financial incentive be put in place.

Having conducted an initial desk based study of suitable crops I identified the Chinese Yam (*Dioscorea oppositifolia*) as a crop that is a potential 'ethnic crop' for British farms. Not only is Chinese Yam fully hardy in the British Isles, it also is eaten in high volumes by Asian communities in the UK. However, no farmers in the UK have experience with growing Chinese Yams, nor is there much information available on their cultivation or agronomic requirements. Therefore before any field trials of any worth can begin, it had to be determined how the plant is currently grown in East Asia. Answering such questions as *what type of soil does it require? Are there major pests and diseases?* were key to this, and I hope that my report goes some way to answering these questions.

Chinese Yams are not currently cultivated in the UK, but diversification into other crops is currently one of the major themes in debates in agriculture. UK grown Chinese Yams should produce a superior crop to imports from Asia, which is the current source and will reduce the food miles. Although called 'Chinese' yams, I am chose to study their cultivation in Japan as the country's existing agriculture system is more in line with that of the UK's; being both mechanised, high input, using synthetic fertilisers and less reliant on cheap labour. Japan currently consumes more Yams than China per capita and it is a more commonly cultivated crop. In addition the climate of Japan is more comparable to the British Isles, than the regions of China where it is currently grown there.

My trip to Japan was originally scheduled for Easter, but as the Tsunami hit Japan two days before I was interviewed for the bursary at the Farmers Club Headquarters it was thought best by all concerned to postpone it until the summer. Although this meant missing the famous blooming of the Cherry trees and a considerable increase in the summer temperature and the concurrent increase in the value of the Yen (both borne by myself) the information I was to garner about Yams should be the same regardless of when in the growing season I arrived. My information came from two notable contact groups who I am indebted to for sparing their time and hospitality to speak with me about yams:

Mr Kiyoji Matsushima, Atsushi Mizuki and Leon Fonseka in the Oirase JA Rokunohe Branch, Aomori Province where the majority of Japanese Yams are cultivated (figure 1 & 7), and Mrs Oishi and Mr

Babil (figure 2) of Tokyo Agricultural University, who have an experimental farm researching and cultivating Yams. This farm holds accessions of around 20 yam varieties.

Chinese Yams are cultivated in the northern regions of Japan, where the climate is similar to the British Isles, as evident by the similar plants cultivated in gardens and the weeds (such as Japanese Knotweed). However, there is one clear difference between field vegetable production in Japan and the UK in that it is undertaken by a vast network of what we would consider to be smallholders. These small scale farms of a hectare or two form a patchwork across the country. The system works because they unite under an agricultural collective, JA (Japanese Agricultural Cooperative). JA works for the farmers on many aspects of their business arrangements and is even the largest savings bank in the country. Also farms do not fall into the rural/countryside bracket as easily as in the UK, and the commercial field production takes place on patches of land right into the heart of many cities, including the outskirts of Tokyo (figure 3). This production system also requires smaller scale machinery such as the rather dainty harvester in figure 4.

Cultivation of yams in Japan

The cultivation of Yams begins in the spring with the planting of seed tubers, akin to the production of potatoes. Although yams are fully hardy and herbaceous perennials, they are produced on an annual basis as the tubers are the food source harvested. Seeds are not used for production as they are far slower to establish and there is a very low viability when trying to germinate them. In addition, only male plants are desired as they do not divert assimilates to seed and fruit product and thus produce bigger yams and so vegetative propagation ensures only male plants are cultivated. Small aerial tubers (Figure 5) are produced on the stems, and although these too can be used for propagation they are normally smaller than the seed tubers and not produced in any great number.

Yams require the soil to be cultivated before planting to an extremely deep level (at least 1m). This restricts its cultivation to the sandy soil areas in the southern sections of the Aomori province, which sits on the northern tip of the main island of Honshu. Clearly this cultivation requires the use of some specialist equipment, which I have been told is based on a rotating mechanism different to a conventional plough (I would imagine in China, soil cultivation for yams is done by hand). As the equally popular Burdock (*Arctium lappa*) crop also requires deep soil cultivation and sandy soils for the growth of its long tap root, these two crops are commonly found growing alongside each other (Figure 6). Even if cultivation to 1 m is simply not possible or financially viable in the UK, it does not mean that yam cultivation is not possible, just that the extremely long and thin yams that are the class 1 crop (figure 7) would be unlikely to be produced. Therefore smaller squatter yams will be

produced, but with no other domestic competitors this should more than satisfy the needs of the domestic market.

From talking to the agronomists at JA, the main challenge to the cultivation of yams is the laborious nature of constructing a frame for the yam vines to grow on (figure 8). As the crop is harvested each year by machine this framework cannot be kept in place (as would be the case for other vine crops, such as hops or grapes). It was stated by the works at JA Aomori that the hectareage devoted to yams is decreasingly annually due to the manual labour required to construct the support framework and harvest the crop. However, it could be that labour costs in the UK might make this cultivation method more financially viable or there may be equipment currently used for a conventional crop in the UK that may lend itself for use in yam cultivation. In Aomori the yams are normally harvested by a machine running along the beds to scoop out the yams. However there are other ways they mentioned of getting the yams out. The area between the beds can be dug out and the yams from within the rows pulled out sideways. This method causes less damage to the crop but is more labour intensive. In addition they mentioned that they had also heard that in the east of Japan they grow yams in near pure sand and then harvest them by injecting compressed air into the sand and the yams simply pop up out of the ground.

Insects do threaten the yam crop and the fields are regularly sprayed with an insecticide and the rows are routinely weeded (often to remove yams from previous years). However, none of my contacts could name one specific insect that attacks the crop. Owing to Yams being cultivated in sandy soils and being a root tuber crop, the most significant pest appears to be nematodes and the soil is treated before cultivation to kill off the worms.

My main concern with the cultivation of yams before travelling to Japan was that the British summer may not be hot enough or that we do not receive enough sunlight to produce the large tubers. However, the agronomists at JA said that this would unlikely to be a problem and in areas with low light they change the production system to take account of the lower irradiance levels. In fact the few Yams that I do have in cultivation at Moulton College appear to be roughly the same size as those being cultivated at Tokyo Agricultural University.

Post-harvest treatment of yams

The Yam tuber is extremely tolerant to post-harvest storage, with simple refrigeration able to keep them edible and turgid for many months (possibly packed into soil). The harvest time for yams is in Early November, however the farmers often leave half of their crop in the ground until the summer

when it can also be harvested. These factors make it a versatile crop for farmers who do not need to worry about harvest and storage as much as other crops with short cropping periods.

Once the crop has been lifted it is taken to a packing house (figure 9) where they are first washed, graded, then either chopped and vacuum packed for sale, or peeled and placed in water ready for transport to a processing unit. The yams can end up in a variety of products including mayonnaise. The longest and roundest yams are considered class 1 and fit for sale in the top end supermarkets, while more ovate and/or shorter tubers go free packed to markets. Split or broken tubers are taken for processing.

The use and sale of Yams in Japan

The main culinary use for the yams in Japan is as a topping for noodle soup (in grated form and cold), but the tubers are also sometimes fried as a sauté and included in the noodles themselves. Interestingly Yams are now being used by chefs as a substitute for seaweed, with edible algae currently being in short supply due to the effects of the Spring Tsunami. The cost of a packed class 1 yam in a Japanese supermarket is £4.00 (figure 7).

In addition to the use of yams in food, they are also now being developed into health products, with extracts purported to help with boosting the immune system (figure 10); possibly due to its unique steroid biochemistry. Products and patents based on these health giving properties have been developed and this is boosting the trade in yams from Aomori. In fact the direct translation of the Chinese name for the plant is “mountain medicine”. Interestingly new or niche crops often see their sales boosted by their inclusion as a ‘superfood’ and any farmer wishing to grow yams could use such claimed (which are already backed up by scientific studies) to boost sales. This has been a successful strategy used by growers of watercress in the UK to market it as a superfood containing high levels of iodine and isothiocyanates. The fact that Yams belong to the Dioscoreaceae plant family means that they are not represented by any other vegetable on the shelves in UK supermarkets and so are likely to have many unique health giving chemical components. In fact, once the demands of the domestic ethnic market have been met, yams could be used in other dishes or processed foods if yields were found to be as high as or higher than conventional carbohydrate crops.

The future for Yams in the UK

Although this trip gave me a far greater insight into the cultivation of a whole range of Oriental vegetables that can be grown in the UK, the question remains, how effectively can these crops be grown in the UK and which can be grown at a profit. This is where I hope our upcoming field trials at

Moulton College can have the answers. If any of my fellow club members would like further information on this project, or have any advice I am more than happy to start a dialogue so that we can advance the development of these new products for British agriculture and horticulture. Having been enthused about the potential for Oriental vegetable production in the UK I will set my research team to work looking at optimising their production in the UK. This will include obtaining data on growth rates under British conditions, comparing these to standard comparable crops and then comparing the market value to see if the potential really does stack up in the favour of their production for farmers.

As well as studying yams, I also used this trip to study other aspects of food production in Japan. I met with Prof. Hiroshi Shimizu of Kyoto University (figure 11) and discussed lettuce production in 'plant factories' and his work on the optimisation of production under LED lights in his state of the art 'shipping container' laboratory (see figure 12). I also travelled to the provincial town of Zensuji to find the farm that grew the Square Watermelons that I once read about on the internet. However, upon travelling to the town it became clear that they have not grown these bizarre fruit there for some years as they succumbed to fungal diseases when placed in the cases required to form the square fruits (see <http://news.bbc.co.uk/1/hi/1390088.stm>). However I was told that they did produce cuboid fruits, along with pyramidal and even ones in the shape of the map of Japan itself!

Aside from me walking the fields of yams, highlights of my trip to Japan included seeing the preserved flower of *Rafflesia arnoldii* (Figure 13), the largest flower in the world, at Kyoto Botanical Garden, seeing the veteran Ginkgo trees in Hiroshima that survived being hit with an atomic bomb in 1945 and turning up on the island of Shikoku just as their major annual festival was in full swing in Kochi. I was also able to collect information on Bamboo species cultivated in Japan for use by Malcolm Goodwin, my fellow lecturer at Moulton College, who is studying their potential use in agro-forestry as part of his Farmers Club bursary.

Figure 1: Mr Kiyoji Matsushima and Leon Fonseka in the Oirase JA Rokunohe Branch, Aomori Province.



Figure 2: Mr Babil of Tokyo Agricultural University in his experimental field where he keeps his accessions of Chinese Yams and Water Yams for determining their genetic diversity.



Figure 3: The intermingling of the urban and rural environment in ZenSuji. In Japan, rice cultivation occurs in the smallest pocket of land in all but the most built up metropolitan locations.



Figure 4: A small scale rice harvester in use on farmland in central Kyoto.



Figure 5: aerial tubers growing on the vines that can be used for propagation of new plants.

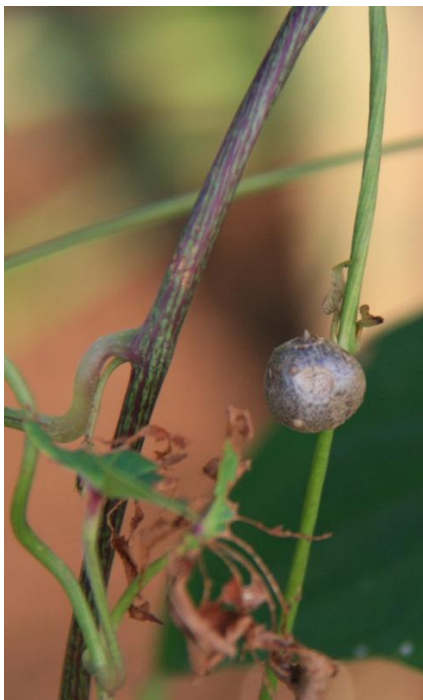


Figure 6: Uprooted Burdock plants in a field adjacent to a Yam crop. Both Yams and Burdock require land to be cultivated to around 1m and will be harvested in late autumn.



Figure 7: Washed and packaged class 1 prime Yams on sale in a supermarket. The tubers sell for around £4. Tubers being held by Atsushi Mizuki of Oirase JA Rokunohe.



Figure 8: The yams in the field. Plants are spaced ~25 cm apart and grown on a netted support. The rows of the field are spaced around 1 m apart and kept weed free.



Figure 9: Workers washing and grading the Yams in the storage and packing house.



Figure 10: Health product made from yam extract that is placed in the bath and is purported to boost the bather's immune system.



Figure 11: Prof. Hiroshi Shimizu of Kyoto University in his laboratory where they study the optimal lighting conditions for plants being cultivated in 'plant factories.

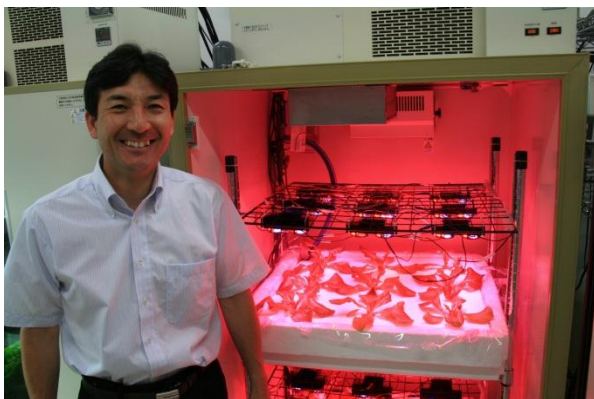


Figure 12: The plant factory laboratory at Kyoto University is built inside a shipping container and is based on a commercial pre-fabricated product that can be delivered and installed in many locations around Japan.

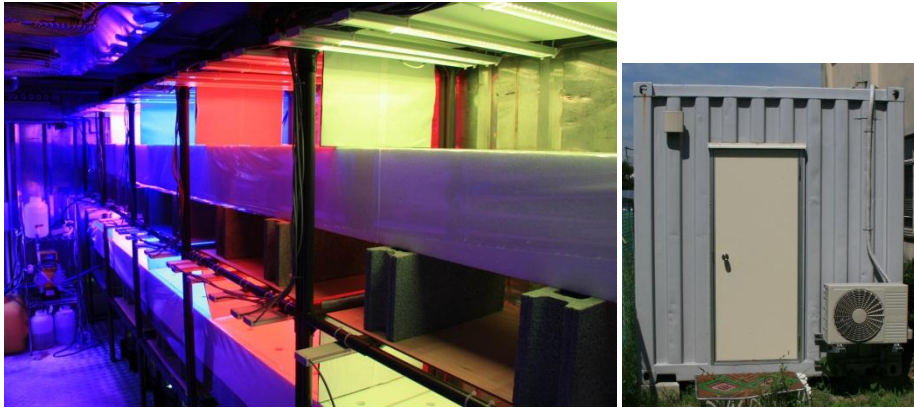


Figure 13: Some non-agricultural highlights of my trip. Top, myself with a preserved specimen of *Rafflesia arnoldii* at Kyoto Botanical Garden, the *Ginkgo* tree that survived a hit with an atomic bomb in Hiroshima, and the annual dance festival in full swing in the town of Kochi.





Costs

Flights £860 (KLM)

Hotels £1200 (As expected)

Transport £700. Japanese Railways Pass (14 days) £500 . Metro, Car-Parking, buses and taxis.

Subsidence £~600 (food higher than expected due to inflation caused by Tsunami)

Total £3360