

# BREEDING, DISEASE RESISTANCE SCREENING AND SEED PRODUCTION OF NEW POTATO VARIETIES

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## SUMMARY

The Potato Breeding Programme at Oak Park Research Centre with associated variety evaluation, seed propagation and disease resistance testing programmes has been in progress since the 1960's. A total of 24 varieties have been named. Some of these varieties are very successful in a range of countries while others are no longer commercially grown.

Cara has been the most successful of the varieties bred to date, with seed being exported to at least ten countries. In recent years 15,000-20,000 tons of Cara seed is sold each year by Irish Potato Marketing Ltd., with overall seed sales of Oak Park bred varieties, ranging from 27-30,000 tonnes. In 1996 Cara occupied 9.8% of the maincrop area in Great Britain.

Rooster has established a considerable share of the ware market in Ireland since it was introduced in 1991–1992. It occupied 19.5% of the potato area in 1999 and is now the second most widely grown variety.

Ambo, Anna, Avondale, Barna, Burren, Red Cara and Slaney are the most important of the other varieties for the seed export trade while varieties such as Banba, Emma, Malin, Orla, and Shannon are emerging for the future.

## INTRODUCTION

The production of new varieties has been an integral part of potato improvement since the crop was first introduced to Ireland in the sixteenth century. As early as 1880 the Report of the Select Committee of the House of Commons expressed the opinion that the breeding of new blight resistant varieties was a subject of considerable national importance. This resulted in some 255 new varieties being exhibited at the Royal Dublin Society's winter show in 1885. Potato breeding was continued by the Department of Agriculture into the late 60's and is now carried out at the Oak Park Research Centre in Carlow.

The potato breeding programme at Oak Park was started in the 1960's and has consisted of a number of distinct phases. In the first phase the focus was on the testing of the main domestic and foreign varieties in field trials in the main potato growing areas of the country. This was followed by a breeding programme for the domestic market, with particular emphasis on the production of a blight resistant replacement for Kerr's Pink. The emphasis then switched to breeding for the export market, with the focus on the UK and Mediterranean markets. Since then the breeding programme has been focused on the domestic, processing and export markets. The process of breeding, testing and multiplying a new potato variety from the making of the initial cross until the new variety can be commercially grown takes about 15 years (see Appendix 2).

The objectives of the present Potato Breeding Programme are:

1. Breeding improved varieties for the seed export trade.
2. Developing high yielding early maincrop and maincrop types with resistance to potato cyst eelworm *Globodera rostochiensis* and or *Globodera pallidae* with quality suitable for the UK market.
3. Developing a high dry-matter red skinned early maincrop or maincrop variety suitable for the home ware trade with a high level of disease resistance especially to late blight.
4. To select early maincrop or maincrop types suitable for processing into crisps and chips.
5. Breeding 1<sup>st</sup> and 2<sup>nd</sup> early varieties suitable for Irish and UK conditions with improved quality and disease resistance.

## METHODS

The potato breeding programme currently undertaken at Oak Park largely consists of three projects. The main programme consists of breeding improved potato varieties for the domestic and seed export market. Two complementary projects involve the propagation of virus tested seed stocks of new potato seedlings and the assessment of their disease resistance.

### **Breeding**

The potato (*Solanum tuberosum*) is an autotetraploid with four sets of homologous chromosomes ( $n=12$ ). The species contains a high level of genetic variation and hybrids will

retain their heterozygous nature due to vegetative propagation. Conventional breeding programmes depend on the production of variation through sexual hybridisation and the subsequent selection of the best recombinant clones for further evaluation and vegetative propagation.

**Year 1** entails the crossing of selected parental material to obtain true seed which should contain the desired commercial characteristics. In **year 2**, 90,000 seedlings are raised from true seed in pots. Around 80% of these are selected and grown as single plants the following year in the isolation centre in the Wicklow mountains (**Year 3**). They are selected severely on appearance, shape, tuber numbers, freedom from defects and potential yield in this first field year. Ten tubers are kept of each seedling selected and these are grown the following year (**Year 4**). The seedlings are assessed at this stage on foliage cover, maturity, tuber size, evenness, appearance, defects and potential yield. Seed tubers are retained for further multiplication in the isolation centre in the Wicklow mountains, while the remainder of the tubers are used for commercial evaluation in Carlow the following year (**Year 5**) and planted in replicated plots each with 20 tubers. By this time, the original 90,000 will have been reduced to some 300-400 seedlings on which more detailed evaluation with respect to yield, eating quality, dry matter content, crisp and chip colour, grading etc. is carried out.

Seedlings considered to be early maturing are evaluated the following year in an early potato growing area at Broadway, Co. Wexford. The remainder of the seedlings selected at year 5 are included in general evaluation trials near Carlow (**Year 6**) and assessed on all characters of commercial importance and for their possible market potential. Seedlings are selected at the end of year 6 for evaluation in the United Kingdom and the Mediterranean region the following year, while the selected seedlings continue their evaluation in Ireland also. The extent of the evaluation programme depends on a seedling's potential for the various markets. Initial evaluation in the United Kingdom has two centres while evaluation in the Mediterranean region can vary from three to five centres depending on the skin colour, maturity and market potential. Parti-coloured varieties are assessed mainly in Cyprus and the Canary Islands while reds are assessed in Morocco, Israel, the Canary Islands and Spain. White varieties are assessed in all five countries.

A diagrammatic outline of the various stages of the programme is given in Appendix 1 and shows that the potato-breeding programme is a continuous process with seedlings at all stages of evaluation each year. It also shows the number of seedlings under evaluation at each stage of the programme.

The evaluation process continues from **year 7** onwards with seedlings being evaluated in trials in Ireland, the United Kingdom and Mediterranean regions. In **year 9**, seedlings considered to have a potential in one or more countries are entered for Irish National List Trials and Plant Variety Rights.

### ***Propagation of Virus Tested Stocks***

The objective of this programme is to ensure that an adequate quantity of virus tested seed is available for multiplication under the Seed Certification Scheme when a new potato variety is recommended for release. It is also designed to produce high quality seed for the commercial evaluation of seedlings at home and abroad.

Samples of all clones are tested for virus infection using the ELISA technique (Baker, *et al.*, 1993). All advanced clones are also tested for the presence of potato spindle tuber viroid (PSTV) using the nucleic spot hybridisation test and for ring-rot using the immuno-flourescent technique. All infected clones are discarded prior to planting in the field.

The field multiplication of virus-tested stocks of new potato seedlings is conducted at the isolation centre in Co. Wicklow. This covers an area of approximately 10 ha and is made up of plots varying in size from single-plant plots to 1,500-plant plots. All plants from year 4 onwards are sampled and tested serologically for PVX, PVS, PVA, PVM, PVY and PLRV using the

enzyme linked immunosorbent assay (ELISA) technique. Visual inspections are carried out at weekly intervals and the health status is confirmed by the inspection service of the Department of Agriculture, Food and Rural Development.

Seed of selected seedlings are sent for trial to different countries while the remainder is used for further propagation, disease resistance screening and demonstration. While National List Trials are being carried out a breeder's seed stock is handed over to the Teagasc agent, Irish Potato Marketing Ltd. so that when a new variety is named, National Listed and obtains Plant Breeder's Rights adequate seed stocks are available for initial commercial assessment at farm level. In year 8, meristem-tip cultures of all seedlings are handed over to the Department of Agriculture, Food and Rural Development to provide the initial propagation material for future multiplication under the Irish Seed Certification Scheme. Using the same technique old cultivars are cleared of virus infection and added to the collection of virus-free stocks of cultivars.

### ***Disease Resistance Screening***

Disease resistance is an important objective of the potato breeding programme and all advanced seedlings are tested for resistance to a wide range of commonly occurring diseases. Using standard laboratory and field techniques (Dorrance & Englis, 1997; Dowley, 1972; Dowley, et al., 1999; Langton, 1971; Malcolmson, 1976; Platt & McRae, 1990; Stewart et al., 1983 and Wastie & Bradshaw, 1995), seedlings are tested for resistance to wart disease (*Synchytrium endobioticum*), foliage and tuber blight (*Phytophthora infestans*), common scab (*Streptomyces scabies*), dry-rot (*Fusarium caeruleum*), gangrene (*Phoma exigua* var *foveata*), *Rhizoctonia* (*Rhizoctonia solani*), powdery scab (*Spongospora subterranea*), black leg (*Erwinia caratovora* var *atroseptica*), potato virus X (PVX), virus Y (PVY) and potato leaf roll virus (PLRV). Testing commences when seedlings have reached their seventh year of commercial evaluation and continues until a seedling is discarded or released as a new cultivar.

## **RESULTS**

### ***Breeding***

A total of 24 varieties produced in Oak Park have been named and released. These include Amber, Ambo, Anna, Avondale, Balmoral, Banba, Barna, Burren, Cara, Clada, Colleen, Cultra, Druid, Emma, Glenroe, Malin, Mizen, Orla, Red Cara, Rooster, Shannon, Slaney, Tulla and Tuskar. The commercial characteristics of these varieties are given in Table 2. Since 1974, Oak Park varieties as a percentage of all varieties on the Irish Certified Seed List have increased consistently (Fig. 1) The total area of certified seed occupied by Oak Park potato varieties has also increased steadily, although some of this seed is now produced outside the State (Fig. 2).

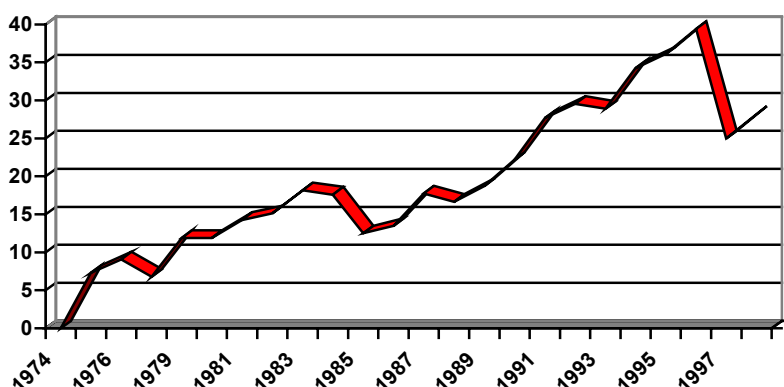


Fig. 1: Oak Park potato varieties as a % of all varieties on Irish Certified Seed List

**Cara** has been the most successful of the varieties bred to date, with seed being exported to at least ten countries. In recent years, about 15,000 tons of Cara seed is sold each year by Irish Potato Marketing Ltd. with overall seed sales of Oak Park varieties ranging from 27-30,000 tons. In 1996 Cara occupied 9.8% of the maincrop area in Great Britain. Ambo, Burren, Slaney, Avondale, Red Cara and Barna are the most important of the other varieties for the seed export trade. Some Rooster is exported to the Canary Islands and England but its main market is in Ireland.

In the initial years of commercialisation Cara was grown exclusively in Ireland with a large volume of seed exports reaching a peak of 15,011 tons in 1984. Due to lower seed prices in England, higher transport costs, and certain production problems, seed growing for the British market was moved to Scotland and exports from Ireland decreased.

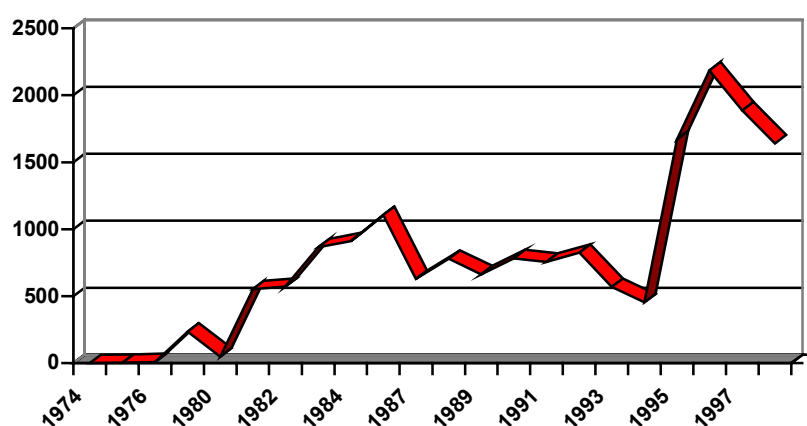


Fig. 2: Total certified seed area for Oak Park potato varieties in hectares

**Rooster** was placed on the Irish National List and granted Plant Variety Rights in Ireland in 1990. The initial commercialisation started in 1991 when 29.5 ha were grown and its progress to date is set out in Table 1.

Table 1: Evolution of Rooster growing

Year	Area		% of total potato area
	Ha	Acres	
1991	29.5	73	0.2
1992	132.0	326	0.8
1993	310.5	745	1.9
1994	608.3	1503	3.6
1995	1058.3	2922	6.6
1996	2206.8	5453	12.2
1997	2081.3	5143	13.6
1998	2790.0	6894	17.6

Source: An Bord Glas National Potato Census 1991-1998

Rooster has established a considerable share of the ware market in Ireland since it was introduced in 1991–1992 and has been the second most widely grown variety for the past two years. It is very suitable for boiling, steaming, mashing, roasting, baking, chipping and can be used whole or mashed cold in salads. This universal appeal has enabled it to achieve a considerable demand and a premium price in the market place. It presently accounts for 18% of the total ware area and is likely to expand further. The value to the economy achieved by the introduction of Rooster has meant a potential 15-20% increase in saleable yields. When calculated on the 1998 area of 2,790 ha, this would mean that the same area would yield an extra 5-8 tonnes/ha and allow growers to compete more effectively with imports. In the 1998-1999 season, growers an additional income of IR£750-IR£1,200 per ha. or approximately £2.8m nationally. A description of the 6 most important varieties is given in Appendix 2.

### ***Disease Resistance Testing***

Disease resistance testing methods have been developed (Dowley, 1972; Dowley *et al.*, 1999) and commercial cultivars have been assessed for disease resistance (Dowley, 1969; Dowley, 1972; Dowley *et al.*, 1991). Many of the new varieties were found to possess high levels of disease resistance and could make a significant contribution to reducing disease losses in potato production (Table 3). Most seedlings exhibit good resistance to common scab, black scurf, stem canker, foliage blight, tuber blight and virus diseases. However, resistance to powdery scab, black leg and dry rot is still relatively rare. The seedlings C2808/11 C1045/98 was found to have very high levels of horizontal resistance to foliage blight and have been sent to Mexico for further testing in the Toluca Valley.

### ***Propagation of virus tested Stocks***

With the advent of the ELISA test, problems with PLRV, PVX, PVA, PVM and PVS have been virtually eliminated from the isolation centre in Wicklow. Problems still exist in a few seedlings with the new strain of potato virus Y (PVY<sup>N</sup>). However, adequate quantities of virus tested stocks have always been available when required.

25,000-30,000 tons of Teagasc bred varieties were sold as certified seed over the last three years. This seed was grown in Ireland and Scotland and exported to England, Cyprus, Canary Islands, Egypt, Israel, Morocco, Greece, Spain, Portugal and the Azores.

## **DISCUSSION**

Since the early sixties the area under potatoes has declined dramatically but output has remained relatively stable due to consistently increasing yields and improved storage facilities.

In the past two decades the Oak Park varieties, particularly Cara, have contributed significantly to maintaining an Irish seed potato industry. Without the very positive influence of the Oak Park varieties there would be little or no seed export trade from Ireland. To develop the seed export it will be necessary to continue the flow of superior varieties from the potato breeding programme.

In a recent review commissioned by An Bord Glas (1997), the roles of the various State agencies involved with the Irish potato industry as well as the current competitiveness of the sector were considered. The strengths and weaknesses of the Irish Seed Potato sector were identified, key success factors outlined and recommendations to better achieve these key factors were then presented and related to target markets, current and long-term market requirements and funding of recommended activities. Measures to assist the long-term development of the sector include i) developing an adequate base for multiplying protected varieties and ii) developing an Irish potato breeding capability.

The potato breeding programme at Oak Park has now been in operation for nearly 40 years. During this period it has been extremely productive with 24 varieties being placed on the

National List. If one allows for a lead in period of 15 years, this represents approximately one new variety being registered each year since the mid-seventies when Cara was first commercialised. This has been achieved with the financial and marketing assistance of our agents, Irish Potato Marketing, without whose help this programme would not have been viable.

The future success of the programme will require the continued support of a commercial partner such as Irish Potato Marketing who can accurately identify future market requirements at home and abroad and aggressively promote new Teagasc varieties on these markets. New markets, outside the traditional export areas will need to be developed if the seed export trade is to be expanded from its present base. The future breeding programme will also need to incorporate new technologies, particularly molecular techniques which will allow the more rapid modification of germplasm to suit individual requirements. There is also a need to develop selection systems which will quickly and more economically identify the most desirable genotypes. A further requirement is to increase the level of mechanisation and to reduce labour inputs at a time of increasing labour shortage. These changes would insure that the breeding programme is on a proper footing to face the challenges of the new millennium.

## CONCLUSIONS

- Twenty-four new varieties have been produced for the domestic, processing and seed export trades
- Cara has been a most successful variety on the UK ware market where it reached over 10% of the ware market.
- Cara has been a major seed export variety to the Mediterranean markets
- Rooster is now the second most important variety on the domestic ware market
- Most varieties show high levels of disease resistance which will reduce production losses
- A number of new varieties and seedlings show excellent promise for the export trade

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## APPENDIX 1

Table 2: Characteristics of Oak Park Potato Varieties

VARIETY DETAILS	AMBER	AMBO	ANNA
Parentage	Craigs Royal x Gineke	Desiree x Cara	OP 4051/2 x Cara
<b>General Characteristic</b>			
<b>S</b>			
Earliness	5	6	6
Yield	7	7	8
Drought resistance	7	6	5
Eelworm resistance	S	S	R
<b>Tuber Characteristics</b>			
Size	7.5	8	7.5
Number	6	7	7.3
Shape	Oval	Oval-short oval	Oval
Skin colour	Deep Red	Creamy white with red eye & red splash	White with faint pink eye
Shallowness of eyes	8	6	8
Flesh colour	Yellow	Creamy White	Creamy White
<b>Consumer Quality</b>			
Dry matter content	6.5	6	5
Freedom from discolouration	8	7	6.8
Crisp colour	5.5	6.3	5.2
Overall eating	6	7	6

9 = Maximum expression of character, 1 = minimum expression of character, R = Resistant and S = Susceptible to *Globodora rostochiensis*

Table 2: Characteristics of Oak Park Potato Varieties (Cont.)

VARIETY DETAILS	AVONDALE	BALMORA	BANBA
Parentage	Ulster Glade x A 25/19	L Ulster Dale x OP 3211/6	Slaney x Estima



**General  
Characteristic**

<b>S</b>			
Earliness	3	8	6
Yield	8	7	8
Drought resistance	8	6	6
Eelworm resistance	R	R	R

<b>Tuber Characteristics</b>			
Size	7	7	7
Number	6	6	4
Shape	Oval	Oval	Oval
Skin colour	Creamy white	Creamy white with red eye & red splash	Creamy yellow, russety
Shallowness of eyes	8	8	8
Flesh colour	Creamy White	Light Yellow	Light Yellow

<b>Consumer Quality</b>			
Dry matter content	5	5	8.5
Freedom from discolouration	8	7.5	8
Crisp colour	5	5	5
Overall eating	6	6	6

9 = Maximum expression of character, 1 = minimum expression of character,  
R = Resistant and S = Susceptible to *Globodora rostochiensis*

**Table 2: Characteristics of Oak Park Potato Varieties (Cont.)**

<b>VARIETY DETAILS</b>	<b>BARNA</b>	<b>BURREN</b>	<b>CARA</b>
<b>Parentage</b>	<b>Desiree x Cara</b>	<b>Marfona x Spunta</b>	<b>Ulster Glade x A 25/19</b>
<b>General Characteristic</b>			
<b>S</b>			
Earliness	3	6	3
Yield	8.5	8	8.5
Drought resistance	8	5	8
Eelworm resistance	S	S	R
<b>Tuber Characteristics</b>			
Size	7.6	7.5	8
Number	7.7	7.6	6
Shape	Oval-long oval	Oval-long oval	Oval-short oval
Skin colour	Pink-red	Creamy yellow	Creamy yellow with red eye & red splash
Shallowness of eyes	8	7	7
Flesh colour	White	Yellow	Creamy white
<b>Consumer Quality</b>			
Dry matter content	7.5	4.5	6
Freedom from discolouration	6.5	7.7	8.3
Crisp colour	4	5.1	5
Overall eating	6	5	6

9 = Maximum expression of character, 1 = minimum expression of character,  
R = Resistant and S = Susceptible to Globodora rostochiensis

Table 2: Characteristics of Oak Park Potato Varieties (Cont.)

VARIETY DETAILS	CLADA	COLLEEN	CULTRA
Parentage	M7 x Ulster Premier	Manna x Mizen	Desiree x Cara
<b>General Characteristic</b>			
<b>S</b>			
Earliness	3	9	5.5
Yield	7	7	8
Drought resistance	7	7	7
Eelworm resistance	S	S	R
<b>Tuber Characteristics</b>			
Size	7	7	7
Number	?	6	7
Shape	Oval	Oval-short oval	Oval
Skin colour	Creamy white	Creamy yellow	Creamy yellow with red eye & red splash
Shallowness of eyes	8	8	7
Flesh colour	White	Light yellow	Creamy white
<b>Consumer Quality</b>			
Dry matter content	7	5	6.5
Freedom from discolouration	8.5	8.2	8
Crisp colour	4	6	5.3
Overall eating	7.5	6	6.1

9 = Maximum expression of character, 1 = minimum expression of character,  
R = Resistant and S = Susceptible to Globodora rostochiensis

Table 2: Characteristics of Oak Park Potato Varieties (Cont.)

VARIETY DETAILS	DRUID	EMMA	GLENROE
Parentage	Ulster Glade x A 25/19	Colleen x Estima	Dunbar Rover x Gineke
<b>General Characteristic</b>			
<b>S</b>			
Earliness	3	9	3
Yield	8	8	8
Drought resistance	8	6	7
Eelworm Resistance	R	5	S
<b>Tuber Characteristics</b>			
Size	7	8.5	7.5
Number	6	6.5	6
Shape	Oval-short oval	Short oval	Oval
Skin Colour	Deep red	Creamy yellow	Deep red
Shallowness of Eyes	7	8	8

<b>VARIETY DETAILS</b>	<b>DRUID</b>	<b>EMMA</b>	<b>GLENROE</b>
<b>Parentage</b>	<b>Ulster Glade x A 25/19</b>	<b>Colleen x Estima</b>	<b>Dunbar Rover x Gineke</b>
<b>General Characteristic</b>			
<b>S</b>			
Flesh Colour	Creamy white	Light yellow	Yellow
<b>Consumer Quality</b>			
Dry matter content	6	5	7.5
Freedom from discolouration	8	8.9	6
Crisp colour	5	5.7	6
Overall eating	6	5	7

9 = Maximum expression of character, 1 = minimum expression of character, R = Resistant and S = Susceptible to *Globodora rostochiensis*

Table 2: Characteristics of Oak Park Potato Varieties (Cont.)

<b>VARIETY DETAILS</b>	<b>MALIN</b>	<b>MIZEN</b>	<b>ORLA</b>
<b>Parentage</b>	<b>Estima x Cara</b>	<b>Ulster Ranger x A 25/19</b>	<b>OP 657/3 x Spunta</b>
<b>General Characteristic</b>			
<b>S</b>			
Earliness	7	6	9
Yield	7	7	7
Drought resistance	5	5	7
Eelworm Resistance	S	S	S
<b>Tuber Characteristics</b>			
Size	6	6	6.5
Number	7	7	7
Shape	Oval	Oval	Oval
Skin Colour	Creamy white with pink eye & pink splash	White	Creamy white
Shallowness of Eyes	8	9	8
Flesh Colour	Creamy white	White	Light yellow
<b>Consumer Quality</b>			
Dry matter content	5	6	5
Freedom from discolouration	8	8	8.5
Crisp colour	5	5.5	5
Overall eating	5.5	6	5

9 = Maximum expression of character, 1 = minimum expression of character, R = Resistant and S = Susceptible to *Globodora rostochiensis*

Table 2: Characteristics of Oak Park Potato Varieties (Cont.)

<b>VARIETY DETAILS</b>	<b>RED CARA</b>	<b>ROOSTER</b>	<b>SHANNON</b>
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Parentage	Ulster Glade X A 25/19	OP 2532/64 X P. Ivory	Olinda X Cara
<b>General Characteristic</b>			
<b>S</b>			
Earliness	3	5	7
Yield	8.5	8	7
Drought resistance	8	7	6
Eelworm Resistance	R	S	S
Tuber Characteristics			
Size	8	6.5	8.5
Number	6	8	5
Shape	Oval-short oval	Oval	Oval
Skin Colour	Pink-red with deep red eye	Deep red	Pink-red
Shallowness of Eyes	7	8	8
Flesh Colour	Creamy white	Light yellow	Creamy white
Consumer Quality			
Dry matter content	5.5	7.5	4.5
Freedom from discolouration	8.3	9	7.4
Crisp colour	5	7.5	4.6
Overall eating	6	8	5

9 = Maximum expression of character, 1 = minimum expression of character,  
R = Resistant and S = Susceptible to *Globodora rostochiensis*

Table 2: Characteristics of Oak Park Potato Varieties (Cont.)

VARIETY DETAILS	SLANEY	TULLA	TUSKAR
Parentage	Maris Page x Cara	P. Dell x Cara	Ulster Prince x Record
<b>General Characteristic</b>			
<b>S</b>			
Earliness	3	6	9
Yield	8.5	7	7
Drought resistance	8	6.5	8
Eelworm Resistance	R	R	S
Tuber Characteristics			
Size	8.5	7	6
Number	6	7	8
Shape	Oval-short oval	Oval-long oval	Oval-short oval
Skin Colour	White	White	White
Shallowness of Eyes	8	8	7
Flesh Colour	White	Creamy white	Creamy white
Consumer Quality			
Dry matter content	6	6.5	4.5
Freedom from discolouration	8	8	6
Crisp colour	4	4.6	6

VARIETY DETAILS	SLANEY	TULLA	TUSKAR
Parentage	Maris Page x Cara	P. Dell x Cara	Ulster Prince x Record

**General  
Characteristic**

S			
Overall eating	6	7.6	5

9 = Maximum expression of character, 1 = minimum expression of character,  
R = Resistant and S = Susceptible to Globodora rostochiensis

**Table 3: Disease resistance of Oak Park potato varieties compared with Kerr's Pink and Home Guard**

Variety	War t	Comm on scab	Powder y scab	Black leg	Black scurf	Stem canke r	Foliage blight
Amber	I	7	NT	NT	NT	NT	5
Ambo	S	6	5	5	6	5	4
Anna	I	7	3	4	7	5	4
Avondale	I	7	3	6	6	4	7
Balmoral	I	6	6	NT	7	7	4
Banba	I	7	6	1	6	6	8
Barna	I	6	3	7	8	5	6
Burren	S	6	4	5	7	4	4
Cara	I	7	3	6	6	4	7
Clada	I	5	NT	NT	NT	NT	8
Colleen	I	6	4	3	7	5	3
Cultra	I	6	NT	NT	NT	NT	5
Druid	I	8	4	6	7	3	8
Emma	I	5	NT	NT	NT	NT	3
Glenroe	S	7	NT	NT	NT	NT	6
Malin	I	7	NT	3	7	6	4
Mizen	I	5	NT	NT	NT	NT	9
Orla	I	6	3	6	6	3	6
Red Cara	I	7	3	6	6	4	7
Rooster	I	6	6	7	6	5	4
Shannon	I	7	3	4	6	4	4
Slaney	S	6	5	5	8	4	7
Tulla	I	7	5	5	7	6	6
Tuskar	I	6	NT	NT	NT	NT	4
Home Guard	I	5	8	6	7	4	3
Kerr's Pink	I	5	5	6	7	5	5

9 = Greatest level of resistance, R = Resistant (field immune),  
S = Susceptible, I = Immune, NT = Not tested

**Table 3: Disease resistance of Oak Park potato varieties compared with Kerr's Pink and Home Guard (Cont.)**

Variety	Tuber blight	Gangrene	Dry rot	PVX	PVY	PLRV
Amber		6	7	6	S	NT

Ambo	5	6	3	I	8	5
Anna	4	6	7	I	6	3
Avondale	8	4	7	I	5	6
Balmoral	4	3	4	S	5	5
Banba	5	4	3	I	NT	NT
Barna	4	6	4	I	5	4
Burren	7	2	4	S	7	8
Cara	8	4	7	I	5	6
Clada	8	5	6	S	NT	NT
Colleen	6	4	7	S	6	3
Cultra	5	5	4	I	4	3
Druid	8	NT	6	I	NT	NT
Emma	4	3	7	NT	NT	NT
Glenroe	7	7	7	S	6	4
Malin	8	4	3	I	4	6
Mizen	9	5	7	S	7	5
Orla	7	4	2	S	7	5
Red Cara	8	4	7	I	5	6
Rooster	6	4	4	S	5	7
Shannon	5	5	6	S	3	8
Slaney	5	6	6	I	5	2
Tulla	7	5	5	I	5	3
Tuskar	8	6	6	S	7	6
Home Guard	3	3	5	S	6	6
Kerr's Pink	4	5	5	S	4	5

9 = Greatest level of resistance, R = Resistant (field immune)  
S = Susceptible, I = Immune, NT = Not tested

## AMBO



Figure 1: Ambo

**BREEDER:** Teagasc, Oak Park Research Centre,  
Carlow, Ireland

**PARENTAGE:** Desiree X Cara  
**MATURITY:** Early Maincrop

**BREEDER:** Teagasc, Oak Park Research Centre,  
Carlow, Ireland

**YIELD:** Very high yield  
**TUBERS:** Large, oval to short-oval, partly coloured. Eyes with distinct eyebrows, creamy white flesh.

**QUALITY:** Suitable for boiling, baking and steaming, etc. Attractive skin finish, medium dry matter. Relatively free from after cooking discolouration and enzymic browning.

**VIRUS DISEASES:** Field immune to PVX. Fairly resistant to PVY.

**OTHER DISEASES:** Slightly susceptible to foliage blight but fairly resistant to tuber blight. Moderately resistant to common scab and stem canker. Slightly susceptible to black scurf.

## **BARNA**



**Figure 2:** Barna

**BREEDER:** Teagasc, Oak Park Research Centre,  
Carlow, Ireland

**PARENTAGE:** Desiree X Cara

**MATURITY:** Late maincrop

**YIELD:** Very high yield of uniform tubers

**TUBERS:** Medium to large, oval to long oval. Bright red skin with white flesh and shallow eyes.

**QUALITY:** Suitable for boiling, baking and steaming. It is a firm multipurpose potato that does not disintegrate on boiling. It is relatively free from after cooking discolouration and enzymic browning.

**VIRUS DISEASES:** Field immune to PVX, slightly susceptible to PLRV.

**OTHER DISEASES:** Moderately resistant to stem canker, foliage blight and common scab. Slightly susceptible to black scurf. Fairly resistant to gangrene and tuber blight.

## CARA



Figure 3: Cara

<b>BREEDER:</b>	<b>Teagasc, Oak Park Research Centre, Carlow, Ireland</b>
<b>PARENTAGE:</b>	Ulster Glade X 3070d3
<b>MATURITY:</b>	Late maincrop
<b>YIELD:</b>	Very high yield
<b>TUBERS:</b>	Medium to large, short oval to round. White skin with red eye and red splash. Cream flesh and shallow eyes.
<b>QUALITY:</b>	Good for boiling, baking, free from disintegration. Good skin finish and medium dry matter. Free from after cooking discolouration and enzymic browning.
<b>VIRUS DISEASES:</b>	Field immune to PVA, immune to PVX, very resistant to PVY resistant to PLRV.
<b>OTHER DISEASES:</b>	High resistance to foliage and tuber blight and common scab. Moderately resistant to dry rot. Susceptible to gangrene and powdery scab. Resistant to (RO1) <i>Globodera Rostochiensis</i>



## COLLEEN



Figure 4: Colleen

<b>BREEDER:</b>	<b>Teagasc, Oak Park Research Centre, Carlow, Ireland</b>
<b>PARENTAGE:</b>	Manna X Mizen
<b>MATURITY:</b>	First early
<b>YIELD:</b>	Medium high yield of regular tubers
<b>TUBERS:</b>	Medium large, short oval. Creamy yellow skin, light yellow flesh and shallow eyes.
<b>QUALITY:</b>	Suitable for boiling, baking and steaming, etc. It is a firm potato, has a good skin finish and does not disintegrate on boiling. Free from after cooking discolouration and enzymic browning.
<b>VIRUS DISEASES:</b>	Moderately resistant to PVY.
<b>OTHER DISEASES:</b>	Resistant to tuber blight. Moderately resistant to dry rot, black scurf and common scab. Slightly resistant to gangrene.

## RED CARA



Figure 5: Red Cara

<b>BREEDER:</b>	<b>Teagasc, Oak Park Research Centre, Carlow, Ireland</b>
<b>PARENTAGE:</b>	Ulster Glade X 3070d3
<b>MATURITY:</b>	Late maincrop
<b>YIELD:</b>	Very high yield
<b>TUBERS:</b>	Medium to large, short oval to round. Red skin with red eye, creamy flesh and shallow eyes.
<b>QUALITY:</b>	Good for boiling, baking and steaming Free from disintegration. Good skin finish and medium dry matter. Free from after cooking discolouration and enzymic browning.
<b>VIRUS DISEASES:</b>	Field immune to PVA, immune to PVX, very resistant to PVY and resistant to PLRV.
<b>OTHER DISEASES:</b>	High resistance to foliage and tuber blight and common scab. Moderately resistant to dry rot. Susceptible to gangrene and powdery scab. Resistant to (RO1) <i>Globodera Rostochiensis</i>

## ROOSTER



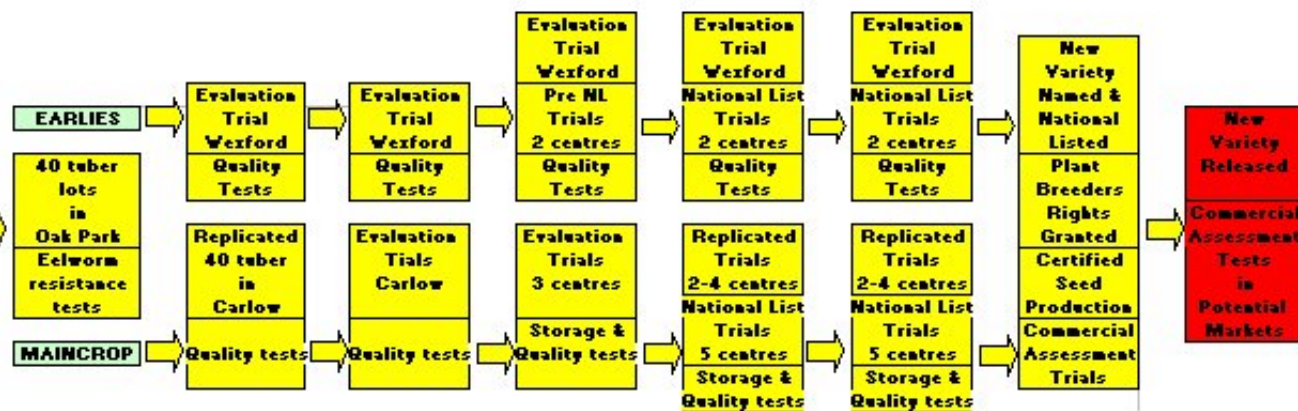
Figure 6: Rooster

<b>BREEDER:</b>	<b>Teagasc, Oak Park Research Centre, Carlow, Ireland</b>
<b>PARENTAGE:</b>	OP 2532/64 X Pentland Ivory
<b>YIELD:</b>	High
<b>TUBERS:</b>	Average size, oval to short oval. Red skin with light yellow to yellow flesh and shallow eyes.
<b>QUALITY:</b>	Excellent for boiling, baking, steaming and chipping (french fries). It has a good skin finish and high dry matter. Free from after cooking discolouration and enzymic browning. Very suitable for crisping.
<b>VIRUS DISEASES:</b>	Moderately resistant to virus Y and resistant to PLRV
<b>OTHER DISEASES:</b>	Susceptible to foliage blight but resistant to tuber blight. Susceptible to dry rot. Moderately resistant to stem canker and common scab.

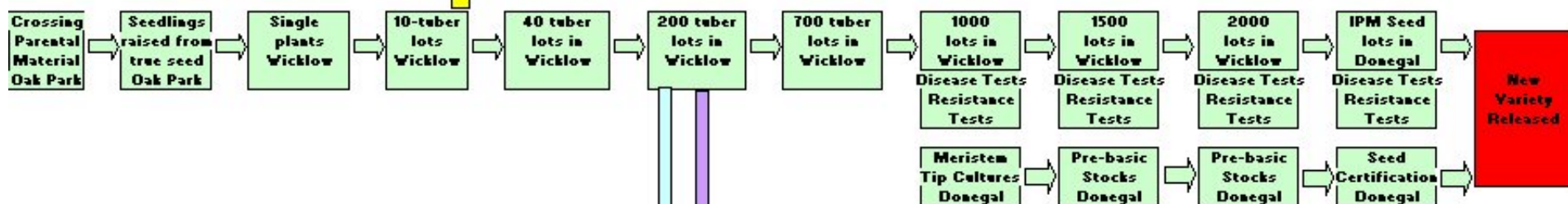
## ***APPENDIX 2***

YEAR 1    YEAR 2    YEAR 3    YEAR 4    YEAR 5    YEAR 6    YEAR 7    YEAR 8    YEAR 9    YEAR 10    YEAR 11    YEARS 12-14

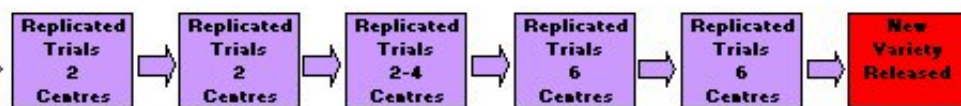
### Seedling Evaluation in Ireland



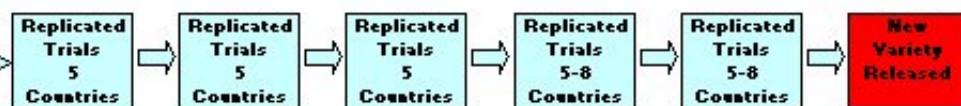
### Production of Virus Tested Stocks



### Seedling Evaluation in the United Kingdom



### Seedling Evaluation in the Mediterranean Region



**Numbers**    90,000    760,000    4,000    300    100    40    12    6    3    2    1

**Figure 7: Outline of Teagasc Potatoe Breeding and Evaluation Programme**