

POTATO BREEDING AT OAK PARK 2000-2006

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SUMMARY

The Potato Breeding Project at Oak Park Research Centre with associated variety evaluation, seed production and disease resistance testing programmes has been in progress since the 1960's. A total of 33 varieties have been named. Some of these varieties are very successful in a range of countries while others are no longer commercially grown.

During the 6 years of the current project (RMIS NO 4270) a total of 8 new potato varieties have been named and released. These include Camelot, Carnaval, Galactica, Kikko, Habibi, Nectar, Savanna and Setanta. These varieties have all been granted Irish and EU Plant Breeders Rights (PBR) and have been included on the Irish National List and the European Common Catalogue.

As these varieties are relatively new to the market, their full commercial potential is still to be established. A full description of each variety, including agronomic characteristics and disease resistance is included in pages 9-24.

INTRODUCTION

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 evaluation of the main domestic and foreign varieties for suitability for the Irish market. 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 both 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 1). This report covers the period 2001-2006 (RMIS NO 4720).

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 varieties with resistance to potato cyst eelworm *Globodera rostochiensis* and or *Globodera pallida* with quality suitable for the UK market.

3. Developing a superior quality, red skinned, white fleshed, early maincrop or maincrop variety suitable for the home ware trade with a high level of disease resistance, especially to blight.
4. To select early maincrop and maincrop varieties suitable for the general processing market.
5. Breeding first and second early varieties suitable for Irish and UK conditions with improved quality and disease resistance.

METHODS

The potato breeding project currently undertaken at Oak Park largely consists of three complimentary programmes. The main programme consists of breeding improved potato varieties for the processing, domestic and seed export markets. Two complementary programmes involve the production 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. Biotechnological techniques such as marker aided selection (MAS) are being gradually introduced to increase selection efficiency.

Year 1 entails the crossing of selected parental material to obtain true seed which should contain the desired commercial characteristics. In **year 2**, 100,000 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 again grown in the isolation centre the following year (**Year 4**). The seedlings are assessed at this stage on foliage cover, maturity, tuber size, evenness, appearance, defects and potential yield. Forty seed tubers are retained for further multiplication in the isolation centre in the Wicklow mountains, while the remaining tubers are used for commercial evaluation as replicated 20 tuber lots in the Carlow area the following year (**Year 5**). 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.

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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 from 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 continued evaluation in Ireland and initial evaluation for markets abroad. In the past, varieties were tested at a range of foreign trial sites on the basis of their suitability for that market. Currently, all year 6 seedlings are tested as single replicate observation plots in Morocco and north Spain. All advanced seedlings from year 7 onwards are tested in replicated trials in Morocco, Spain and the Canary Islands.

The evaluation process continues from **year 7** onwards with seedlings being evaluated in trials in Ireland, the United Kingdom and Mediterranean regions. In **year 10**, seedlings considered to have a potential in one or more countries are entered for Irish National List Trials and Plant Breeders Rights. Following the granting of Irish National Listing and Plant breeders rights in Ireland, documentation on each variety is submitted to the EU requesting EU Plant Breeders Rights and entry onto the European Common Catalogue.

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 which is free from potato cyst nematode. 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 and Food.

Seed of selected seedlings are sent for breeders trials to different countries while the remainder is used for further propagation, disease resistance screening and domestic trials. In year 8, meristem-tip cultures of all advanced seedlings are handed over to the Department of Agriculture and Food to provide the initial propagation material for mini-tuber production and future multiplication under the Irish and Scottish Seed Certification Schemes. This seed is exclusively used by the Teagasc agent, Irish Potato Marketing Ltd. for commercial assessment at home and abroad.

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, 1969; Dowley, 1972a; Dowley, 1972b; Dowley, *et al.*, 1991; 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*) and 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

During the 6 years of the current project (RMIS NO 4270) a total of 8 new potato varieties have been named and released. These include Camelot, Carnaval, Galactica, Kikko, Habibi, Nectar, Savanna and Setanta. These varieties have all been granted Irish and EU Plant Breeders Rights (PBR) and have been included on the Irish National List and the European Common Catalogue.

Camelot: This is a parti-coloured, early maincrop variety for the UK and Mediterranean markets.

Carnaval: This is a deep red, late maincrop variety for the Middle East and Mediterranean markets.

Galactica: This is a parti-coloured, early variety for the UK and Mediterranean markets.

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Kikko: This is a creamy yellow, late maincrop variety for the Mediterranean market.

Habibi: This is a parti-coloured, late maincrop variety for the UK and Mediterranean markets.

Nectar: This is a creamy yellow (with slight red eye), early maincrop variety for pre-pack and punnet market.

Savana: This is a creamy yellow, maincrop variety for the Mediterranean pre-pack market.

Setanta: This is a deep red, late maincrop variety with high blight resistance and good eating quality for the Irish and UK organic markets.

As these varieties are relatively new to the market, their full commercial potential is still to be established. A full description of each variety, including agronomic characteristics and disease resistance is included in pages 9-24.

Propagation of virus tested Stocks

Problems with PLRV, PVX, PVA, PVM and PVS have been virtually eliminated from the isolation centre in Wicklow. Problems still exist with the new strain of potato virus Y (PVY^N). However, adequate quantities of virus tested stocks have always been available to supply all requirements..

25,000-30,000 tons of Teagasc bred varieties were sold as certified seed in each of the last six 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 as well as Ireland.

Disease Resistance Screening

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. Most seedlings exhibit good resistance to common scab, black scurf, foliage blight, tuber blight and gangrene. However, resistance tests for black leg, black dot and silver scurf should be included in future breeding programmes.

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.

The Oak Park varieties, particularly Cara, have contributed significantly to maintaining an Irish seed potato industry while Rooster has been the mainstay of the Irish ware industry. Without the very positive influence of the Oak Park varieties there would be a much reduced Irish seed industry and little or no seed export trade from Ireland. To develop the seed export trade it will be necessary to continue the flow of superior varieties from the potato breeding programme. While the full commercial impact of the eight new varieties is yet to be fully established, it is expected that they will have a positive impact on the seed export trade.

The potato breeding programme at Oak Park has now been in operation for 45 years. During this period it has been extremely productive with 33 varieties being placed on the National List. If one allows for a lead in period of 15 years, this represents more than 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 genetic engineering 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

- Eight new varieties have been produced for the domestic, processing and seed export trades
- Most varieties show high levels of disease resistance which will reduce production losses
- A number of the new varieties show excellent promise for the export trade

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A complete description for each of the 8 varieties is given in alphabetical order in pages 9-24. The 1-9 figure quoted for most traits is the best information available at the date of printing. However, these figures are subject to change over time as the data bank on each variety increases.

KEY TO VARIETY DECSCRIPTORS

1 = Lowest expression of character (i.e. lowest disease resistance)

9 = Highest expression of character (i.e. highest disease resistance)

RG1 = Immune to European race 1 of wart disease

RG2 = Field immune to European race 1 of wart disease

I = Immune

R_o1 = Resistant to race 1 of *Globodera rostochiensis*

S = Susceptible

NT = Not tested

CAMELOT

BREEDER: Crops Research Centre, Oak Park, Carlow, Ireland
PARENTAGE: Malin x Picasso (T1583/73)
AGENT: Irish Potato Marketing
IRISH NL: 21/01/2003
IRISH PBR: Grant No. 379, 01/04/2003
UK PBR: No application made
EU COM. CAT. 08/05/2003
EU PBR: File No. EU13124, 19/04/2004

GENERAL CHARACTERISTICS

Earliness	Yield	Tuber Appearance	Market
7	7.5	7.8	UK & Mediterranean

TUBER CHARACTERISTICS

Size	Number	Shape	Skin Colour	Shallowness of eyes	Flesh Colour
7.3	7.1	Oval – long oval	Creamy yellow + red eye & splash	8	White

CONSUMER QUALITY

Dry Matter Content	Freedom from discolouration	Crisp Colour	Overall Eating
3	7.4	3.1	5.7

DISEASE RESISTANCE

Wart	Common Scab	Powdery Scab	Black leg	Black Scurf	Stem Canker	Foliage Blight
RG2	8	NT	NT	8	NT	4

Tuber Blight	Gangrene	Dry Rot	PVX	PVY	PLRV	Eelworm
1	5	2	NT	NT	NT	R ₀ 1

CAMELOT



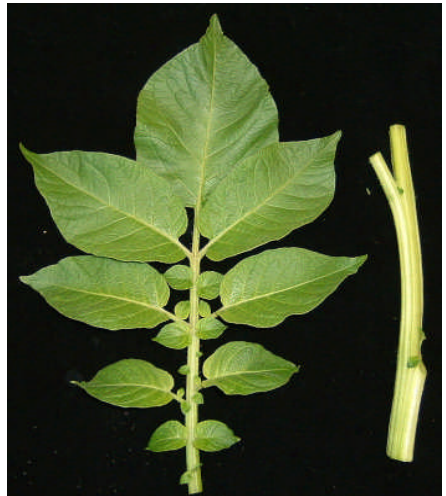
TUBER



SPROUT



FLOWER



LEAF/STEM

CARNAVAL

BREEDER: Crops Research Centre, Oak Park, Carlow, Ireland
PARENTAGE: Bartina x Picasso (T958/7)
AGENT: Irish Potato Marketing
IRISH NL: 18/07/2005
IRISH PBR: Grant No. 391, 14/07/2005
UK PBR: No application made
EU COM. CAT. 04/12/06
EU PBR: File No. EU 18728

GENERAL CHARACTERISTICS

Earliness	Yield	Tuber Appearance	Market
3.8	8.5	7.6	Middle East & Mediterranean

TUBER CHARACTERISTICS

Size	Number	Shape	Skin Colour	Shallowness of eyes	Flesh Colour
8	7	Oval – long oval	Deep red	8	Light yellow

CONSUMER QUALITY

Dry Matter Content	Freedom from discolouration	Crisp Colour	Overall Eating
5	8.3	4.4	6.6

DISEASE RESISTANCE

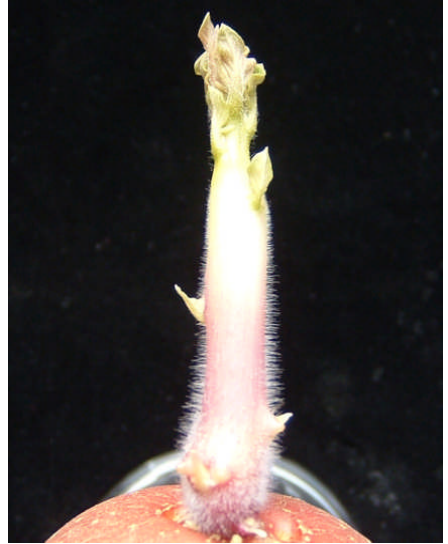
Wart	Common Scab	Powdery Scab	Black leg	Black Scurf	Stem Canker	Foliage Blight
RG1	8	NT	NT	9	NT	5

Tuber Blight	Gangrene	Dry Rot	PVX	PVY	PLRV	Eelworm
3	5	6	NT	NT	NT	R ₀ 1

CARNAVAL



TUBER



SPROUT



FLOWER



LEAF STEM

GALACTICA

BREEDER:	Crops Research Centre, Oak Park, Carlow, Ireland
PARENTAGE:	Torridon x Picasso (T1399/17)
AGENT:	Irish Potato Marketing
IRISH NL:	28/01/2003 (as Cristina)
IRISH PBR:	Grant No. 378, 11/11/2004
UK PBR:	No application made
EU COM. CAT.	28/02/2006
EU PBR:	File No. EU13892, 13/09/2004

GENERAL CHARACTERISTICS

Earliness	Yield	Tuber Appearance	Market
6.4	7.5	7.3	UK & Mediterranean

TUBER CHARACTERISTICS

Size	Number	Shape	Skin Colour	Shallowness of eyes	Flesh Colour
7.3	7.2	Oval – long oval	Creamy yellow + red eye & splash	8	Light yellow

CONSUMER QUALITY

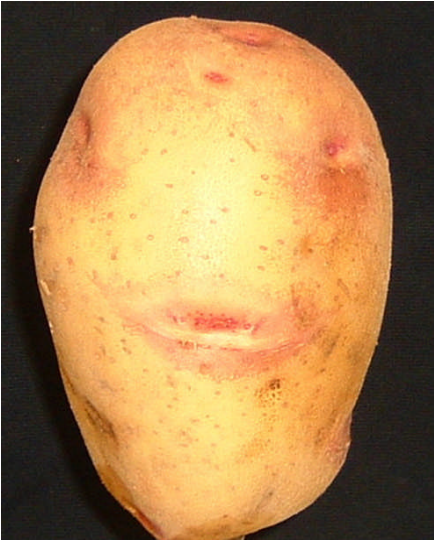
Dry Matter Content	Freedom from discolouration	Crisp Colour	Overall Eating
4	9	4	6.3

DISEASE RESISTANCE

Wart	Common Scab	Powdery Scab	Black leg	Black Scurf	Stem Canker	Foliage Blight
S	7.8	NT	NT	7	NT	7

Tuber Blight	Gangrene	Dry Rot	PVX	PVY	PLRV	Eelworm
4	5.5	2.4	NT	NT	NT	R ₀ 1

GALACTICA



TUBER



SPROUT



FLOWER



LEAF/STEM

HABIBI

BREEDER: Crops Research Centre, Oak Park, Carlow, Ireland
PARENTAGE: Famosa x Cara (T1543a92)
AGENT: Irish Potato Marketing
IRISH NL: 19/12/2003
IRISH PBR: Grant No. 389, 11/11/2004
UK PBR: No application made
EU COM. CAT. 23/06/2006
EU PBR: File No. EU 16882, 13/2/2006

GENERAL CHARACTERISTICS

Earliness	Yield	Tuber Appearance	Market
3	8.5	7.4	UK & Mediterranean

TUBER CHARACTERISTICS

Size	Number	Shape	Skin Colour	Shallowness of eyes	Flesh Colour
8.2	7.1	Oval – long oval	Creamy yellow + red eye & splash	8	Light yellow - yellow

CONSUMER QUALITY

Dry Matter Content	Freedom from discolouration	Crisp Colour	Overall Eating
4	7.5	3.4	6

DISEASE RESISTANCE

Wart	Common Scab	Powdery Scab	Black leg	Black Scurf	Stem Canker	Foliage Blight
RG1	7	NT	NT	9	NT	6.5

Tuber Blight	Gangrene	Dry Rot	PVX	PVY	PLRV	Eelworm
7.5	5	1.5	NT	NT	NT	R ₀ 1

HABIBI



TUBER



SPROUT



FLOWER



LEAF/STEM

KIKKO

BREEDER: Crops Research Centre, Oak Park, Carlow, Ireland
PARENTAGE: Slaney x C1992/42 (T1670/19)
AGENT: Irish Potato Marketing
IRISH NL: 19/12/2003
IRISH PBR: 01/01/2004
UK PBR: No application made
EU COM. CAT. 23/06/2006
EU PBR: File No. EU14421, 06/12/2004

GENERAL CHARACTERISTICS

Earliness	Yield	Tuber Appearance	Market
3.4	8.5	7.5	Mediterranean

TUBER CHARACTERISTICS

Size	Number	Shape	Skin Colour	Shallowness of eyes	Flesh Colour
8	7	Oval-long oval	Creamy yellow	8	Light yellow - yellow

CONSUMER QUALITY

Dry Matter Content	Freedom from discolouration	Crisp Colour	Overall Eating
3	7.5	3.4	5.9

DISEASE RESISTANCE

Wart	Common Scab	Powdery Scab	Black leg	Black Scurf	Stem Canker	Foliage Blight
S	5.9	NT	NT	9	NT	7.7

Tuber Blight	Gangrene	Dry Rot	PVX	PVY	PLRV	Eelworm
4.8	5	2	NT	NT	NT	S

KIKKO



TUBER



SPROUT



FLOWER



LEAF/STEM

NECTAR

BREEDER: Crops Research Centre, Oak Park, Carlow, Ireland
PARENTAGE: Famosa x Red Cara (T1903/48)
AGENT: Irish Potato Marketing
IRISH NL: 18/07/2005
IRISH PBR: Grant No. 390, 14/07/2005
UK PBR: No application made
EU COM. CAT. 03/07/2006
EU PBR: File No. EU 18015

GENERAL CHARACTERISTICS

Earliness	Yield	Tuber Appearance	Market
5.4	7.5	8	Pre-pack & punnet

TUBER CHARACTERISTICS

Size	Number	Shape	Skin Colour	Shallowness of eyes	Flesh Colour
6.5	7.8	Oval – long oval	Creamy yellow + faint red eye	8.3	Light yellow

CONSUMER QUALITY

Dry Matter Content	Freedom from discolouration	Crisp Colour	Overall Eating
4	8.4	3.7	6

DISEASE RESISTANCE

Wart	Common Scab	Powdery Scab	Black leg	Black Scurf	Stem Canker	Foliage Blight
RG1	6.2	NT	NT	4	NT	4.5

Tuber Blight	Gangrene	Dry Rot	PVX	PVY	PLRV	Eelworm
8	7	2	NT	NT	NT	S

NECTAR



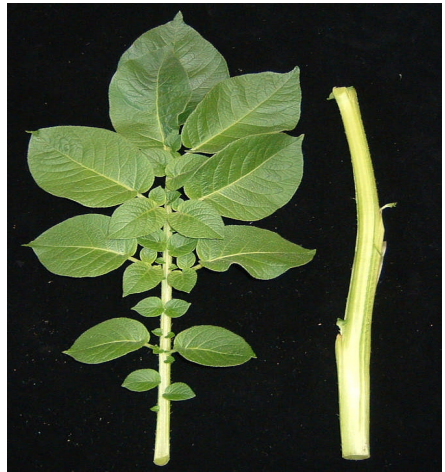
TUBER



SPROUT



FLOWER



LEAF/STEM

SAVANNA

BREEDER: Crops Research Centre, Oak Park, Carlow, Ireland
PARENTAGE: Famosa x Atlantic (T1544/6)
AGENT: Irish Potato Marketing
IRISH NL: 22/12/2005
IRISH PBR: Grant No. 393, 14/02/2006
UK PBR: No application made
EU COM. CAT. 23/06/2006
EU PBR: File No EU 19305, 05/03/2007

GENERAL CHARACTERISTICS

Earliness	Yield	Tuber Appearance	Market
5	7	8	Mediterranean pre-pack

TUBER CHARACTERISTICS

Size	Number	Shape	Skin Colour	Shallowness of eyes	Flesh Colour
7.3	6	Round	Creamy yellow	8	White

CONSUMER QUALITY

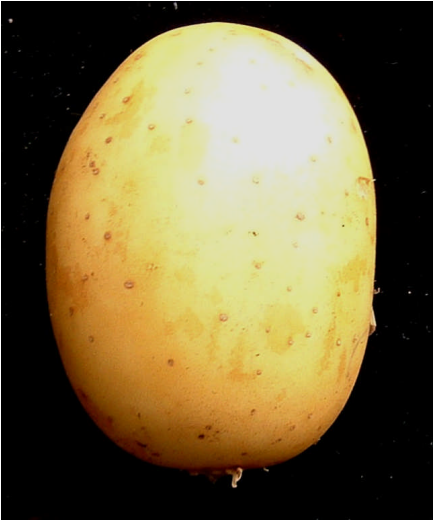
Dry Matter Content	Freedom from discolouration	Crisp Colour	Overall Eating
6	6.5	3.6	6.2

DISEASE RESISTANCE

Wart	Common Scab	Powdery Scab	Black leg	Black Scurf	Stem Canker	Foliage Blight
RG2	7.7	NT	NT	7	NT	4.7

Tuber Blight	Gangrene	Dry Rot	PVX	PVY	PLRV	Eelworm
8	NT	1.3	NT	NT	NT	S

SAVANNA



TUBER



SPROUT



FLOWER



LEAF/STEM

SETANTA

BREEDER: Crops Research Centre, Oak Park, Carlow, Ireland
PARENTAGE: Brodick x Rooster (T1823/10)
AGENT: Irish Potato Marketing
IRISH NL: 19/12/2003
IRISH PBR: Grant No. 387, 01/04/2004
UK PBR: No application made
EU COM. CAT. 23/06/2006
EU PBR: File No. EU14420, 06/12/2004

GENERAL CHARACTERISTICS

Earliness	Yield	Tuber Appearance	Market
4	6.5	6.5	Irish and UK organic & processing markets

TUBER CHARACTERISTICS

Size	Number	Shape	Skin Colour	Shallowne ss of eyes	Flesh Colour
7.3	6.8	Short oval	Deep red slightly russet	8	Yellow

CONSUMER QUALITY

Dry Matter Content	Freedom from discolouration	Crisp Colour	Overall Eating
8	8.8	6.9	7.5

DISEASE RESISTANCE

Wart	Common Scab	Powdery Scab	Black leg	Black Scurf	Stem Canker	Foliage Blight
RG1	7	NT	NT	7.5	NT	8.3

Tuber Blight	Gangrene	Dry Rot	PVX	PVY	PLRV	Eelworm
7.8	8	9	NT	2	7	S

SETANTA



TUBER



SPROUT



FLOWER



LEAF/STEM

