

## Potato Breeding in Ireland

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The potato arrived in Ireland sometime toward the end of the 16<sup>th</sup> century (Bourke 1993). Very few varieties were grown until the late 18<sup>th</sup>, early 19<sup>th</sup> century. William Rye (1730) described five different varieties of potato in early 18th century Ireland. These he named “the white flat Kidney Potatoe (sic) the round White, the Yellow, the round Red and the Black Potatoe” . Potato breeding was primitive at best and the gene pool limited. T.A. Knight began deliberate crossing in the beginning of the 19<sup>th</sup> century but this practice did not become widespread until after the Great Potato Famine of 1845-1849. New varieties were introduced from the Americas and bred with the few varieties that survived the *phytophthora infestans* epidemic and led to an explosion of varieties being grown here and in North America (Glendinning 1983). This paper aims to discuss potato breeding in Ireland over the past four centuries.

The potato is believed to have been domesticated between seven and eight thousand years ago in Peru (Zuckerman 1998; Reader 2008). Reader amazes at how this plant whose ancestral species with poisonous foliage and in most wild species, tubers packed with glycoalkaloids ever became domesticated. It is believed that the first edible varieties were developed around Lake Titicaca on the borders of Peru and Bolivia (Salaman 2000). Today in Peru there are over 4300 varieties of native species (<http://cipotato.org/potato/facts> 2012) and 183 wild potato species.

In the Andes, farmers have over a thousand named edible varieties that they grow regularly (Reader 2008). While some of these names may be synonyms it is generally believed that over 400 different varieties of potato grown, grouped into three broad groups depending on suitability to different altitudes. *Papa Maway* grow between 3000 and 3500 metres where precipitation and temperatures are favourable. *Papa Puna* are more enduring and grow between 3500 and 4000 metres while only the frost resistant *papa ruki* grow above 4000 metres (Reader 2008).

Diversity is guarded on farms in the Andes and varieties are chosen for personal taste as well as compatibility to local environment. Most farmers will grow a selection of between 30 to 50 different varieties and can converse on the traits and attributes of each variety in his or her collection. This is not as difficult as it would seem to westerners as the varieties differ in as much as pulses look and taste to us. They are multicolored, striped, round, kidney shaped, short, fat, thin, white to black and all the colours of the rainbow (Reader 2008).

Potatoes are generally grown from other potatoes known as seed potato. They are herbaceous annuals that can grow up to one metre in height. This foliage manufactures starch that is transferred to the ends of the stolons which thicken to form tubers. One seed potato can produce up to 20 new tubers. Potato grown from potato seed will be genetic clones of the seed potato (Robinson 2012).

Potato breeders use true botanical seed potato to breed new varieties of potato. David Langford whose potato collection of over 300 different varieties is grown and exhibited in the walled garden of Lissadell House in Sligo explained how an amateur garden enthusiast can grow a new variety of potato:

‘Decide the attributes you desire in your new potato by selecting the parents. You may want to breed a variety that produces a flowery potato that is not susceptible to eelworm so you will cross varieties that each have one of the attributes you desire. When the potato plants flower, cross pollinate the plants by removing the stamens from the plant you wish to grow the new seed and pollinate with the pollen from the other parent plant’.

Langford crossed a Highland Burgundy with a Salad Blue and bred a dark skinned potato with pink flesh. The plant will then produce little berries which will contain up to 400 seedlings. The berries are broken open, the seeds dried out and stored until next year. The following spring each of the seeds are germinated on tissue and form a mini potato plant. The first to sprout are first earlies, the second are second earlies and the third to sprout are maincrop varieties. Weed out the weak ones and transfer the good ones to little pots and label them. These true potato seed (TPS) can grow into potato plants and produce a full crop of tubers. It is better to harvest them when they are small and store them over the winter for next years seed potato. Only one tuber is kept from each seed for planting the following year (Langford 2012)

When you remove them from storage again weed out the weak ones. Some will have developed fungus diseases such as gangrene, dry rot or common scab. These should be discarded and plant only the stronger seed potato. From Langfords original 1000 seeds three years later he has reduced this down to 9.

Langford (2012) also claimed that there is no guarantee that your new breed will have the attributes desired of the parents. Two purple potatoes will not necessarily produce a new purple variety and likewise the true seed from a Salad Blue may produce a white potato. In fact the true botanical seed from self-pollinated potato plant berry may have very different characteristics to that of the parent potato because botanical seed potato display high levels of genetic variation.

The potato is the fourth major food crop in the world after wheat, rice and maize (Teagasc 2012). The Potato Centre in Peru claim that the potato is third most important food crop after wheat and maize in terms of human consumption with over one billion of the worlds population eating the tuber.

Zuckerman (1998) laments the malevolent attitude of the Western World to the potato since its arrival from South America over 400 years ago and claims that the humble tuber is no longer beneath contempt but beneath notice. Much of the blame for this he aligns to the fact that nearly all of the previous potato experts stumbled upon their skill by accident: Parmentier from being fed potatoes as a prisoner of war by the Prussians, Goodrich who took up market gardening on a sabbatical from the ministry, Salaman retired from medicine due to ill health and studied genetics while convalescing and Austin Bourke analyzed weather patterns enabling him to predict early blight outbreaks and thus justify the existence of the Irish weather service.

While the fact may be true that they did not set out to be potato experts, none the less their contribution to western cultivation of the potato is outstanding. Potato experts today will be well versed in their exploits and arguably more knowledgeable because of them. It is no accident that Teagasc, the Irish Agriculture and Food Development Authority, have developed over thirty five successful potatoes since its inception in

the early 1960s. Established to breed a high yielding, phytophthora infestans resistant varieties for the home market it had initial success with the Cara variety which secured the future of potato breeding at Oak Park (Dowley 2007). Cara at its peak accounted for 10% of the total potatoes produced for consumption in the UK. Legislation protecting plant breeders intellectual rights was only introduced in the 1970's giving plant breeders legal protection for the investment they make in breeding and developing new varieties. The new variety has plant breeders rights for 30 years and royalties collected from new varieties arguably help sustain companies and fund future research into better breeds.

This was the catalyst that formed one of Ireland's longest and most successful public private partnerships with the Irish Potato Marketing given exclusive rights to market Teagasc Varieties (Teagasc 2012). Dr Denis Griffin breeds potatoes in the Irish Agriculture and Food Development Authority potato breeding centre in the crops research centre, Oak Park, Co. Carlow. Oak Park breed potatoes in a similar but more scientific manner than Langford. Every year up to 100,000 true seeds are raised for evaluation compared to Langfords 1000. One tuber is selected and propagated in the field from each seed. At the end of the first field season only 3000 will be selected by eye and advanced for further rigorous evaluation over a period of eight years. The potatoes are tested for foliage maturity in year four through to disease resistance screening as well as agronomic performance across the range of testing sites controlled by Teagasc depending on the market the potato is intended for (Teagasc 2012). Teagasc currently have field testing sites in the north and south of Spain, two sites in Morocco, two in England and one in Israel (McDonnell 2012). After over ten years of assessment the breeder is left with one or two seedling. Then they are sent for trials to determine if they are suitable for variety status and plant breeders rights. This long process understandably has a very high cost. Estimates range from €700,000 to €800,000 although McDonnell states it is very difficult to quantify the actual cost. "It's not like you start out in January 2012 and start to breed a new variety of potato, the process is ongoing with a new variety coming on stream every year"(McDonnell 2012). The question as to how you determine what to breed for the market in 15 years time received the same reply.

The main attributes a potato breeder considers still today is yield and disease resistance. The main disease concerning Griffin are late blight and potato cyst nematode. Both these diseases can cause considerable damage to the crop harvest yield. Griffin also stated that while yield and disease were important, flavour was making a welcoming return to the breeding program (Griffin 2012). His predecessor Harry Keogh bred the very successful variety the Rooster. Since its launch in the mid 1990s the Rooster has become the dominant potato in the Irish market accounting for 70% of the market today (McDonnell 2012). The Rooster was launched in the authors restaurant.

Cara has been the most successful potato bred in Oak Park to date accounting for nearly half the total annual seed sales of approximately 30,000 tons. Dr. Harry Keogh was Oak Park's most successful breeder and indeed ranks up with the great names in potato breeding like Archibald Finley (1841-1921), Donald McKelvie (1867-1947), Dr. William Black (1903-1975), Dr Harold Howard, John Clarke, (1889- 1980) and Dr Brian Costello (still living) (McHenry 2012).

Finley bred a host of varieties such as the 'Up to Date' (1894), 'The British Queen' (1894) and the 'Majestic' (1911). His greatest success was with the Majestic which dominated the the British market for over fifty years. It is a testament to his skill in breeding that over a century later the British Queen, a second early, is still Irelands favorite summer crop.

McKelvie bred eleven varieties with the prefix Arran having hailed from Lamlash on the Isle of Arran (Wilson 1995). He gave his breeds names such as 'Arran Consul' (1925), 'Arran Banner' (1927), 'Arran Crest' (1928), Arran Pilot (1930) and Arran Peak (1935) (Davidson 1938). In an interview with this author, Mr. Sean O' Suilabhain, head librarian in Leitrim Co. Council, claimed his mother always stated that 'the Arran Banner was only good for making Boxty'(Gallagher 2008).

Finley and McKelvie both very successful Scottish individual breeders raised potatoes in the era before state sponsored plant breeding. Dr William Black headed up the Scottish society for Research in Plant Breeding and gave the prefix 'Craigs' and 'Pentland' to the varieties they raised. Black bred six 'Craigs', named after the house in Edinburgh where the breeding station was first located. 19 'Pentlands' were also raised by the team led by Dr. Black after the institution relocated to the Pentland Hills (McHenry 2012). Pentland Dell, their most famous was launched in 1961, a year before Dr Harry Keogh established the Republics Plant Breeding Station at Oak Park in Co. Carlow.

Oak Parks most successful variety bred to date has been the Cara with seed being exported to over ten countries (Dowley, O'Connor et al. 2007). Cara was raised in 1972 and by the mid nineties covered 10% of the maincrop area of Great Britain. Ambo, Burren, Slaney, Avondale, Red Cara and Barna are the most important in seed export trade. The Rooster although Ireland's most popular is not a major seed export. Due to high labour and transport costs, seed growing for the British market is carried out in Scotland today.

The Plant Breeding Institute, founded in 1912 as part of the University of Cambridge's School of Agriculture was headed up by Dr Harold Howard when it moved to Maris Lane, Trumpington, Cambridgeshire. The PBI in Maris Lane bred all the varieties with the prefix Maris. The most popular potato in Britain over the past forty years has undoubtedly been the Maris Piper with the Maris Peer, Maris Page and Maris Bard all widely available (McHenry 2012).

Dr Brian Costello led the Northern Ireland Plant Breeding Station in Loughgall, County Armagh. Their most successful potato is the Navan which is a cross with the Maris Piper.

Miss L. King was a noted Irish breeder from Mountmellick in Co. Laois. Miss King raised the Flourball in 1895. Davidson (1938) stated that the flourball's yield was fair, quality good and that it keeps well while noting 'a popular variety at one time and still grown in small quantities about the Midlands of Ireland'.

John Clarke was with out doubt ireland's most prolific individual potato breeder having bred 33 varieties certified by the Seed potato certification schemes (McHenry

2012). The first thirty bred before the the ruling requiring new potato breeds to have only one name, all had the prefix 'Ulster'. The last three breeds were named Dunluce, Dundrum and Dundrod (McHenry 2012).

Clarke was a very gifted breeder of potatoes and highly respected among his peers. Radcliffe Salaman said of him 'his appreciation of the scientific approach is as outstanding, as is his flair for selecting the most promising seedlings'(Salaman 2000). North Antrim was identified by Salaman as an ideal area to raise virus free potato stocks and in 1941 the National Institute of Agriculture Botany invested in expanding the glasshouse stocks under the supervision of Clarke at his farm in Broughgammon Salaman visited Clarke at his farm in Broughgammon such was the esteem he was held in. McHenry (2012) states that when Clarke was awarded his OBE in 1969 for services to Agriculture he received many congratulatory letters. One was from Mr. F R Horne, Director of the National Institute of Agriculture Botany in which Horne added a personal scribbled note 'how proud Dr Salaman would be. He used to speak of you as a favorite student of his' (Salaman 2000).

Salaman was not alone in travelling to Broughgammon which was no mean feat in the war years of the 1940s. Howard travelled from Cambridge to North Antrim which could take up to two days to exchange views and potato varieties with a farmer who finished his formal schooling at the age of 14 (McHenry 2012). Davidson (1938) said of his just released 'Ulster Monarch' 'the most promising variety raised in Ireland since the introduction of the 'Rock' about 100 years ago... a new variety well worthy of trial'.

A testament to Clarke's genius lie in the fact that some of the most popular potato varieties of the 20th century have some 'Ulster' variety progeny. Britain's most popular potato the Maris Piper (1963), Maris Bard (1972), Maris Page (1966) and the Maris Peer (1966) are all a cross with 'Ulster Knight'. The 'Navan'(1987) is a cross with the 'MarisPiper'. The Irish republic's most successful potato to date the 'Cara' was bred from the 'Ulster Glade'. The 'Cara' is a very popular variety used internationally for crossing to create new breeds today.

Hobbyist potato breeding has largely died off in the Republic today. A number of factors can be ascribed to this but without doubt the main one has to be the prohibitive costs involved in getting the new breed listed on the National List. Langford stated he would never be able to afford to put his potatoes through the required legislative processes to get them listed. 'I'm harvesting them each year and we enjoy them with family and friends' (Langford 2012). In Northern Ireland a number of small potato producers have formed the Northern Ireland Potato Breeders Association. Robin Cherry from Ballymena has had success with 'Sunbeam' (1995) and Sunray (2008). Robert Brady again from Ballymena has had 'Hunter' (2004) listed and Alex Dobbin from Bushmills got 'Aldo' (2003) listed (McHenry 2012). All of these potato breeders have raised their potatoes within a fifteen mile radius of where Clarke raised his varieties.

There are no breeding societies in the Republic and Langford does not know of any other breeder outside of Oak Park. McDonnell claims that potato breeding is quite popular in the Netherlands. Raoul A. Robinson is a plant pathologist and an exponent of breeding crops for horizontal resistance as opposed to vertical resistance, the

method of crop breeding of choice among professional plant breeders of the 20<sup>th</sup> century (Robinson, 2012).

Robinson explains how there are two classes of protection against parasites, stable and unstable. He uses the example of how during WWII the Allies afraid of an epidemic of typhoid and even malaria sprayed the entire city and people of Naples with DDT and successfully prevented an outbreak. Within months Naples was plagued with house flies that were DDT-resistant. This Robinson claims makes DDT an unstable protection mechanism. On the other hand he explains how in Yugoslavia, the people have been using a wild flower that contains pyrethrin to control fleas and bedbugs for centuries without a suggestion of pyrethrin-resistant fleas or bedbugs. Thus the use of natural pyrethrins are a stable protection mechanism (Robinson 2012).

Without suggesting conspiracy, Robinson claims that it is in the interest of both the seed potato and the chemical industries that modern potato cultivars are susceptible, so that farmers need certified seed and chemicals to spray them with for protection. This is just how the industry developed and there is no major drive to change the status quo. Quite the contrary according to Robinson (2012):

“many of the big chemical corporations have been buying up seed companies. They have also been buying up plant breeding institutes. These take-overs, which have nothing to do with chemical manufacture, will give them an almost monopolistic control of the cultivars available to farmers. And the best way to guarantee their market for crop protection chemicals is to ensure that these cultivars are susceptible, and that they can be cultivated only under the shield of both certified seed and crop protection chemical..

Robinson suggests forming plant breeding clubs worldwide with the goal of eliminating potato parasites, use of crop protection chemicals, need to purchase certified seed and creating near perfect, but different, potato cultivars for each agro-ecosystem (Robinson 2012). 100 breeding clubs could potentially screen 100,000 true seedlings each resulting in over 10 million seedlings screened worldwide annually and within twenty years achieve the proposed goals. University's are ideal starting grounds for these clubs, run by students under the supervision of a lecturer. There is the added bonus of receiving plant breeders rights and royalties for breeding successful cultivars. Robinson (2012) challenges anybody that may think amateurs are not capable of achieving these objectives by citing the success of amateur Marijuana breeders. 'Motivation is prime incentive' (Robinson 2012).

## **Bibliography**

Bourke, A. (1993). The visitation of God'? the potato and the great Irish famine. Dublin, Lilliput Press Ltd.

Davidson, W. D. (1938). Potato Growing for Seed Purposes. Dublin, The Stationary Office.

Dowley, L. J., N. O'Connor, et al. (2007). The Oak Park Potato Varieties. Carlow, Teagasc.

Dowley, L. J., O'Connor, N., Dillon, J., Deegan, J., Hutton, F., Griffen, D. (2007). The Oak Park Potato Varieties, Teagasc.

Gallagher, P. Ó. (2008). 'Boxy- The Caviar of North Longford', an investigation into the origins and peculiarities of the traditional Irish Potato dish, boxty. School of Culinary Arts & Food Technology, DIT.

Glendinning, D. R. (1983). "Potato Introductions and Breeding up to the early 20th Century." New Phytologist **94**(No 3): 479-505.

Griffin, D. (2012). Potato Breeding 2012. P. Ó. Gallagher. Dublin.

<http://cipotato.org/potato/facts>. (2012). "Facts & Figures." Retrieved 04/05, 2012.

Langford, D. (2012). Potato Breeding. P. Ó. Gallagher. Dublin.

McDonnell, C. (2012). Marketing Potatoes in 2027. P. Ó. Gallagher. Dublin.

McHenry, M. (2012forthcoming). John Clarke Potato Breeder. Belfast.

Reader, J. (2008). Potato, a history of the propitious esculent. New Haven, Yale University Press.

Robinson, R. A. (2012). Potato-Breeders-Manual.pdf. Ontario, shareBooks Publishing.

Salaman, R. N. (2000). The History and Social Influence of the Potato. Cambridge, University Press.

Teagasc. (2012). "<http://www.teagasc.ie/topics/cropsenvland/potatoes.asp>."

Wilson, A. (1995). The Story of the Potato through illustrated varieties. , Balding & Mansell.

Zuckerman, L. (1998). The Potato, How the Humple Spud Rescued the Western World. New York, North Point Press.

<http://www.europotato.org/menu.php>