Research Report

Independent Variety Trials 2007

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1. SUMMARY FOR GROWERS

1.1 Project Aims

In order to comply with both national and European Community legislation for the marketing of seed potatoes, all potato varieties must be placed on the official National List (NL) of a Member State. When this is achieved, the variety is automatically entered on to the Common Catalogue which is, in effect, an EC National List. Part of the NL testing involves assessing a new variety for Value for Cultivation and Use. In the UK, this testing is largely concentrated on assessing varietal performance for susceptibility to diseases, pests and some tuber quality characteristics considered to be of most importance in UK potato production. After a review of the Independent Variety Trials (IVT) programme, industry, through the British Potato Council (BPC), concluded that additional tests for some other diseases were also desirable in order to provide growers with the fullest information on the performance of new varieties before large scale production occurred. In addition, potato varieties on the Common Catalogue which are being developed for GB production were also to be tested to provide independent data on these varieties for GB growers. It was also decided that IVT tests would be conducted over 2 years and not 3 years as previously, and that industry alone would be responsible for conducting field trials to assess varietal performance with respect to yield and usage quality.

The integration of the IVT test programme with that of UK National List Value for Cultivation and Use test programme was achieved in 2005 by the consortium of Scottish Agricultural Science Agency (SASA), SAC Commercial Ltd (SAC), Biomathematics & Statistics for Scotland (BioSS) and Scottish Crop Research Institute (SCRI) which was awarded a 3 year contract to conduct the IVT programme. The tests conducted for IVT purposes were to determine varietal susceptibility to foliage late blight in the field, black dot, black scurf, silver scurf and skin spot.

1.2 Work Undertaken and Findings

In 2007, tests were conducted on 6 varieties undergoing their 2nd year of UK NL testing, 6 varieties which had completed UK NL tests and 7 Common Catalogue varieties (see Table 2). SASA conducted a test to determine susceptibility to foliage late blight at a site near Ayr. Pot tests for black dot and black scurf were conducted by SAC and tests for silver scurf and skin spot by SASA. The Common Catalogue varieties were also tested by SASA for susceptibility to tuber late blight, common scab, powdery scab, blackleg (*Pectobacterium atrosepticum*), dry rot (*Fusarium sulphureum* and *F. solani* var. *coeruleum*), potato cyst nematodes (pathotypes of *Globodera rostochiensis* and *G. pallida*), external damage (splitting) and internal damage (bruising). In addition, Mayan Gold and Harmony were tested for susceptibility to dry rot species. All tests were completed satisfactorily.

Susceptibility/resistance was rated on 1-9 scale. Table 1 summarises the test results for 2006-07 but ratings shown in italic font are based on one year's test results and should be regarded as provisional.

Table 1. Summary of varietal ratings (1=low, 9=high) for resistance to diseases, pests and defects (provisional ratings are shown in italics, final ratings are in bold).

	Mozart	Toluca	Daisy	Fontane	Saphire	Sassy	Lady Claire	Sunray	Richhill	Upmarket	Lulu	Charlemont	Excalibur	Mayan Gold	Harmony	TX 15231	Gemson	Sparkle
Maturity	EM	EM	M	EM	EM	M	M	M	M	EM	2E	EM	M	M	E M	2E	2E	M
Foliage late blight (field)	*5*	*8*	*4*	**3**	**4**	**4**	**3**	*5*	*5*	*5*	*4*	*4*	*4*	**7**	**3**	**3**	**4**	**5**
Black dot	*9*	*8*	*6*	**3**	**5**	**5**	**3**	*1*	*6*	*7*	*5*	*7*	*7*	**6**	**9**	**5**	**5**	**7**
Black scurf	*4*	*6*	*7*	**6**	**2**	**3**	**4**	*6*	*6*	*1*	*9*	*9*	*4*	**9**	**6**	**1**	**4**	**7**
Silver scurf	*7*	*5*	*1*	**5**	**7**	**6**	**4**	*3*	*5*	*6*	*4*	*5*	*6*	**5**	**3**	**8**	**6**	**6**
Skin spot	*8*	*6*	*1*	**7**	**6**	**8**	**8**	*1*	*7*	*7*	*3*	*8*	*3*	**7**	**8**	**3**	**5**	**8**
Foliage late blight (lab)	nt	nt	nt	nt	nt	nt	nt	**5**	**6**	**6**	**6**	**4**	**5**	**4**	**5**	**4**	**4**	**5**
Tuber late blight	*7*	*4*	*5*	**5**	**4**	**5**	**4**	**7**	**6**	**1**	**7**	**3**	**5**	**4**	**3**	**1**	**2**	**5**
Blackleg- *Pectobacterium atrosepticum*	*6*	*6*	*8*	**5**	**9**	**9**	**4**	**6**	**7**	**8**	**6**	**2**	**9**	**5**	**3**	**6**	**8**	**6**
Powdery scab	*5*	*6*	*5*	**4**	**4**	**7**	**4**	**5**	**5**	**6**	**7**	**5**	**7**	**9**	**4**	**6**	**7**	**5**
Common scab	*6*	*5*	*5*	**5**	**6**	**4**	**6**	**5**	**5**	**7**	**7**	**5**	**5**	**7**	**6**	**6**	**5**	**4**
Dry rot – *Fusarium coeruleum*	*5*	*5*	*6*	**6**	**5**	**4**	**5**	**5**	**6**	**6**	**5**	**6**	**6**	**5**	**5**	**5**	**3**	**5**
Dry rot – *Fusarium sulphureum*	*2*	*3*	*1*	**4**	**1**	**6**	**5**	**1**	**4**	**4**	**1**	**4**	**5**	**1**	**3**	**8**	**1**	**2**
PCN Ro-1	**7**	**1**	**8**	**9**	**4**	**9**	**9**	**9**	**9**	**9**	**9**	**7**	**9**	**1**	**4**	**1**	**1**	**9**
PCN Pa 2/3	**2**	**2**	**2**	**2**	**3**	**4**	**4**	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**4**	**2**	**2**	**4**
External damage	*3*	*1*	*6*	**5**	**6**	**4**	**6**	**7**	**7**	**4**	**4**	**4**	**6**	**6**	**6**	**4**	**6**	**5**
Internal damage	*7*	*5*	*7*	**6**	**6**	**5**	**6**	**5**	**5**	**6**	**8**	**6**	**6**	**6**	**7**	**3**	**3**	**6**

nt = Not tested

1.3 Conclusions

In summary, the main findings (Resistant = 7 or more; Susceptible = 3 or less) for the test varieties, with final ratings in bold were as follows:

Gemson

Resistant to: **blackleg** and **powdery scab**

Susceptible to: **tuber late blight**, **dry rot- *F. coeruleum*** and ***F. sulphureum*,** **internal damage**, **PCN Ro1, Pa2/3 and 1.**

Mayan Gold

Resistant to: **foliage late blight**, **black scurf**, **skin spot**, **powdery scab and common scab**

Susceptible to: **dry rot– *F. sulphureum***, **PCN Ro1, Pa2/3 and 1**

Harmony

Resistant to: **black dot, skin spot** and **internal damage**

Susceptible to: **foliage** and **tuber late blight, silver scurf**, **blackleg and dry rot – *F.sulphureum***

TX 15231

Resistant to: **silver scurf** and **dry rot– *F. sulphureum***

Susceptible to: **foliage** and **tuber late blight**, **black scurf, skin spot**, **blackleg, internal damage, PCN Ro1, Pa 2/3 and 1.**

Sparkle

Resistant to: **black dot**, **black scurf, skin spot** and **PCN Ro1**

Susceptible to: **dry rot– *F. sulphureum*** and **PCN Pa 2/3 and 1**

Fontane

Resistant to: **skin spot** and **PCN Ro1**

Susceptible to: **foliage late blight**, **black dot** and **PCN Pa2/3 and 1**

Saphire

Resistant to: **silver scurf** and **blackleg**

Susceptible to: **black scurf, dry rot – *F.sulphureum*, PCN Ro1**

Lady Claire

Resistant to: **skin spot** and **PCN Ro1**

Susceptible to: **foliage late blight**, **black dot,** and **PCN Pa2/3 and 1.**

Sassy

Resistant to: **skin spot, blackleg, powdery scab** and **PCN Ro1**

Susceptible to: **black scurf.**

Mozart

Resistant to: *black dot, silver scurf, foliage late blight, internal damage* and **PCN Ro1**

Susceptible to: *dry rot – F. sulphureum*

Toluca

Resistant to: *foliage late blight* and *black dot,*

Susceptible to*: dry rot – F. sulphureum, external damage* and **PCN Ro1, Pa 2/3 and 1**

Daisy

Resistant to: *black scurf*, *blackleg* and **PCN Ro1**

Susceptible to: *silver scurf, skin spot, dry rot – F. sulphureum* and **PCN Pa2/3 and 1**

Sunray

Resistant to: **tuber late blight, external damage** and **PCN Ro1**

Susceptible to: *black dot, skin spot,* **dry rot – F. sulphureum** and **PCN Pa2/3 and 1**

Richhill

Resistant to: *skin spot*, **blackleg, external damage** and **PCN Ro1**

Susceptible to: **PCN Pa2/3 and 1**

Upmarket

Resistant to: *black dot, skin spot*, **blackleg, common scab** and **PCN Ro1**

Susceptible to: *black scurf***, tuber late blight** and **PCN Pa2/3 and 1**

Lulu

Resistant to: *black scurf,* **tuber late blight, powdery scab, common scab, internal damage** and **PCN Ro1**

Susceptible to: *skin spot,* **dry rot – F. sulphureum** and **PCN Pa2/3 and 1**

Charlemont

Resistant to: *black dot, black scurf, skin spot* and **PCN Ro1**

Susceptible to: **tuber late blight, blackleg** and **PCN Pa 2/3 and 1**

Excalibur

Resistant to: *black dot,* **blackleg, powdery scab** and **PCN Ro1**

Susceptible to: *skin spot* and **PCN Pa2/3 and 1**

2. EXPERIMENTAL REPORT

2.1 INTRODUCTION

A review of the UK National List programme was concluded in 2004 and the various varietal characteristics were prioritised according to national importance and to industry. In consultation with industry stakeholders, it was also agreed that closer co-operation with IVT funded by BPC would be advantageous in minimising duplication of testing and in ensuring that the decision making process for the official listing of new varieties could utilise all available, good quality independent data such as that generated in IVT tests.

For National List purposes, the diseases and pests prioritised as being of national importance were foliage late blight, tuber late blight, blackleg (*Pectobacterium atrosepticum* syn. *Erwinia carotovora* var. *atroseptica*) and potato cyst nematodes (*Globodera rostochiensis* pathotype Ro1 and *Globodera pallida* pathotypes Pa2/3 and Pa1). The characters agreed as being of less significance nationally but important to industry were powdery scab, common scab, dry rot - *Fusarium solani* var. *coeruleum,* dry rot - *F.sulphureum,* potato virus Y^o, potato leafroll virus, external damage (splitting) and internal damage (bruising). In addition, unreplicated assessments of tuber yield, and external and internal tuber defects were to be made in order to comply with the requirements of the EU Directive 72/180/EEC and

02/8/EC. The consultation also agreed that varieties entered for IVT testing could be incorporated into NL tests.

In 2005, a 3 year contract to conduct a revised IVT programme was awarded to a consortium of SASA, SAC, BioSS and SCRI. The tests to be conducted for IVT purposes were foliage late blight in the field (SASA), black scurf (SAC), black dot (SAC), silver scurf (SASA) and skin spot (SASA). In addition, SASA would test Common Catalogue varieties entered for IVT for all NL characters, except PVY and leafroll. Tests were to be conducted over 2 years instead of 3 years. This report summarises the testing conducted over the 2007-2008 season.

2.2 MATERIALS AND METHODS

2.2.1. Standard Varieties

The standard varieties used in 2006 were reviewed and retained for the 2007 test programme. The varieties used in each test are listed below with, in brackets, their foliage maturity and the susceptibility rating as published in NIAB Pocket Guide to Varieties of Potatoes, 2006 :

Foliage late blight:	Home Guard [1E, 4], Orla [1E, 8], Bintje [M, 2], Russet Burbank [M, 3], Stirling [M, 8], Cara [M, 6]
Black scurf:	Sante [M, 3], Duke of York [1E, 5], Saxon [2E, 5], King Edward [M, 6], Cara [M, 7], Lady Christl [1E, 8]
Black dot:	Lady Christl [1E, 2], Pentland Squire [M, 3], Fianna [M, 5] Cara [M, 6], Saxon [2E, 7]
Silver scurf:	Lady Christl [1E, 2], Pentland Squire [M, 3], Romano [2E, 4], Fianna [M, 5], Saxon [2E, 5], Cara [M, 7]
Skin spot:	Pentland Squire [M, 2], King Edward [M, 3], Sante [M, 3], Saxon [2E, 6], Romano [2E, 7], Fianna [M, 8]

2.2.2 **Varieties in Trial** (Table 2)

In line with the policy established by BPC, of the varieties submitted for UK National List Trials, only those varieties entering the 2nd year of testing or those that had completed NL testing were considered for entry to the IVT programme. In addition, 3 new Common Catalogue varieties were identified for inclusion in the test programme. Vales Rustic was withdrawn from NL trials in June, 2007 so most tests on this variety were not completed although the variety was included in all.

Table 2. Varieties in IVT in 2007

Variety	Breeder/Agent	Maturity	Stage of testing prior to 2007	
			NL	IVT
UK National List				
Excalibur (96C159-023)	Cygnet PB	Maincrop	1	-
Lulu	Caithness	2nd Early	1	-
Upmarket	Caithness	E.Maincrop	1	-
Richhill	Paul Watts, NIHPBS	Maincrop	1	-
Charlemont	Paul Watts, NIHPBS	E.Maincrop	1	-
Sunray	R. Cherry	Maincrop	1	-
Harmony	Caithness PB	E. Maincrop	Completed	1
Mayan Gold	SCRI/Greenvale	L. Maincrop	Completed	1
TX 15231	Pseedco Ltd	2nd Early	Completed	1
Gemson	Grampian Growers	2nd Early	Completed	1
Vales Rustic	SCRI/Greenvale	2nd Early	Completed	1
Sparkle (L4729/1)	NIHPBS	L Maincrop	Completed	1
Common Catalogue				
Mozart	HZPC	E. Maincrop	-	-
Toluca	Agrico	E.Maincrop	-	-
Daisy	MBMG	Maincrop	-	-
Fontane	Agrico	E. Maincrop	-	1
Lady Claire	MBMG	Maincrop	-	1
Saphire	MBMG	E. Maincrop	-	1
Sassy	MBMG	Maincrop	-	1

As a plant health precaution, all seed potatoes from non-UK sources were tested for brown rot (*Ralstonia solanacearum)* and ring rot (*Clavibacter michiganensis* subsp. *sepodonicus*) bacteria, and also for Potato Spindle Tuber Viriod.

2.2.3 IVT Test Methods

The test methods used were those agreed and set out in the standard protocols prepared for the 2005 programme. Details of the tests are provided below:

2.2.3.1 **Foliage late blight in the field, 2007**: the test tubers were planted in plots of 2 tubers at Dalrymple, by Ayr. The 2nd early/maincrop experiment was planted on 15 May. There was no 1st early trial. The layout was a randomised block design with 4 replications,

each of 2 tubers. Plants of King Edward, in small pots, infected by a complex isolate (1.2.3.4.6.7.8.10.11) of *P. infestans* were laid out along the adjacent rows of King Edward on 10 July. On 23, 27, 30 July and 15 August, the % foliage affected by late blight was assessed using the diagrammatic key of Cruickshank *et al.* (1982). The % Area Under the Disease Progress Curve (AUDPC) was calculated according to the formulae of Fry (1978), after applying the angular transformation to the percentage values on each date.

2.2.3.2 **Skin spot, 2007:** test tubers were dipped for 0.5 min in a suspension of spores and mycelia (Carnegie & Cameron, 1983) and planted in pots containing a 1:1 mix of Bulrush compost and John Innes No 2 compost on 16 April. Pots were placed outdoors in peat beds on 18 April and watered by drip irrigation into each pot. The layout was randomised block with 6 replications. The haulm was killed by applying diquat dibromide (Reglone) on 22 August at the half the manufacturer's recommended rate. The tubers were harvested into separate plastic boxes between 18 and 22 October and then stored at 5-8^{0}C until the last week in February. The % surface area affected by skin spot was recorded in 5 categories and a surface infection index calculated (Boyd, 1957).

2.2.3.3 **Silver scurf, 2007:** test tubers were dipped for 0.5 min in a suspension of macerated spores and mycelia and planted in pots containing Bulrush compost. Pots were placed in a polytunnel on 11 April. The layout was a randomised block design with 6 replications. Haulms were allowed to senesce naturally. Tubers were harvested between 3 and 9 August into separate plastic boxes and incubated at around 12^{o}C and high humidity until silver scurf lesions had developed sufficiently on the susceptible standard varieties. In late February, the % surface area affected by silver scurf on each tuber was assessed using 6 categories. A mean silver scurf index was calculated for each plot by multiplying the number of tubers in each category by the mid-point value and dividing the sum of these values by the total number of tubers assessed.

2.2.3.4 **Black dot, 2007:** Petri dishes containing potato dextrose agar (PDA) were inoculated with three isolates of *C. coccodes*. When, after one week, the colonies had reached the edge of the dishes, the cultures were macerated using a liquidiser. The suspension was added to Bulrush compost at the rate of 1 Petri dish of *C. coccodes* per 8 kg compost in a cement mixer and mixed for 10 minutes. Test tubers were planted on 22 May in 15 cm diameter pots filled with amended compost which were set in individual watering saucers and

then placed in a polytunnel in a randomised block design with 6 replications. Pots were watered every 2 days so that the compost was kept damp but not over-watered. Haulms were allowed to senesce naturally. Tubers were harvested on 19 October, after symptoms of black dot had been seen on the daughter tubers of the susceptible reference varieties. The tubers were placed into paper bags and kept over night in a cold store. The % surface area affected by black dot was then assessed on the 23 October.

2.2.3.5 **Black scurf, 2007:** Petri dishes containing PDA were inoculated with three isolates of *R. solani* AG-3. When, after 1 week, the colonies had reached the edge of the agar plate, the cultures were macerated in a liquidiser and added to compost in a cement mixer at a rate of 1 dish per 8 kg of Bulrush compost. On 24 May, a single seed tuber of each variety was planted in a 15 cm diameter pot which was placed in an individual watering saucer. Pots were laid out in a polytunnel in a randomised block design with 6 replicates. Plants were grown and maintained as in Section 2.2.3.4. All daughter tubers from each pot were harvested on 12 October, after symptoms of black scurf were seen on the susceptible reference varieties. The tubers were placed into paper bags and kept in a cold store. The % surface area covered by black scurf was assessed on 30 November.

2.2.4 NL Tests

These were conducted on Common Catalogue varieties in accordance with the document "United Kingdom National List Trials: Trials Procedures for the Official Examination of value for Cultivation and Use (VCU) – Potato 2007". The methods are summarised below:

Tuber late blight: the rose-end of field-grown tubers is sprayed with a known R-gene complex isolate(s) of *P. infestans*. The number of tubers affected by late blight is counted after 10-14 days incubation.

Common Scab: test tubers are planted in pots in artificially infested compost kept dry during tuber initiation. Severity of common scab is assessed on daughter tubers.

Powdery scab: test tubers are planted in compost infected with scab peelings and kept wet during tuber initiation. Severity of powdery scab is assessed on daughter tubers.

Blackleg: test tubers are inoculated at the heel end with *Pectobacterium atrosepticum* and planted in an irrigated field trial. Incidence of blackleg is assessed 3 times during the growing season.

Dry rot (separate test for *Fusarium solani* var. *coeruleum* and *F.sulphureum*): test tubers are wounded and inoculated with a suspension of spores and incubated at 12-15^{0}C. The degree of internal rotting is assessed.

Potato Cyst Nematode (*Globodera* spp.): tubers are planted in pots in compost infected with a standard concentration of PCN eggs. Cyst multiplication on roots is assessed.

Damage, external (splitting) and internal (bruising): a standard force is applied to the heel end of field grown tubers. Tubers for the splitting test are stored at 4-6^{o}C and the incidence of splitting at the point of impact is recorded. Tubers for the bruising test are stored at 9-11^{o}C and the depth of damage at point of impact measured.

2.2.5. Statistical analysis

Most of the data was recorded as percentages and was angularly transformed before conducting an individual trial analysis of variance. For PCN, log transformations were used. Over-year trial means were calculated using REML from transformed trial means; for IVT the test years from 2005 (the year when the consortium took over the trialling) were used, giving three years for this report, and for NL tests, all years from 1981 were used where data was available. 1-9 ratings were derived by linear transformation (or according to a multiplication index for PCN) using varieties with known consistent susceptible and resistant reactions as fixed reference points.

2.3 RESULTS

Neither ring rot nor brown rot bacteria were found in tested seed potatoes.

2.3.1 **IVT Tests**

2.3.1.1 **Foliage late blight (field)**

2.3.1.1.1 Summary of 2006/07 Trials (Table 3)

The AUDPC values were much greater in 2007 than in 2006, reflecting the faster development of late blight because of the wetter weather conditions during July in 2007. In the 2nd Early/Maincrop trial, the most susceptible variety was Vales Rustic scoring 2. In NL test using greenhouse plants, Vales Rustic was scored as 3. Although Cara and Stirling reacted similarly in 2006, Stirling was more susceptible than Cara in 2007 when the blight pressure was greater. In addition, there was also an ingress of isolates, other than that on the inoculated infected plants. When the infected plants were being laid out in the field, a couple of lesions were noted on some plants and tests at SCRI confirmed that this was a "Blue A2" genotype. SASA also recovered a "Blue A2" isolate from blighted leaflets of a plant of R5 differential. It is intended to use this isolate in 2008 as it overcomes all R genes except for R9. None of the varieties completing 2 years of IVT testing showed useful resistance, apart from Sparkle which scored 5. However, Sparkle was less resistant in 2007 than in 2006, suggesting that its reaction might vary with year and isolate.

2.3.1.1.2 2007 Trial (Table 3)

Most of first year varieties showed some resistance to late blight, scoring between 4 and 5 but Toluca was outstanding, scoring 8. No active sporulating lesions developed on plants of Toluca but many hypersensitive lesions were observed. These dead areas of tissue may affect the capacity of plants to synthesise and thus reduce potential yield.

Table 3. Mean % (angular transformation) Area under Disease Progress in foliage late blight field test for 2nd Early and Maincrop varieties in 2006 and 2007 (final rating in bold).

	Test Year		
Variety	**2006**	**2007**	**1-9 rating**
Bintje	40.5	68.9	**3**
Russet Burbank	39.6	60.2	**3**
Cara	19.8	36.1	**6**
Stirling	15.5	48.7	**7**
Mozart	-	47.7	*5*
Toluca	-	18.3	*8*
Daisy	-	58.2	*4*
Sunray	-	47.0	*5*
Richhill	-	42.6	*5*
Upmarket	-	50.8	*5*
Lulu	-	51.8	*4*
Charlemont	-	52.7	*4*
Excalibur	-	53.4	*4*
Fontane	46.1	63.3	**3**
Saphire	33.4	53.7	**4**
Lady Claire	49.5	60.4	**3**
Sassy	43.2	55.7	**4**
TX 15231	47.6	60.8	**3**
Gemson	46.0	47.9	**4**
Vales Rustic	48.7	74.5	**2**
Sparkle	16.2	55.7	**5**
Harmony	44.8	58.4	**3**
Mayan Gold	16.4	26.7	**7**
LSD (P<0.05)	5.6	9.8	

2.3.1.2. **Black scurf**

2.3.1.2.1 Summary of 2006/2007 Trials (Table 4)

In general, the severity of black scurf on reference and test varieties was greater in 2007 than in 2006. The scores ranged from 9.2 to 19.4 in 2007 compared with 7.3 to 12.4 in 2006 and this was reflected in a higher least significant difference (LSD) value for 2007 test than for 2006 test. TX 15231 and Saphire were the most susceptible of test varieties scoring 1 and 2 respectively. The most resistant variety was Mayan Gold scoring 9, followed by Sparkle with 7, and Harmony and Fontane scoring 6.

Table 4. Mean % (angular transformation) surface area affected by black scurf

	Test Year		
Variety	**2006**	**2007**	**1-9 rating**
Sante (3)*	11.4	12.3	**4**
Duke of York (5)	10.6	11.2	**5**
Saxon (5)	10.1	11.9	**4**
King Edward (6)	9.4	11.7	**4**
Cara (7)	9.7	11.1	**5**
Lady Christ (8)	8.4	9.4	**7**
Mozart	-	14.2	*4*
Toluca	-	12.6	*6*
Daisy	-	12.2	*7*
Sunray	-	12.7	*6*
Richhill	-	12.6	*6*
Upmarket	-	19.4	*1*
Lulu	-	10.2	*9*
Charlemont	-	10.4	*9*
Excalibur	-	14.7	*4*
Fontane	8.0	13.1	**6**
Saphire	11.5	16.7	**2**
Lady Claire	9.5	15.2	**4**
Sassy	10.7	16.4	**3**
TX 15231	12.4	16.7	**1**
Gemson	10.5	13.7	**4**
Sparkle	8.7	11.1	**7**
Harmony	8.8	12.8	**6**
Mayan Gold	7.3	9.2	**9**
LSD (P<0.05)	2.1	3.7	

* rating as published in NIAB Pocket Guide of Varieties of potato, 2006

2.3.1.2.2 2007 Trial (Table 4)

Of the 1st year varieties, Upmarket appeared to be very susceptible to black scurf, provisionally scoring 1. Lulu and Charlemont were very resistant, scoring 9, and Sunray, Toluca and Richhill were also relatively resistant scoring 6.

2.3.1.3. **Black dot**

2.3.1.3.1 Summary of 2006/2007 Trials (Table 5)

In general, disease severity was greater in 2007 than in 2006. Of the control varieties, the severity of black dot was greater on tubers of Cara and Pentland Squire in 2007 than in 2006. In calculating the 1-9 scores, the rating for Saxon was reduced from 7 to 6 because a number of test varieties appear to be significantly more resistant. Harmony was most resistant test variety scoring 9, with Sparkle next scoring 7. However, both Sparkle and Mayan Gold were relatively resistant in 2006 but, in 2007, were similar in susceptibility to Lady Christl (4). Cara displayed similar variability in reaction over the two years.

2.3.1.3.2 2007 Test (Table 5)

All 1st year varieties except for Sunray showed some resistance to black dot with Mozart and Toluca being best, scoring 9 and 8 respectively.

Table 5. Mean % (angular transformation) surface area affected by black dot

	Test Year		
Variety	**2006**	**2007**	**1-9 rating**
Lady Christl (2)*	45.3	43.5	**4**
Pentland Squire (3)	43.2	55.5	**3**
Fianna (5)	39.2	45.9	**4**
Cara (6)	22.5	41.8	**6**
Saxon (7)	36.6	36.6	**6**
Mozart	-	20.2	*9*
Toluca	-	30.5	*8*
Daisy	-	41.3	*6*
Sunray	-	62.3	*1*
Richhill	-	41.5	*6*
Upmarket	-	36.6	*7*
Lulu	-	43.6	*5*
Charlemont	-	34.9	*7*
Excalibur	-	34.6	*7*
Fontane	41.6	57.2	**3**
Saphire	30.7	49.7	**5**
Lady Claire	46.9	57.8	**3**
Sassy	34.9	42.1	**5**
TX 15231	38.1	37.9	**5**
Gemson	33.1	50.6	**5**
Sparkle	24.3	40.3	**7**
Harmony	29.3	12.3	**9**
Mayan Gold	27.6	45.7	**6**
LSD (P<0.05)	11.4	11.5	

*rating of the variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2006

2.3.1.4. **Silver scurf**

2.3.1.4.1 Summary of 2006/2007 Trials (Table 6)

Apart from Pentland Squire, the ratings for the reference varieties were in good agreement with published ratings. The severity of silver scurf on Pentland Squire tubers was much less in 2007 than in 2006. The most resistant candidate varieties were Sassy, Gemson and Sparkle scoring 6 and the most susceptible were Harmony

(3) and Lady Claire (4). None of the candidate varieties were as susceptible as Lady Christl.

Table 6. Mean % (angular transformation) surface are affected by silver scurf

	Test Year		
Variety	**2006**	**2007**	**1-9 rating**
Lady Christl (2)*	38.3	23.5	**2**
Pentland Squire (3)	36.0	10.7	**5**
Romano (4)	13.8	11.8	**8**
Fianna (5)	21.2	19.0	**4**
Saxon (5)	26.5	12.5	**5**
Cara (7)	18.0	10.7	**7**
Mozart	-	10.5	*7*
Toluca	-	16.6	*5*
Daisy	-	32.7	*1*
Sunray	-	21.0	*3*
Richhill	-	16.0	*5*
Upmarket	-	12.8	*6*
Lulu	-	18.5	*4*
Charlemont	-	15.3	*5*
Excalibur	-	14.2	*6*
Fontane	24.5	16.0	**5**
Saphire	17.4	10.4	**7**
Lady Claire	35.0	12.0	**4**
Sassy	14.4	17.2	**6**
TX 15231	12.3	7.8	**8**
Gemson	17.5	16.2	**6**
Sparkle	19.7	13.0	**6**
Harmony	34.1	20.0	**3**
Mayan Gold	20.5	18.6	**5**
LSD (P<0.05)	8.1	7.4	

*rating of the variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2006

2.3.1.4.2 2007 test (Table 6)

The severity of silver scurf was somewhat less in 2007 than in 2006. The severity scores ranged from 12.3 to 38.3 in 2006 compared with 7.8 to 32.7 in 2007. However, expression of the symptom was distinct although the lesions took some time to develop. Of the varieties in the 1st year of testing, three appeared to be relatively resistant, scoring 6 or greater. Daisy was the most susceptible variety in the 2007 trial, scoring 1.

2.3.1.5. **Skin spot**

2.3.1.5.1 Summary of 2006/2007 Trials (Table 7)

The severity of skin spot was much greater in 2007 than in 2006 and this was reflected in a greater least significant difference. Most of the varieties completing IVT testing were moderately or very resistant to skin spot. Three varieties scored 8 and two scored 7. TX 15231 was the most susceptible variety, scoring 3.

2.3.1.5.2 2007 Test (Table 7)

The incidence and severity of skin spot was greater in 2007 than in 2006 or 2005, probably attributable to the cool wet summer in 2007 which tends to favour the development of *P. pustulans* on stem bases and stolons. Two of 1st year candidate varieties, Daisy and Sunray, appeared to be susceptible to skin spot, reacting similarly to Pentland Squire and King Edward.

Table 7. Mean % (angular transformation) surface area affected by skin spot.

Variety	Test Year 2006	2007	1-9 rating
Pentland Squire (2)*	11.4	27.2	**1**
King Edward (3)	6.6	23.4	**2**
Sante (3)	11.8	13.0	**3**
Saxon (6)	7.3	8.3	**5**
Romano (7)	0.5	6.6	**7**
Fianna (8)	1.2	6.2	**7**
Mozart	-	3.9	*8*
Toluca	-	9.0	*6*
Daisy	-	26.2	*1*
Sunray	-	28.7	*1*
Richhill	-	5.7	*7*
Upmarket	-	7.2	*7*
Lulu	-	14.7	*3*
Charlemont	-	4.8	*8*
Excalibur	-	15.2	*3*
Fontane	1.3	5.2	**7**
Saphire	7.5	7.1	**6**
Lady Claire	1.7	4.4	**8**
Sassy	0.7	4.5	**8**
TX 15231	13.8	12.9	**3**
Gemson	5.9	10.6	**5**
Sparkle	0.4	2.4	**8**
Harmony	0	5.7	**7**
Mayan Gold	0	10.1	**7**
LSD (P<0.05)	4.3	7.2	

*rating of the variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2006

2.3.2. NL Tests

2.3.2.1 **Tuber late blight** (Table 8)

A separate test for 1st Early varieties was not required because there were no candidates for this maturity category. Of the test common catalogue varieties completing IVT testing, Saphire and Lady Claire were most susceptible, scoring 4. Sassy and Fontane were slightly more resistant. Of the 1st year varieties, Toluca was the most susceptible, scoring 4 and Mozart was the most resistant. This suggests that

high foliar resistance of Toluca to *P. infestans* is not complemented by resistance in tubers.

Table 8. Mean % (angular transformation) tubers affected by late blight

Variety	2006	2007	1-9 rating
Bintje	83.0	69.4	**2**
Stirling	3.1	3.2	**8**
Mozart	-	18.6	*6*
Toluca	-	44.6	*4*
Daisy	-	32.5	*4*
Fontane	48.4	29.5	**5**
Saphire	55.5	58.6	**3**
Lady Claire	75.6	33.1	**4**
Sassy	61.6	26.0	**5**
LSD (P<0.05)	15.6	20.0	-

2.3.2.2 **Blackleg (***Pectobacterium atrosepticum***)** (Table 9)

Despite a cool wet summer, the incidence of plants affected by blackleg was much less in 2007 than in 2006. This was probably attributable to the weak pathogenicity of isolates used in the test. Pathogenicity tests using tubers will be conducted prior to inoculation in future to reduce this risk. However, there was a clear difference between the susceptible and resistant reference varieties. Both Cultra and Ailsa were rated as 7 and 8 respectively over 2 years of testing and the susceptible reference varieties Concurrent, Estima, and Morene were rated as susceptible to varying degrees, scoring 3, 5 and 5 respectively. Of the varieties completing testing, Sassy and Saphire were very resistant. After one year of testing, Daisy appeared to be very resistant with Mozart and Toluca being moderately resistant.

Table 9. Mean % (angular transformation) plants affected by blackleg (*Pectobacterium atrosepticum)*

Variety	2006	2007	1-9 rating
Concurrent	90.0	42.1	3
Estima	70.4	26.3	5
Morene	53.1	32.5	5
Cultra	40.1	19.6	7
Ailsa	17.9	0	8
Mozart	-	20.5	*6*
Toluca	-	15.9	*6*
Daisy	-	0	*8*
Fontane	85.4	4.6	**5**
Saphire	15.9	0	**9**
Lady Claire	80.8	22.5	**4**
Sassy	0	6.6	**9**
LSD (P<0.05)	16.7	16.5	

2.3.2.3 **Common Scab** (Table 10)

The severity of common scab was much less in 2007 than in 2006 and this was reflected in a lower LSD value. The most susceptible of the standard varieties was Maris Piper rated as 2. Moreover, apart from Maris Piper, the discrimination amongst the other varieties was generally weak with the most resistant being Pentland Crown, scoring 7. All of the varieties completing testing were intermediate in their reaction, none being as susceptible as Maris Piper or as resistant as Pentland Crown. Of the varieties in 1st year of testing, Mozart was the most resistant.

Table 10. Mean % (angular transformation) surface area affected by common scab

Variety	2006	2007	1-9 rating
Maris Peer	13.5	5.8	**5**
Estima	11.0	4.5	**6**
Maris Bard	28.0	7.1	**4**
Home Guard	13.7	4.8	**5**
Maris Piper	37.9	17.2	**2**
Desiree	25.6	9.5	**3**
Pentland Crown	12.9	3.1	**7**
Mozart	-	2.4	*6*
Toluca	-	7.8	*5*
Daisy	-	6.6	*5*
Fontane	23.9	7.6	**5**
Saphire	13.6	5.3	**6**
Lady Claire	17.4	4.4	**6**
Sassy	30.8	4.2	**4**
LSD (P<0.05)	9.7	4.9	

2.3.2.4 **Powdery Scab** (Table 11)

Overall, the severity of powdery scab was similar in both years. Estima continued to be clearly more susceptible than any of the other varieties. The susceptible maincrop varieties, Cara and Pentland Crown, appear to be more resistant than Estima. The similar size of difference between Estima and Cara was also recorded in the British Potato Council funded trial conducted by SASA in 2007 to examine varietal differences in PMTV susceptibility. In this experiment, PMTV-free tubers were planted in a soil known to be infested by PMTV and hence also infested by powdery scab organism. Accent's reaction in 2006 and 2007 was closer to the rating of 6 in NIAB Pocket Guide to Varieties of Potatoes than in previous tests. Of the varieties completing the 2 year test programme, Sassy was the most resistant of the four. Saphire and Fontane showed some susceptibility in 2007. The three 1st year Common Catalogue varieties all appeared to be moderately resistant. None of the test varieties showed any evidence of susceptibility to cankerous powdery scab (data not shown).

Table 11. Mean % (angular transformation) surface area affected by powdery scab

Variety	2006	2007	1-9 rating
Accent	12.0	27.4	**6**
Estima	32.1	46.4	**3**
Cara	9.6	18.4	**7**
Pentland Crown	10.3	12.9	**8**
Sante	7.8	14.1	**8**
Mozart	-	27.8	*5*
Toluca	-	25.0	*6*
Daisy	-	27.1	*5*
Fontane	15.6	41.4	**4**
Saphire	19.8	45.3	**4**
Lady Claire	18.3	39.7	**4**
Sassy	7.3	17.5	**7**
LSD (P<0.05)	6.4	7.6	-

2.3.2.5 **Dry rot (***Fusarium* spp.)

2.3.2.5.1 *F. solani* var. *coeruleum* (Table 12)

The number of successful infections and hence the amount of internal rotting was generally greater in 2007 than in 2006. The reactions of Pentland Squire, Nadine and Sante were in agreement with published ratings. The suceptible reaction of Catriona was in line with its known reaction in practice. Estima appeared to be more susceptible in the test in 2007 than that in 2006. Sante was the most resistant of the reference varieties, reacting consistently over the 2 years. None of the varietires were as susceptible as Pentland Squire or Catriona over 2 years although Sassy was as susceptible as these varieties in 2007. The other 1st and 2nd year candidate varieties showed a range of resistance, with Fontane being as resistant as Sante.

Table 12. Mean % (angular transformation) internal area affected by *Fusarium coeruleum*

Variety	2006	2007	1-9 rating
Pentland Squire	24.0	37.6	**3**
Catriona	45.1	44.6	**1**
Estima	6.0	27.1	**5**
Nadine	11.6	28.5	**4**
Sante	4.1	4.5	**6**
Mozart	-	17.0	*5*
Toluca	-	14.7	*5*
Daisy	-	8.2	*6*
Fontane	4.5	4.6	**6**
Saphire	5.1	14.9	**5**
Lady Claire	4.1	17.3	**5**
Sassy	7.7	36.0	**4**
Harmony	8.2	13.5	**5**
Mayan Gold	9.5	22.7	**5**
LSD (P<0.05)	4.7	8.9	

2.3.2.5.2 *F.sulphureum* (Table 13)

Amongst the reference varieties, the amount of rotting in tubers of Atlantic and Saxon was greater in 2007 than in 2006 whereas the reverse occurred with Maris Piper. Sante was the most resistant variety in test in both years. In general, rotting amongst test varieties was more severe in 2007 test than in 2006 test. Amongst the varieties completing testing, Mayan Gold and Saphire were very susceptible, scoring 1. All of the varieties in 1st year of testing appeared to be very susceptible.

Table 13. Mean % (angular transformation) internal area affected by *Fusarium sulphureum*

Variety	2006	2007	1-9 rating
Maris Piper	42.5	31.0	**2**
Atlantic	26.7	31.2	**3**
Nadine	29.9	34.3	**3**
Saxon	26.2	40.0	**3**
Sante	9.4	5.2	**7**
Mozart	-	41.1	*1*
Toluca	-	52.9	*1*
Daisy	-	61.0	*1*
Fontane	20.5	33.6	**4**
Saphire	31.7	51.4	**1**
Lady Claire	15.2	29.6	**4**
Sassy	16.3	23.5	**5**
Harmony	30.1	34.5	**3**
Mayan Gold	46.1	46.0	**1**
LSD (P<0.05)	6.8	8.4	

2.3.2.6 **External Damage (splitting)** (Table 14)

The incidence of splitting was greater in 2007 than in 2006. Ulster Sceptre (3) was the most susceptible of the 1st early varieties and Russet Burbank (3) was the most susceptible of the maincrop varieties. The reaction of Red Craigs Royal in 2007 was more typical of its known performance than that in 2006. Overall, none of the varieties completing 2nd year test programme were as susceptible as Russet Burbank although Sassy was as susceptible in 2007. Of the 1st year candidate varieties, Mozart and Toluca showed susceptibility and Daisy showed resistance.

Table 14. Mean % (angular transformation) tubers affected by splitting after applying standard force

Variety	2006	2007	1-9 rating
Ulster Sceptre	34.0	49.0	**3**
Home Guard	9.8	1.8	**7**
Red Craigs Royal	18.0	58.3	**3**
Russet Burbank	26.5	45.6	**3**
Maris Peer	2.0	7.0	**7**
Record	0	23.1	**6**
Maris Piper	0	10.0	**7**
Mozart	-	40.0	*3*
Toluca	-	59.6	*1*
Daisy	-	11.8	*6*
Fontane	2.0	28.1	**5**
Saphire	0	9.1	**6**
Lady Claire	0	9.6	**6**
Sassy	2.0	42.3	**4**

2.3.2.7 **Internal Damage (bruising)** (Table 15)

The amount of bruising on the reference varieties was similar over the 2 years although the differences amongst the varieties were relatively small. None of the candidate varieties showed a major weakness to bruising. Of 1st year varieties, Toluca was most susceptible, scoring 4. Mozart and Daisy showed good resistance in the 1st year of testing. However, such an assessment needs to be treated with some caution as there is no replication in the yearly test.

Table 15. Mean depth (mm) of bruise at point of impact of standard force

Variety	2006	2007	1-9 rating
Ulster Sceptre	6.3	6.8	**2**
Home Guard	4.4	4.6	**5**
Red Craigs Royal	4.9	5.0	**5**
Maris Peer	5.0	7.3	**3**
Record	5.6	5.4	**4**
Russet Burbank	5.1	5.7	**4**
Maris Piper	3.6	4.3	**6**
Mozart	-	3.4	*8*
Toluca	-	5.5	*4*
Daisy	-	3.5	*7*
Fontane	5.2	3.4	**6**
Saphire	3.8	3.8	**6**
Lady Claire	5.4	3.5	**6**
Sassy	6.2	4.0	**5**

2.3.2.8 **Potato Cyst Nematode** (Table 16)

Resistance to PCN (*G. rostochiensis* Ro1) is normally conferred by the major gene H1 and results in no, or minimal, multiplication of cysts on the potato. Varieties expressing this type of resistance to Ro1 were Lady Claire, Sassy, Fontane, Mozart and Daisy.

Saphire and Sassy showed partial resistance to Pa 2/3 pathotypes. This is not the full resistance occurring with H1 gene for Ro1 which limits cyst multiplication to no more than the original population.

Table 16. Multiplication of cysts of 3 pathotypes of potato cyst nematode (*Globodera rostochiensis*) pathotype 1, *G. pallida* pathotypes 2/3) on test varieties, expressed as 1-9 rating.

Variety	Ro1	Pa 2/3	Pa1
Estima	2 (S) †		1
Desiree	2 (S)	2	1
Maris Piper	9 (R)	2	
Mozart	**7**	***2***	
Toluca	**1**	***2***	
Daisy	**8(R)**	***2***	
Fontane	**9(R)**	**2**	
Saphire	**3(S)**	**4**	**3**
Lady Claire	**9 (R)**	**3**	
Sassy	**9(R)**	**4**	**4**

† R denotes full resistance and S denotes full susceptibility

2.4 Discussion and Conclusions

The full range of disease tests was completed on time with good disease development in all tests. In the IVT tests, disease development was generally greater in all tests in 2007 than in previous years except for silver scurf. Such changes in disease pressure did, on occasions, appear to affect the reaction of varieties, expressing as yearly variation. For example, in the black dot test, Mayan Gold and Cara were relatively resistant in 2006 but, in 2007, a year of greater disease development, both varieties reacted with greater relative susceptibility, similar to the susceptible Lady Christl. By contrast, the reaction of Harmony was consistent over the two years. With a disease such as late blight, environmental conditions during test year may also affect the growth of plant and the number and length of periods favourable for spore production and infection. The amount of inoculum to which test plants are exposed may thus vary throughout the trial period and amongst trials. These differing disease pressures may affect variety reaction. The potential for variability in a variety's reaction needs to be recognised when considering ratings based on one test in one year.

The situation with late blight is more complex and dynamic because of the more recent capacity of the pathogen to produce new genotypes following the introduction of A2 strain of *P. infestans* into UK. There was evidence this year that isolates other than the test isolate

were involved in the late blight epidemic at the field site. Developing lesions of late blight were produced on plants of R5 differential even although the test isolate was known to be avirulent to R5. Differences in disease pressure and in isolate virulence may affect the reaction of varieties to *P. infestans.* This can be illustrated by looking at the reaction of Stirling and Cara over the past few years. In 2005 and 2006, Stirling was as or more resistant than Cara in the field trial. However, in 2004 and 2007, Stirling reacted with greater relative susceptibility. Although this might be explained in terms of the presence of "Blue A2" genotype in the trial in 2007, it would not account for the reaction in 2004. It may be that the reaction of Stirling is more responsive to different amounts of disease pressure than Cara. Sparkle was another variety which was relatively more susceptible in 2007 than in 2006. The isolate of "Blue A2" genotype with increased virulence recovered from the 2007 field trial will be used in 2008 testing to try to ensure that the assessment of varietal resistance measures durable resistance and not race specific resistance. In addition, some screening of existing varieties tested with a non "Blue A2" isolate will be undertaken as part of IVT programme.

In the National List and IVT testing programmes, the resistance of a candidate variety to a range of diseases is evaluated in a series of standardised tests which each include a set of standard reference varieties whose reactions are known. For each disease, the resistance rating of a candidate variety is determined by comparing the amount of disease developing on the candidate variety with that on the standard varieties over at least two years of testing. The process of calculating variety scores is subject to regular review. As part of a review of NL decision making, statistical advice was that over-year means should be calculated from data for as many years as possible rather than 2 test years. This proposal has been adopted for NL analysis using data since 1981 and has been applied to IVT data for last 3 years. This has meant that small changes in some of the historic ratings ascribed to a variety have occurred, sometimes exacerbated by the process of rounding up or down to a whole number. For example, a variety scoring 3.7 for a character is recorded as 4, same as a variety scoring 4.4. Small shifts in the calculations may move these values up or down. Another factor which can affect ratings over time is a change to the rating for a reference variety because of evidence that varietal reaction operates on a wider scale than previously thought. This occurred with black dot this year because varieties with considerably more resistance than Saxon were found. This necessitated an adjustment of Saxon's score from 7 to 6 in order to allow the size of differences to be reflected properly in the calculated scores. Users of such data should bear

in mind that the final rating of a variety should, therefore, be treated as a broad guide as to how a variety might perform in practice rather being an absolute value. Disease resistance ratings are recorded on a 1 to 9 scale where 1 is highly susceptible and 9 very resistant. Thus the higher the value, the more resistant a variety is to a disease. Typically, varieties with a score of 1, 2 or 3 would be considered highly susceptible, those with a score 4 or 5 considered susceptible, those with a score 6 or 7 moderately resistant and those with scores 8 or 9 highly resistant. A high resistance score should not be taken as indicating that a disease will be absent but that there is less risk of the disease developing on these varieties. With most other diseases and faults, all varieties can be affected to a greater or lesser extent. In consequence, the need for other control measures such as fungicide application should be evaluated, based on other factors such as the level of inoculum likely to be present and whether environmental conditions favour the pathogen.

The British Potato Variety Database was launched on the web in July, 2007 and formally presented to industry at the Potatoes in Practice event in August, 2007. This is now the mechanism for publication of both NL and IVT data and brings this data together with breeder's information formerly presented in publications such as "Scotland - The Natural Home of Potatoes". This database allows SASA to publish immediately variety information from various trials as soon as it is finalised. To date, the database has been accessed 21,147 times by 9,733 visitors from 107 countries since its launch. Each visitor has made an average of 6 searches and 85% of visitors have been from UK with other main visitors being from USA, Serbia, Australia, Ireland, Canada, France, Spain and Germany.

The 10 varieties which completed IVT in 2007 were Fontane, Saphire, Sassy, Lady Claire, Mayan Gold, Harmony, TX 15231, Gemson and Sparkle. In summary, the key findings for these varieties are as follows:

<u>Fontane</u>

Resistant to: skin spot and PCN Ro1

Susceptible to: foliage late blight, black dot and PCN Pa2/3 and 1

<u>Saphire</u>

Resistant to: silver scurf and blackleg

Susceptible to: black scurf, tuber late blight, dry rot – *F.sulphureum* and PCN Ro1

Lady Claire

Resistant to: skin spot and PCN Ro1

Susceptible to: foliage late blight, black dot, and PCN Pa2/3 and 1**.**

Sassy

Resistant to: skin spot, blackleg, powdery scab and PCN Ro1

Susceptible to: black scurf.

Gemson

Resistant to**:** blackleg and powdery scab

Susceptible to: tuber late blight, dry rot- *F. coeruleum* and *F. sulphureum,* internal damage and PCN Ro1, Pa2/3 and 1**.**

Mayan Gold

Resistant to: foliage late blight, black scurf, skin spot, powdery scab and common scab

Susceptible to: dry rot– *F. sulphureum*, PCN Ro1, Pa2/3 and 1

Harmony

Resistant to: black dot, skin spot and internal damage

Susceptible to: foliage and tuber late blight**,** silver scurf, blackleg and dry rot – *F.sulphureum*

TX 15231

Resistant to: silver scurf and dry rot– *F. sulphureum*

Susceptible to: foliage and tuber late blight, black scurf, skin spot, blackleg, internal damage, PCN Ro1, Pa 2/3 and 1.

Sparkle

Resistant to: black dot, black scurf, skin spot and PCN Ro1

Susceptible to: dry rot– *F. sulphureum* and PCN Pa 2/3 and 1

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