Research Project Report

Independent Variety Trials 2011

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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, a 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 (now Potato Council), it was 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, industry also concluded that potato varieties on the Common Catalogue which were being developed for GB production should 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 growing 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 (now Science and Advice for Scottish Agriculture, SASA), SAC Commercial Ltd (SAC), Biomathematics & Statistics Scotland (BioSS) and Scottish Crop Research Institute (SCRI) (now James Hutton Institute (JHI)) 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. This contract was extended for a further 3 years starting 2008 and again for a further 3 years starting in 2011. An additional test to determine susceptibility to potato mop top virus (spraing) was included in the programme from 2011. Work to develop a test to evaluate varietal susceptibility to '*Dickeya solani*' is also being carried out. As the test is still in development results for the test are not available at this time.

1.2. Work Undertaken and Findings

In 2011, tests were conducted on 8 varieties undergoing their 2nd year of UK NL testing, 8 varieties which had completed UK NL tests and 12 Common Catalogue varieties (Table 2). SASA conducted a test to determine susceptibility to foliage late blight at a site near Ayr which is operated in conjunction with JHI. Pot tests for black dot, black scurf and a field trial for mop top (spraing) were conducted by SAC and pot 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 rostochiensi*s and *G. pallida*), external damage (splitting) and internal damage (bruising). All tests were completed satisfactorily.

Susceptibility/resistance was rated on a 1-9 scale. Tables 1a and b summarise the results for varieties being tested in 2011. Table 1a presents the final ratings for varieties completing the test programme. For varieties in the 1st year of IVT programme, Table 1b presents provisional ratings shown in italic font for one year's test results and final ratings from NL tests in bold.

TABLE 1A. SUMMARY OF FINAL VARIETAL RATINGS (1=LOW, 9=HIGH) FOR RESISTANCE TO DISEASES, PESTS AND DEFECTS FOR VARIETIES COMPLETING IVT PROGRAMME BASED ON OVER YEARS ANALYSIS OF IVT 2005-2011 AND NL FROM 1981 EXCEPT FOR LATE BLIGHT FOR WHICH ANALYSIS COVERED ONLY PERIOD OF TESTING WITH A 13_A2 GENOTYPE. RESULTS IN INDIVIDUAL TEST TABLES ARE BASED ON 2 YEARS ONLY AND MAY VARY FROM DATA IN THIS TABLE.

	Victoria	Axona	Linton	Marvel (SM-01-81-01)	Tresdale	Clevna	Orwell	Lionheart (99c115-002)	Pioneer	Chopin	Mustang	Orchestra	Ramos	Safari
Maturity	EM	LM	EM	EM	EM	EM	EM	M	2E	EM	EM	M	EM	M
Foliage late blight (field)	**4**	**7**	**5**	**5**	**4**	**4**	**3**	**4**	**2**	**3**	**5**	**2**	**4**	**5**
Black dot	**5**	**7**	**4**	**4**	**7**	**5**	**4**	**5**	**5**	**6**	**5**	**5**	**5**	**6**
Black scurf *														
Silver scurf	**7**	**7**	**7**	**6**	**8**	**5**	**9**	**7**	**5**	**6**	**8**	**7**	**7**	**8**
Skin spot	**7**	**4**	**5**	**2**	**8**	**8**	**5**	**8**	**1**	**2**	**7**	**3**	**4**	**5**
Foliage late blight (lab) ^	**-**	**7**	**5**	**3**	**5**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**
Tuber late blight	**-**	**5**	**5**	**3**	**5**	**5**	**2**	**3**	**4**	**2**	**2**	**3**	**2**	**3**
Blackleg- *Pectobacterium atrosepticum*	**-**	**6**	**7**	**4**	**7**	**7**	**9**	**4**	**7**	**6**	**3**	**3**	**4**	**8**
Powdery scab	**-**	**5**	**6**	**6**	**4**	**6**	**3**	**6**	**7**	**5**	**5**	**6**	**5**	**4**
Common scab	**-**	**4**	**6**	**4**	**3**	**6**	**6**	**6**	**7**	**7**	**3**	**8**	**5**	**4**
Dry rot – *Fusarium coeruleum*	**8**	**6**	**6**	**8**	**6**	**8**	**4**	**8**	**4**	**3**	**8**	**1**	**8**	**6**
Dry rot – *Fusarium sulphureum*	**1**	**1**	**3**	**9**	**1**	**3**	**5**	**1**	**1**	**4**	**1**	**1**	**4**	**6**
PCN Ro-1	**-**	**2**	**9**	**8**	**4**	**2**	**2**	**3**	**8**	**8**	**7**	**7**	**8**	**7**
PCN Pa 2/3	**-**	**2**	**2**	**5**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**4**	**2**
External damage (splitting)	**-**	**4**	**5**	**8**	**7**	**7**	**4**	**6**	**6**	**7**	**7**	**6**	**5**	**6**
Internal damage (bruising)	**-**	**5**	**3**	**3**	**6**	**4**	**6**	**6**	**4**	**7**	**7**	**5**	**4**	**6**

* = Due to a high level of variability in varietal differences between years in the Black Scurf test data, resulting in inconsistent resistance ratings for this pathogen, scores for Black Scurf have not been published.

^ = The laboratory test for foliage late blight is only conducted as part of the NL programme, results have been included for information only

TABLE 1B. SUMMARY OF RATINGS (1=LOW, 9=HIGH) FOR RESISTANCE TO DISEASES, PESTS AND DEFECTS FOR POTATO VARIETIES COMPLETING ONE YEAR OF IVT PROGRAMME (PROVISIONAL RATINGS ARE SHOWN IN ITALICS, FINAL RATINGS ARE IN BOLD). SCORES ARE BASED ON OVER-YEARS ANALYSIS OF IVT 2005-2011 AND NL FROM 1981 EXCEPT FOR LATE BLIGHT FOR WHICH ANALYSIS COVERED ONLY PERIOD OF TESTING WITH A 13_A2 GENOTYPE. RESULTS IN INDIVIDUAL TEST TABLES MAY VARY FROM DATA IN THIS TABLE.

	Shelford	Violetta	Red Emmalie	Mistay	Nitza	Zohar	Zahov	Safiyah	Bremner	Ambassador	Electra	Emma	Lady Valora	Taurus	VR808
Maturity	EM	EM	EM	EM	EM	EM	M	2E	EM	1E	EM	2E	M	EM	EM
Foliage late blight (field)	*4*	*5*	*4*	*4*	*4*	*4*	*4*	*3*	*5*	*4*	*4*	*3*	*4*	*4*	*2*
Black dot	*6*	*6*	*9*	*6*	*5*	*3*	*5*	*2*	*7*	*5*	*6*	*5*	*5*	*6*	*5*
Black scurf *															
Silver scurf	*8*	*7*	*8*	*4*	*8*	*8*	*8*	*6*	*8*	*6*	*7*	*6*	*8*	*7*	*7*
Skin spot	*5*	*9*	*9*	*3*	*7*	*6*	*2*	*7*	*6*	*7*	*7*	*4*	*8*	*8*	*8*
Potato mop top virus (spraing)	*6*	*9*	*9*	*9*	*7*	*8*	*9*	*9*	*8*	*6*	*4*	*9*	*7*	*4*	*9*
Foliage late blight (lab) ^	**4**	**2**	**1**	**3**	**3**	**4**	**3**	**2**	**6**	-	-	-	-	-	-
Tuber late blight	**2**	**3**	**3**	**5**	**1**	**3**	**2**	**1**	**4**	*2*	*2*	*3*	*4*	*3*	*2*
Blackleg-*Pectobacterium atrosepticum*	**7**	**5**	**8**	**4**	**8**	**6**	**3**	**8**	**6**	*1*	*5*	*1*	*3*	*6*	*3*
Powdery scab	**5**	**4**	**4**	**7**	**4**	**5**	**6**	**3**	**5**	*5*	*3*	*2*	*4*	*7*	*1*
Common scab	**3**	**4**	**7**	**3**	**5**	**3**	**5**	**6**	**6**	*5*	*6*	*6*	*8*	*3*	*6*
Dry rot – *Fusarium coeruleum*	**5**	**5**	**8**	**7**	**4**	**7**	**9**	**6**	**8**	*9*	*4*	*3*	*3*	*8*	*9*
Dry rot – *Fusarium sulphureum*	**1**	**7**	**8**	**1**	**4**	**5**	**1**	**9**	**2**	*9*	*4*	*1*	*9*	*6*	*8*
PCN Ro-1	**2**	**2**	**2**	**5**	**8**	**2**	**7**	**7**	**3**	**3**	*7*	**4**	*7*	*8*	*6*
PCN Pa 2/3	**2**	**3**	**3**	**5**	**2**	**1**	**3**	**2**	**3**	*6*	**2**	**2**	**2**	**3**	**2**
External damage (splitting)	**5**	**6**	**4**	**2**	**2**	**1**	**7**	**2**	**6**	*6*	*5*	*4*	*7*	*6*	*4*
Internal damage (bruising)	**4**	**6**	**4**	**4**	**4**	**3**	**5**	**5**	**5**	*6*	*7*	*3*	*5*	*5*	*3*

* = Due to a high level of variability in varietal differences between years in the Black Scurf test data, resulting in inconsistent resistance ratings for this pathogen, scores for Black Scurf have not been published.
^ = The laboratory test for foliage late blight is only conducted as part of the NL programme, results have been included for information only

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:

Victoria

Resistant to: **silver scurf, skin spot** and **dry rot - *F. coeruleum***

Susceptible to: **dry rot - *F. sulphureum***

Axona

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

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

Linton

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

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

Marvel (SM-01-81-01)

Resistant to: **dry rot – *F. coeruleum* and *F. sulphureum*, PCN Ro1** and **external damage**

Susceptible to: **skin spot, tuber late blight** and **internal damage**

Tresdale

Resistant to: **black dot, silver scurf, skin spot, blackleg** and **external damage**

Susceptible to: **common scab, dry rot - *F. sulphureum*** and **PCN Pa 2/3 and 1**

Clevna

Resistant to: **skin spot, blackleg, dry rot - *F. coeruleum*** and **external damage**

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

Orwell

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

Susceptible to: **foliage late blight, tuber late blight, powdery scab, PCN Ro1** and **PCN Pa 2/3 and 1**

Lionheart (99C115-002)

Resistant to: **silver scurf, skin spot** and **dry *rot – F. coeruleum***

Susceptible to: **tuber late blight, dry rot – *F. sulphureum*, PCN Ro1** and **PCN Pa 2/3 and 1**

Pioneer

Resistant to: **blackleg, powdery scab, common scab** and **PCN Ro1**

Susceptible to: **foliage late blight, skin spot, dry rot – *F. sulphureum*** and **PCN Pa 2/3 and 1**

Chopin

Resistant to: **common scab, PCN Ro1, internal damage** and **external damage**

Susceptible to: **foliage late blight, skin spot, tuber late blight, dry rot – *F. coeruleum*** and **PCN Pa 2/3 and 1**

Mustang

Resistant to: **silver scurf, skin spot, dry rot – *F. coeruleum*, PCN Ro1, external damage** and **internal damage**

Susceptible to: **tuber late blight, blackleg, common scab, dry rot – *F. sulphureum*** and **PCN Pa 2/3 and 1**

Orchestra

Resistant to: **silver scurf, common scab** and **PCN Ro1**

Susceptible to: **foliage late blight, skin spot, tuber late blight, blackleg, dry rot – *F. coeruleum* and *F. sulphureum*** and **PCN Pa 2/3 and 1**

Ramos

Resistant to: **silver scurf, dry rot – *F. coeruleum*** and **PCN Ro1**

Susceptible to: **tuber late blight**

Safari

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

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

Shelford

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

Susceptible to: **tuber late blight, common scab, dry rot – *F. sulphureum,* PCN Ro1** and **PCN Pa 2/3 and 1**

Violetta

Resistant to: *silver scurf, skin spot, mop top (spraing)* and **dry rot – *F. sulphureum***

Susceptible to: **tuber late blight, PCN Ro1** and **PCN Pa 2/3 and 1**

Red Emmalie

Resistant to: *black dot, silver scurf, skin spot, mop top (spraing),* **blackleg, common scab** and **dry rot – *F. coeruleum* and *F. sulphureum*,**

Susceptible to: **tuber late blight, PCN Ro1** and **PCN Pa 2/3 and 1**

Mistay
Resistant to: *mop top (spraing),* **powdery scab** and **dry rot – *F. coeruleum***

Susceptible to: *skin spot***, common scab, dry rot – *F. sulphureum*** and **external damage**

Nitza
Resistant to: *silver scurf, skin spot, mop top (spraing),* **blackleg and PCN Ro1**

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

Zohar
Resistant to: *silver scurf, mop top (spraing)* and **dry rot – *F. coeruleum***

Susceptible to: *black dot,* **tuber late blight, common scab, PCN Ro1, PCN Pa 2/3 and 1, external damage** and **internal damage**

Zahov
Resistant to: *silver scurf, mop top (spraing),* **dry rot – *F. coeruleum,* PCN Ro1** and **external damage**

Susceptible to*: skin spot,* **tuber late blight, blackleg, dry rot – *F. sulphureum*** and **PCN Pa 2/3 and 1**

Safiyah
Resistant to: *skin spot*, *mop top (spraing),* **blackleg, dry rot – *F. sulphureum*** and **PCN Ro1**

Susceptible to: *foliage late blight, black dot*, **tuber late blight, powdery scab, PCN Pa 2/3 and 1** and **external damage**

Bremner
Resistant to: *black dot*, *silver scurf, mop top (spraing)* and **dry rot – *F. coeruleum***

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

Ambassador
Resistant to: *skin spot,* and *dry rot – F. coeruleum and F. sulphureum*

Susceptible to: *tuber late blight, blackleg* and **PCN Ro1**

Electra
Resistant to: *silver scurf*, *skin spot, PCN Ro1* and *internal damage*

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

Emma
Resistant to: *mop top (spraing)*

Susceptible to: *foliage late blight, tuber late blight, blackleg, powdery scab, dry rot – F. coeruleum and F. sulphureum,* **PCN Pa 2/3 and 1** and *internal damage*

Lady Valora
Resistant to: silver scurf, skin spot, mop top (spraing), common scab, dry rot – F. sulphureum, PCN Ro1 and *external damage*

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

Taurus
Resistant to: *silver scurf, skin spot, powdery scab, dry rot – F. coeruleum* and *PCN Ro1*

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

VR808
Resistant to: *silver scurf, skin spot, mop top (spraing)* and *dry rot – F. coeruleum and F. sulphureum*

Susceptible to: *foliage late blight, tuber late blight, blackleg, powdery scab*, **PCN Pa 2/3 and 1** and *internal damage*

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 PCL 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 nematode (*Globodera rostochiensis* pathotype Ro1). 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 leaf roll virus*, potato cyst nematode (*Globodera pallida* pathotypes Pa2/3 and Pa1), 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 JHI. 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). The contract was extended for a further 3 years to cover the growing seasons 2008-2010, and renewed again for a further 3 year period covering the growing seasons 2011-2013. From 2011, an additional test was included in the programme this was potato mop top virus (spraing) (SAC). Work to develop a test to evaluate varietal susceptibility to '*Dickeya solani*' would also be carried out (SASA). In addition, SASA would test Common Catalogue varieties entered for IVT for all NL characters, except potato viruses (Y^{o}, Y^{N}, A and leafroll). Tests were to be conducted over 2 years instead of 3 years. This report summarises the testing conducted over the 2011-2012 season.

* It was agreed to extend the NL programme from 2009 onwards to test for two additional potato viruses, these were virus A and virus YN.

2.2. Materials and Methods

2.2.1. Standard Varieties

The standard varieties used in 2010 were reviewed and mainly retained in 2011. Three of the late blight control varieties are listed with updated ratings as detailed in R407 IVT Annual Report 2010 following testing with the new isolate. 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, 2*], Bintje [M, 2], Russet Burbank [M, 3], Valor [M, 6*], Cara [M, 6], Sarpo Mira {M, 7*} * = Resistance rating has changed in response to work carried out with the new isolate
Black scurf:	Sante [M, 3], Duke of York [1E, 5], Saxon [2E, 5], King Edward [M, 6], Cara [M, 7], Lady Christl [1E, 8], Blue Danube [M,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]
Potato mop top:	Cara [M, 3], Nicola [M, 4], Valor [M, 6], Saturna [M, 7], Maris
virus (spraing)^	Piper [M, 5] ^ 1st year of trial in 2011

2.2.2. Varieties in Trial

The varieties are listed in Table 2. In line with the policy established by Potato Council, for 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, 6 new Common Catalogue varieties were identified for inclusion in the test programme. As a plant health precaution to prevent the introduction of non-indigenous bacterial pathogens, all seed potatoes from non-Scottish sources were tested for brown rot (*Ralstonia solanacearum*, ring rot (*Clavibacter michiganensis* subsp. *sepodonicus*) and *Dickeya* spp. bacteria.

TABLE 2. VARIETIES IN IVT IN 2011

UK National List

				Stage of test 2011	
AFP	**Variety**	**Breeder/Agent**	**Maturity**	**NL**	**IVT**
4/693	Axona	Sarvari Research Trust	L. Maincrop	Completed	2
4/731	Linton	PepsiCo Intnl Ltd	E. Maincrop	Completed	2
4/760	Marvel (SM-01-81-01)	Caithness Potatoes Ltd	E. Maincrop	Completed	2
4/761	Tresdale	Jack Dunnett	E. Maincrop	Completed	2
4/762	Clevna	Jack Dunnett	E. Maincrop	Completed	2
4/764	Orwell	PepsiCo Intnl Ltd	E. Maincrop	Completed	2
4/766	Lionheart (99C115-002)	Cygnet PB Ltd	Maincrop	Completed	2
4/768	Pioneer	JHI/MRS Ltd	2nd Early	Completed	2
4/770	Violetta	Karsten Ellenberg	E. Maincrop	2	1
4/771	Red Emmalie	Karsten Ellenberg	E. Maincrop	2	1
4/772	Mistay	JHI/MRS Ltd	E. Maincrop	2	1
4/775	Nitza	Volcani Center/Jacques Onona Intl Ltd	E. Maincrop	2	1
4/775	Zohar	Volcani Center/Jacques Onona Intl Ltd	E. Maincrop	2	1
4/776	Zahov	Volcani Center/Jacques Onona Intl Ltd	Maincrop	2	1
4/779	Safiyah	Higgins Agriculture Ltd	2nd Early	2	1
4/780	Bremner	Higgins Agriculture Ltd	E. Maincrop	2	1

Common Catalogue

				Stage of test 2011	
AFP	**Variety**	**Breeder/Agent**	**Maturity**	**NL**	**IVT**
	Victoria	HZPC	E. Maincrop	-	2*
	Chopin	HZPC UK Ltd	E. Maincrop	-	2
	Mustang	NOS Austria/Agrico	E. Maincrop	-	2
	Orchestra	Meijer/Potato Innovations	Maincrop	-	2
	Ramos	Van-rijn - KWS B.V.	E. Maincrop	-	2
	Safari	Stet/Branston	Maincrop	-	2
	Ambassador	Agrico Research/Agrico UK	1st Early	-	1
	Electra	IPM Ltd	E. Maincrop	-	1
	Emma	IPM Ltd	2nd Early	-	1
	Lady Valora	Meijer/Potato Innovations	Maincrop	-	1
	Taurus	HZPC	E. Maincrop	-	1
	VR808	Van-rijn - KWS B.V.	E. Maincrop	-	1

* dry rot tests only in 2011, other IVT tests completed in 2010

2.2.3. IVT Test Methods

The test methods used were those agreed and set out in the standard protocols prepared for the 2011 programme. Details of this year's tests are provided below:

2.2.3.1. Foliage late blight in the field, 2011

The test tubers were planted in plots of 2 tubers at Dalrymple, by Ayr. Due to very wet weather the 1st early and 2nd early/maincrop experiments were planted on 2 June. 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 (1.2.3.4.5.6.7.10.11) of *P. infestans* were laid out along the adjacent rows of King Edward on 18 July. On 29 July, 2, 5, 9, 12 and 16 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, 2011

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 21 April. Pots were placed outdoors in peat beds and watered by drip irrigation into each pot. The layout was randomised block with 6 replications. As plants had senesced by mid August there was no requirement to apply diquat dibromide (Reglone) to kill the haulms. The tubers were harvested into separate plastic boxes on 19-21 October and then stored at 5-8˚C until the third week in March. 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, 2011

Petri dishes containing 2% malt extract agar were inoculated using three isolates of silver scurf which were grown for a minimum of 14 days, then macerated in sterile distilled water. The suspension was added to Bulrush compost at a rate of 1L of suspension per 42L of soil and mixed in a small cement mixer. The test tubers were planted in pots containing the infested soil and placed in a polytunnel on 18 May and watered by drip irrigation into each pot. The layout was a randomised block design with 6 replications. Haulms were allowed to senesce naturally. Tubers were harvested on 26 October into separate plastic boxes and washed so visible symptoms could be observed, the tubers were then stored at 12-15^{o}C and high humidity until silver scurf lesions had developed sufficiently on the susceptible standard varieties. On 1 and 2 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, 2011

Three isolates of *Colletotrichum coccodes* were cultured in Petri dishes on PDA agar. When 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 11 May in 25 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 overnight in a cold store. The % surface area affected by black dot was then assessed on the 28 November 2011.

2.2.3.5. Black scurf, 2011

Three isolates of *Rhizoctonia solani* AG-3 were grown in Petri dishes on PDA agar. When 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 9 May, a single seed tuber of each variety was planted in a 25 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 17 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 5 December 2011.

2.2.3.6. PMTV, 2011

A plot in the Woodlands field at SAC Aberdeen previously contaminated with powdery scab / PMTV in 2009 was planted on 2 May 2011 with varieties grown in single tuber randomised blocks with 6 replicates. The plots were irrigated during the season.
After harvest on the 19 /20 September the tubers were placed in a cool store (c.18^{o}C) for 3 weeks before being placed in a cold store at 4^{o}C. Tubers were assessed for visual symptoms of PMTV spraing after cutting on 11 November 2011. All tubers from each of the 6 replicates were assessed individually. The results were expressed as the average percentage of the tubers showing symptoms.

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 2011”. The methods are summarised below:

Tuber late blight: the rose-end of field-grown tubers is sprayed with the 13_A2 isolate 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^{o}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 were recorded as percentages and were angularly transformed before conducting an individual trial analysis of variance. For PCN and skin spot, 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 seven years for this report, and for NL tests, all years from 1981 were used where data was available. Late blight data is from 2008 when testing with the new isolate was introduced. This data was used to calculate the provisional and final ratings presented in Tables 1a and 1b. However, in the individual test reports, ratings presented are based on the analysis for 2 years only and have been presented to one decimal point to provide greater clarity. All ratings of 1-9 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

Ring rot, brown rot and *Dickeya* bacteria were not 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 2010 and 2011 Trials (Table 3b)

Late blight was recorded on some varieties at a very low severity on 29 July 2011 with slow progress by 5 August. However, by 9 August 2011, late blight on susceptible varieties had progressed well and the foliage of all but the more resistant varieties was dead by 16 August. The AUDPC values on the reference varieties in 2011 were lower than those in 2010. Foliage of the differentials R1, R2, R3, R4, R5, R6, R7, R10 and R11 was killed by late blight. No growing lesions developed on plants of R8 or R9 differentials. This confirmed the results of detached leaflet tests that the virulence of the isolate was 1.2.3.4.5.6.7.10.11.

Axona (6.9) was the most resistant candidate variety undergoing IVT trialling in 2011, but was still less resistant than the Sarpo Mira (8.0) standard. Safari, Marvel and Mustang had some level of resistance scoring 5.4, 4.9 and 4.8, respectively. The remaining varieties were relatively susceptible, with Orchestra (2.2), Pioneer (2.3) and Chopin (2.4) being the most susceptible varieties on test, with a score lower than the two susceptible reference varieties Bintje (3.0) and Russet Burbank (3.4).

2.3.1.1.2. 2011 Trial (Table 3a+b)

VR808 (2.7) was the most susceptible 1st year candidate variety in 2011, with a score ranking lower than the susceptible control varieties. Bremner, Violetta, Mistay and Electra were moderately resistant with scores of 5.2, 5.1, 4.8 and 4.7, respectively. There was one 1st early candidate variety, Ambassador, which was susceptible with a score (3.0) lower than the susceptible reference variety Home Guard.

TABLE 3A MEAN % (ANGULAR TRANSFORMATION) AREA UNDER DISEASE PROGRESS IN FOLIAGE LATE BLIGHT FIELD TEST IN 2010 AND 2011 (1ST EARLY VARIETIES)

Variety	Test Year 2010	2011	1-9 rating
HOME GUARD	*	29.6	*4.2*
AMBASSADOR		38.7	*3.0*
LSD (P0.05)		5.0	

* = no data available

TABLE 3B MEAN % (ANGULAR TRANSFORMATION) AREA UNDER DISEASE PROGRESS IN FOLIAGE LATE BLIGHT FIELD TEST IN 2010 AND 2011 (2ND EARLY/MAINCROP VARIETIES)

Variety	Test Year 2010	2011	1-9 rating
BINTJE	42.7	38.4	**3.0**
CARA	30.2	20.6	**5.6**
RUSSET BURBANK	44.0	32.7	**3.4**
SARPO MIRA	19.2	3.0	**8.0**
VALOR	27.3	14.6	**6.3**
AXONA	28.1	7.3	**6.9**
LINTON	36.1	26.5	**4.6**
MARVEL	32.6	26.0	**4.9**
TRESDALE	38.9	27.6	**4.2**
CLEVNA	40.6	27.6	**4.1**
ORWELL	48.8	34.2	**2.8**
LIONHEART	40.6	24.6	**4.4**
PIONEER	52.1	37.3	**2.3**
CHOPIN	50.7	37.3	**2.4**
MUSTANG	36.1	23.7	**4.8**
ORCHESTRA	54.0	36.8	**2.2**
RAMOS	40.4	32.1	**3.7**
SAFARI	31.6	21.8	**5.4**
SHELFORD	-	27.4	*4.6*
VIOLETTA	-	23.5	*5.1*
RED EMMALIE	-	28.2	*4.4*
MISTAY	-	26.0	*4.8*
NITZA	-	29.5	*4.3*
ZOHAR	-	29.1	*4.3*
ZAHOV	-	29.6	*4.2*
SAFIYAH	-	34.5	*3.6*
BREMNER	-	22.6	*5.2*
ELECTRA	-	26.6	*4.7*
EMMA	-	36.1	*3.3*
LADY VALORA	-	31.1	*4.0*
TAURUS	-	29.1	*4.3*
VR808	-	40.5	*2.7*
LSD (P0.05)	4.7	5.1	**1.0**

2.3.1.2. Black scurf

Due to a high level of statistical variability in varietal differences between years in the Black Scurf test data, resulting in inconsistent resistance ratings for this pathogen; scores for Black Scurf have not been published.

2.3.1.3. Black dot

2.3.1.3.1. Summary of 2010 and 20011 Trials (Table 4)

There was generally greater disease severity in the 2011 trial compared with the 2010 trial. Tresdale (6.7) and Axona (6.4) were the most resistant candidate varieties scoring higher than the resistant reference variety Cara; the other varieties were moderately resistant. Marvel, Linton and Orwell were the least resistant varieties with scores of 4.5, 4.4, and 4.4 respectively.

2.3.1.3.2. 2011 Test (Table 4)

Red Emmalie was the most resistant variety scoring 8.0. The majority of the other 1st year varieties showed some resistance to black dot. Safiyah was the least resistant candidate variety with a score of 3.1.

TABLE 4. MEAN % (ANGULAR TRANSFORMATION) SURFACE AREA AFFECTED BY BLACK DOT

Variety	Test Year 2010	2011	1-9 rating
CARA	6.7	15.6	**6.2**
FIANNA	8.4	18.5	**5.9**
LADY CHRISTL	15.2	28.3	**4.7**
P SQUIRE	23.8	41.8	**3.0**
SAXON	6.5	19.1	**6.0**
AXONA	7.5	12.2	**6.4**
LINTON	8.8	37.8	**4.4**
MARVEL	13.3	31.7	**4.5**
TRESDALE	6.1	9.8	**6.7**
CLEVNA	9.2	29.5	**5.0**
ORWELL	11.7	35.8	**4.4**
LIONHEART	5.5	30.2	**5.2**
PIONEER	8.9	25.5	**5.3**
CHOPIN	7.0	23.5	**5.6**
MUSTANG	10.9	30.3	**4.8**
ORCHESTRA	10.9	24.4	**5.3**
RAMOS	13.0	22.2	**5.3**
SAFARI	6.3	23.5	**5.7**
SHELFORD	-	21.7	*5.7*
VIOLETTA	-	18.2	*6.1*
RED EMMALIE	-	3.8	*8.0*
MISTAY	-	22.6	*5.5*
NITZA	-	28.4	*4.8*
ZOHAR	-	35.4	*3.9*
ZAHOV	-	26.7	*5.0*
SAFIYAH	-	40.9	*3.1*
BREMNER	-	15.8	*6.4*
AMBASSADOR	-	27.6	*4.9*
ELECTRA	-	21.7	*5.7*
EMMA	-	27.3	*4.9*
LADY VALORA	-	28.6	*4.7*
TAURUS	-	18.3	*6.1*
VR808		23.7	*5.4*
LSD (P0.05)	5.3	12.3	**1.5**

2.3.1.4. Silver scurf

2.3.1.4.1. Summary of 2010 and 2011 trials (Table 5)

Overall, candidate varieties showed a good level of resistance, with all varieties scoring 5.0 of higher. Orwell and Mustang were the most resistant scoring 7.3 and 7.2, respectively.

2.3.1.4.2. Summary of 2011 test (Table 5)

Overall, 1st year candidate varieties showed a good level of resistance, with 13 of the 14 scoring 5.8 or higher. The most susceptible variety was Mistay (4.3).

TABLE 5. MEAN % (ANGULAR TRANSFORMATION) SURFACE ARE AFFECTED BY SILVER SCURF

Variety	Test Year 2010	2011	1-9 rating
CARA	12.2	22.6	**7.0**
FIANNA	14.0	27.7	**6.5**
LADY CHRISTL	51.8	51.0	**2.0**
PENTLAND SQUIRE	31.4	42.7	**4.1**
ROMANO	12.3	16.3	**7.5**
SAXON	28.3	33.7	**5.0**
AXONA	12.6	31.9	**6.3**
LINTON	23.8	22.4	**6.2**
MARVEL	19.9	28.4	**6.0**
TRESDALE	16.9	22.1	**6.7**
CLEVNA	35.1	25.8	**5.1**
ORWELL	12.8	17.6	**7.3**
LIONHEART	13.7	30.4	**6.3**
PIONEER	19.6	41.9	**5.0**
CHOPIN	21.1	27.0	**6.0**
MUSTANG	18.1	14.4	**7.2**
ORCHESTRA	17.3	28.7	**6.2**
RAMOS	15.3	30.6	**6.2**
SAFARI	11.9	26.7	**6.7**
SHELFORD	-	19.9	*7.5*
VIOLETTA	-	26.6	*6.3*
RED EMMALIE	-	22.0	*7.1*
MISTAY	-	37.9	*4.3*
NITZA	-	23.3	*6.9*
ZOHAR	-	22.0	*7.1*
ZAHOV	-	23.3	*6.9*
SAFIYAH	-	28.3	*6.0*
BREMNER	-	22.8	*7.0*
AMBASSADOR	-	28.8	*5.9*
ELECTRA	-	27.5	*6.1*
EMMA	-	29.6	*5.8*
LADY VALORA	-	21.9	*7.1*
TAURUS	-	24.4	*6.7*
VR808	-	24.7	*6.6*
LSD (P0.05)	6.5	9.0	**1.8**

2.3.1.5. Skin spot

2.3.1.5.1. Summary of 2010 and 2011 Trials (Table 6)

The severity of skin spot symptoms was greater in 2011 than 2010. Clevna (8.0), Tresdale (7.5) and Lionheart (7.5) were the most resistant candidate varieties, all scoring higher than resistant reference varieties. Marvel and Pioneer were the most susceptible scoring 2.0 and 1.4, respectively.

2.3.1.5.2. 2011 Test (Table 6)

Of the 1st year candidate varieties, the majority had moderate or high resistance. Red Emmalie and Violetta were highly resistant scoring 8.8 and 8.6, respectively. The most susceptible varieties were Zahov (2.5) and Mistay (3.4).

TABLE 6. MEAN % (LOG TRANSFORMATION [LOG (SKIN SPOT% + 0.1) WHERE LOG IS LOG TO BASE 10]) SURFACE AREA AFFECTED BY SKIN SPOT.

Variety	Test Year 2010	2011	1-9 rating
FIANNA	-0.7	-0.4	**7.0**
KING EDWARD	0.2	0.8	**2.3**
PENTLAND SQUIRE	0.3	1.0	**2.0**
ROMANO	-0.7	-0.5	**7.0**
SANTE	0.5	0.8	**1.9**
SAXON	-0.9	-0.4	**7.3**
AXONA	-0.0	0.4	**3.8**
LINTON	0.0	-0.1	**4.8**
MARVEL	-0.1	1.3	**2.0**
TRESDALE	-1.0	-0.5	**7.5**
CLEVNA	-0.9	-0.7	**8.0**
ORWELL	-0.4	0.2	**4.9**
LIONHEART	-0.9	-0.6	**7.5**
PIONEER	0.5	1.0	**1.4**
CHOPIN	0.8	0.2	**2.5**
MUSTANG	-0.8	-0.3	**6.8**
ORCHESTRA	0.3	0.4	**3.0**
RAMOS	-0.2	0.2	**4.4**
SAFARI	-0.4	-0.0	**5.4**
SHELFORD	-	0.1	*5.0*
VIOLETTA	-	-0.9	*8.6*
RED EMMALIE	-	-1.0	*8.8*
MISTAY	-	0.6	*3.4*
NITZA	-	-0.3	*6.5*
ZOHAR	-	-0.1	*5.9*
ZAHOV	-	0.8	*2.5*
SAFIYAH	-	-0.3	*6.5*
BREMNER	-	-0.1	*5.9*
AMBASSADOR	-	-0.4	*6.8*
ELECTRA	-	-0.4	*6.9*
EMMA	-	0.3	*4.4*
LADY VALORA	-	-0.6	*7.4*
TAURUS	-	-0.5	*7.2*
VR808	-	-0.7	*7.9*
LSD (P0.05)	0.5	0.6	**2.9**

2.3.1.6. Potato mop top virus (spraing)

2.3.1.6.1. 2011 Test (Table 7)

In the first year of the trial Violetta, Red Emmalie, Mistay, Zahov and VR808 were resistant scoring 9.0. Safiyah, Emma and Bremner were highly resistant scoring 8.7, 8.6 and 8.2 respectively. Taurus (3.7) and Electra (3.6) were the least resistant varieties.

TABLE 7. MEAN % (ANGULAR TRANSFORMATION) OF TUBERS SHOWING SYMPTOMS OF POTATO MOP TOP VIRUS (SPRAING).

Variety	Test Year 2011	1-9 rating
CARA	14.1	*7.0*
NICOLA	27.7	*4.9*
VALOR	19.8	*6.1*
SATURNA	33.3	*4.0*
MARIS PIPER	0.0	*9.0*
SHELFORD	19.2	*6.2*
VIOLETTA**	0.0	*9.0*
RED EMMALIE**	0.0	*9.0*
MISTAY	0.0	*9.0*
NITZA	11.3	*7.4*
ZOHAR	8.5	*7.9*
ZAHOV	0.0	*9.0*
SAFIYAH	3.5	*8.7*
BREMNER	6.6	*8.2*
AMBASSADOR	20.4	*6.0*
ELECTRA	35.7	*3.6*
EMMA	4.0	*8.6*
LADY VALORA	13.6	*7.1*
TAURUS	35.0	*3.7*
VR808	0.0	*9.0*
LSD (P0.05)	16.4	

** it should be noted that the assessment of coloured flesh varieties is limited as spraing can be difficult to observe in these circumstances.

2.3.2. NL Tests

2.3.2.1. Tuber late blight (Tables 8a+b)

Of the candidate varieties entered for testing, all were relatively susceptible with scores between 1.9 and 2.9

Most 1st year varieties were relatively susceptible; Lady Valora was the least susceptible scoring 3.5.

TABLE 8A MEAN % (ANGULAR TRANSFORMATION) TUBERS AFFECTED BY LATE BLIGHT (1ST EARLY VARIETIES)

Variety	Test Year 2010	2011	1-9 rating
HOME GUARD	-	81.0	*2.0*
AMBASSADOR	-	78.9	*2.2*
LSD (P0.05)		13.7	

TABLE 8B MEAN % (ANGULAR TRANSFORMATION) TUBERS AFFECTED BY LATE BLIGHT (2ND EARLY/MAINCROP VARIETIES)

Variety	Test Year 2010	2011	1-9 rating
BINTJE	87.0	72.4	**2.0**
CARA	52.9	34.9	**6.0**
SARPO MIRA	84.8	62.2	**2.7**
VALOR	46.1	46.8	**5.7**
CHOPIN	87.0	73.5	**1.9**
MUSTANG	83.7	75.5	**2.0**
ORCHESTRA	84.1	60.6	**2.8**
RAMOS	82.7	77.9	**1.9**
SAFARI	80.0	63.1	**2.9**
ELECTRA	-	76.6	*1.6*
EMMA	-	65.0	*2.8*
LADY VALORA	-	58.8	*3.5*
TAURUS	-	60.7	*3.2*
VR808	-	77.8	*1.4*
LSD (P0.05)	13.3	15.3	**1.6**

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

The incidence of blackleg was variable for some varieties between the two years of testing.

For example, Chopin and Ramos had fewer blackleg symptoms recorded in 2010 than in 2011, whereas Orchestra had more blackleg recorded in 2010. Safari was the most resistant candidate scoring 8.5 and Chopin was moderately resistant scoring 6.0. Mustang and Orchestra were the most susceptible candidate varieties scoring 1.8 and 2.3 respectively.

Of the 1st year varieties entered, the majority were susceptible scoring less than 2.3; Taurus had moderate resistance scoring 5.2 and the other variety in test, Electra, scored 4.3.

TABLE 9. MEAN % (ANGULAR TRANSFORMATION) PLANTS AFFECTED BY BLACKLEG (*PECTOBACTERIUM ATROSEPTICUM*)

Variety	Test Year 2010	2011	1-9 rating
AILSA	7.5	0.0	**8.0**
CONCURRENT	47.1	52.4	**3.0**
CULTRA	21.5	36.9	**5.8**
ESTIMA	55.0	36.5	**2.8**
MORENE	54.1	48.6	**3.2**
CHOPIN	15.0	30.3	**6.0**
MUSTANG	49.9	51.9	**1.8**
ORCHESTRA	60.5	34.1	**2.3**
RAMOS	31.1	49.6	**3.4**
SAFARI	3.1	9.2	**8.5**
AMBASSADOR	-	66.5	*1.0*
ELECTRA	-	32.9	*4.3*
EMMA	-	79.4	*1.0*
LADY VALORA	-	52.0	*1.7*
TAURUS	-	26.9	*5.2*
VR808	-	47.5	*2.3*
LSD (P0.05)	13.3	15.1	**2.7***l4.7*

2.3.2.3. Common Scab (Table 10)

Of the varieties completing testing, Orchestra and Chopin were the most resistant with scores of 7.3 and 6.1, respectively. Mustang was the most susceptible variety with a score of 2.9.

Of the varieties in their 1st year of testing, Lady Valora was the most resistant with a score of 7.1 which was slightly higher than the score obtained by the most resistant control variety, P. Crown (7.0). Taurus was the most susceptible variety on test (3.3).

TABLE 10. MEAN % (ANGULAR TRANSFORMATION) SURFACE AREA AFFECTED BY COMMON SCAB

Variety	Test Year 2010	2011	1-9 rating
DESIREE	58.9	51.3	**2.9**
ESTIMA	40.6	42.4	**5.5**
HOME GUARD	64.7	45.2	**3.3**
MARIS BARD	58.4	54.4	**3.4**
MARIS PEER	56.7	52.9	**4.3**
MARIS PIPER	59.3	59.1	**2.0**
PENTLAND CROWN	37.6	33.5	**7.0**
CHOPIN	45.1	38.8	**6.1**
MUSTANG	57.6	54.7	**2.9**
ORCHESTRA	39.6	33.9	**7.3**
RAMOS	51.0	49.8	**4.2**
SAFARI	52.4	54.7	**3.5**
AMBASSADOR	-	47.9	*4.6*
ELECTRA	-	44.4	*5.3*
EMMA	-	44.8	*5.3*
LADY VALORA	-	36.5	*7.1*
TAURUS	-	53.6	*3.3*
VR808	-	43.3	*5.6*
LSD (P0.05)	11.1	8.6	**2.5**/*3.5*

2.3.2.4. Powdery Scab (Table 11)

There was a greater incidence of powdery scab in 2011 than 2010. Estima continued to be clearly more susceptible than any of the other reference varieties. Most varieties had moderate resistance with scores ranging from 6.3 to 4.6.

Of the 1st year candidate varieties Taurus was most resistant scoring 7.6. The most susceptible varieties were Emma (1.0), VR808 (1.0) and Electra (1.2).

TABLE 11. MEAN % (ANGULAR TRANSFORMATION) SURFACE AREA AFFECTED BY POWDERY SCAB

	Test Year		
Variety	**2010**	**2011**	**1-9 rating**
ACCENT	10.9	21.5	**6.8**
CARA	12.4	19.1	**6.9**
ESTIMA	33.5	35.3	**3.0**
PENTLAND CROWN	8.8	14.4	**7.8**
SANTE	9.3	11.7	**8.0**
CHOPIN	14.9	34.9	**5.0**
MUSTANG	16.7	31.9	**5.1**
ORCHESTRA	8.8	28.6	**6.3**
RAMOS	15.4	28.6	**5.6**
SAFARI	21.6	32.3	**4.6**
AMBASSADOR	-	25.3	*5.1*
ELECTRA	-	43.6	*1.2*
EMMA	-	48.6	*1.0*
LADY VALORA	-	35.5	*2.9*
TAURUS	-	13.7	*7.6*
VR808	-	51.6	*1.0*
LSD (P0.05)	5.8	7.3	**2.4**

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

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

There was generally more disease recorded in 2011 than 2010. Victoria (7.8) Mustang (7.7) and Ramos (7.7) were the most resistant candidate varieties. The most susceptible variety was Orchestra which scored 2.1.

Two 1st year varieties were highly resistant, these were VR808 (8.1) and Ambassador (8.1). There was no susceptible 1st year variety, the least resistant were Lady Valora and Emma scoring 4.3 and 4.1, respectively.

TABLE 12. MEAN % (ANGULAR TRANSFORMATION) INTERNAL AREA AFFECTED BY *FUSARIUM COERULEUM*

Variety	Test Year 2010	2011	1-9 rating
CATRIONA	48.6	56.4	**2.0**
ESTIMA	23.2	42.3	**4.7**
NADINE	17.2	24.8	**6.4**
PENTLAND SQUIRE	35.7	55.0	**3.0**
SANTE	10.9	7.3	**8.0**
CHOPIN	27.7	47.6	**4.1**
MUSTANG	16.9	5.7	**7.7**
ORCHESTRA	43.6	59.6	**2.1**
RAMOS	10.0	11.8	**7.7**
SAFARI	18.3	27.4	**6.1**
VICTORIA	8.9	12.6	**7.8**
AMBASSADOR	-	7.1	*8.0*
ELECTRA	-	35.3	*5.1*
EMMA	-	44.4	*4.1*
LADY VALORA	-	43.0	*4.3*
TAURUS	-	16.9	*7.0*
VR808	-	6.1	*8.1*
LSD (P0.05)	6.5	8.6	**1.9**

2.3.2.5.2. *F. sulphureum* (Table 13)

There was generally more disease recorded in 2011 than 2010. Safari was the most resistant variety with a score of 6.2. Orchestra and Victoria were completely susceptible, scoring only 1.0. Of the 1st year varieties, Ambassador (9.0) and Lady Valora (9.0) were the most resistant varieties. Emma was the most susceptible scoring 1.0.

TABLE 13. MEAN % (ANGULAR TRANSFORMATION) INTERNAL AREA AFFECTED BY *FUSARIUM SULPHUREUM*

	Test Year		
Variety	**2010**	**2011**	**1-9 rating**
ATLANTIC	23.7	42.9	**2.5**
MARIS PIPER	*	36.2	**3.0**
NADINE	16.1	32.9	**4.4**
SANTE	*	13.6	**8.0**
SAXON	8.2	15.3	**7.2**
CHOPIN	23.8	30.6	**3.8**
MUSTANG	28.3	48.0	**1.4**
ORCHESTRA	44.2	59.9	**1.0**
RAMOS	14.2	38.4	**4.0**
SAFARI	13.8	19.3	**6.2**
VICTORIA	43.0	42.5	**1.0**
AMBASSADOR	-	8.3	*9.0*
ELECTRA	-	32.7	*3.8*
EMMA	-	54.6	*1.0*
LADY VALORA	-	6.9	*9.0*
TAURUS	-	25.1	*5.5*
VR808	-	14.5	*7.8*
LSD (P0.05)	6.1	9.1	**3.9**

* = indicative score only. The control variety results were the opposite of those expected in 2010, so the data was reversed for the analysis to give indicative scores for the candidate varieties.

2.3.2.6. External damage (splitting) (Table 14)

The incidence of splitting was generally greater in 2010 than 2011, with large differences between some reference and candidate varieties; but this trend was not seen for all varieties as Red Craigs Royal and Ramos recorded more splitting in 2011. Overall the majority of varieties showed moderate resistance. Chopin and Mustang showed the most resistance both scoring 6.8, while Ramos (5.1) had the least resistance of the candidate varieties on test. Of the reference varieties, Ulster Sceptre (2.1) and Russet Burbank (2.3) were most susceptible to splitting damage, while the majority of the remaining reference varieties showed moderate resistance.

Of the 1st year candidate varieties, the most resistant variety was Lady Valora (7.4). VR808 was the least resistant variety on test scoring 4.0.

TABLE 14. MEAN % (ANGULAR TRANSFORMATION) TUBERS AFFECTED BY SPLITTING AFTER APPLYING STANDARD FORCE

	Test Year		
Variety	**2010**	**2011**	**1-9 rating**
ULSTER SCEPTRE	78.4	44.9	**2.1**
HOME GUARD	39.2	0.0	**6.1**
RED CRAIGS ROYAL	40.0	50.0	**3.7**
RUSSET BURBANK	77.1	42.3	**2.3**
RECORD	25.0	16.0	**6.0**
MARIS PIPER	38.0	9.8	**5.7**
MARIS PEER	37.7	6.1	**5.9**
CHOPIN	18.0	5.9	**6.8**
MUSTANG	18.0	6.1	**6.8**
ORCHESTRA	43.1	6.1	**5.6**
RAMOS	25.5	34.6	**5.1**
SAFARI	28.0	17.3	**5.8**
AMBASSADOR	-	17.6	*5.8*
ELECTRA	-	19.2	*5.7*
EMMA	-	31.4	*4.5*
LADY VALORA	-	2.0	*7.4*
TAURUS	-	13.5	*6.3*
VR808	-	36.0	*4.0*
LSD (P0.05)			**4.4**

2.3.2.7. Internal damage (bruising) (Table 15)

Chopin and Mustang were the most resistant to bruising with a score of 6.9 and 6.7 respectively. The least resistant candidate variety was Ramos (4.1).

For the 1st year varieties, most varieties had some level of resistance. Electra (6.8) was the most resistant variety, obtaining a score higher than the resistant reference varieties. VR808 (3.8) and Emma (3.9) were the most susceptible candidate varieties.

TABLE 15. MEAN DEPTH (MM) OF BRUISE AT POINT OF IMPACT OF STANDARD FORCE

Variety	Test Year 2010	2011	1-9 rating
ULSTER SCEPTRE	4.5	5.4	**3.3**
HOME GUARD	2.5	2.0	**5.9**
RED CRAIGS ROYAL	3.3	3.1	**4.9**
RUSSET BURBANK	3.0	5.4	**4.0**
RECORD	3.4	4.5	**4.2**
MARIS PIPER	1.7	2.4	**6.0**
MARIS PEER	2.6	2.8	**5.4**
CHOPIN	1.3	1.1	**6.9**
MUSTANG	1.1	1.7	**6.7**
ORCHESTRA	2.7	3.2	**5.2**
RAMOS	3.3	5.0	**4.1**
SAFARI	1.9	1.9	**6.2**
AMBASSADOR	-	2.5	*5.9*
ELECTRA	-	1.2	*6.8*
EMMA	-	5.6	*3.9*
LADY VALORA	-	3.5	*5.3*
TAURUS	-	3.9	*5.0*
VR808	-	5.8	*3.8*
LSD (P0.05)			**2.3**

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 Chopin, Orchestra, Ramos, Safari, Lady Valora and Taurus.

The 1st year candidate variety Ambassador appears to have some resistance to *G. pallida*. 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
DESIREE	**2 (S)** †	**2 (S)**	**2 (S)**
ESTIMA	**2 (S)**	*	*
MARIS PIPER	**7 (R)**	**2 (S)**	**2 (S)**
12380	**7 (R)**	**7 (R)**	**6**
VANTAGE	**5**	**6**	**6**
MORAG	**4**	**4**	**3 (S)**
VALES EVEREST	*	**6**	**8 (R)**
INNOVATOR	*****	**8 (R)**	**8 (R)**
CHOPIN	**7 (R)**	**2 (S)**	*
MUSTANG	**6**	**3 (S)**	*
ORCHESTRA	**7 (R)**	**2 (S)**	*
RAMOS	**7 (R)**	**4**	*
SAFARI	**7 (R)**	**2 (S)**	*
AMBASSADOR	**2 (S)**	*6*	*
ELECTRA	*6*	**2 (S)**	*
EMMA	**3 (S)**	**2 (S)**	*
LADY VALORA	*7*	**2 (S)**	*
TAURUS	*8*	**3 (S)**	*
VR808	*6*	**2 (S)**	*

† 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 reasonable disease development in all tests. In some tests e.g. black dot, skin spot, powdery scab and dry rot – *F. coeruleum* and *F. sulphureum*, disease severity was greater in 2011 than in 2010, whereas the incidence of foliage late blight and external damage (splitting) was less in 2011 than 2010. As in previous years, some differences in the relative reactions of varieties were found between test years. For example, Pioneer and Axona were more susceptible to silver scurf in 2011 than 2010. Such yearly variation appears to be an inherent part of this type of testing and may be a consequence of differing disease pressures and environmental conditions in the test year. Conditions in a polytunnel will, for example, be affected by outside temperature, amount of sunshine and humidity and this could impact on disease pressure. The amount of disease pressure to which a variety is exposed can affect its reaction as reported by Hilton *et*

al. (2000) for silver scurf. The potential for variability in a variety's reaction needs to be recognised when considering ratings, particularly those based on one test in one year.

Due to a high level of variability in varietal differences between years in the black scurf test data, resulting in inconsistent resistance ratings for this pathogen, scores for black scurf have not been published in this report. At the annual IVT partners meeting in January 2012 it was agreed to remove the black scurf scores previously published on the British Potato Variety Database because of the variation in performance of reference varieties. Trialling of a new *Rhizoctonia solani* test method evaluating potential varietal differences in susceptibility to stem canker and stolon pruning has been approved and testing will commence in 2012.

BioSS produced a paper (Appendix 1) for the IVT partners meeting in January 2012 which investigated using a log transformation in the analysis of the skin spot data. The IVT partners agreed that a log + 0.1 transformation should be used and that this method would be reviewed after 5 years. Analysis of the skin spot data in this report has been completed using the new method.

2011 saw the introduction of a test for potato mop top virus (spraing). In this test the number of tubers with spraing symptoms is recorded; the majority of varieties tested in 2011 had moderate to good resistance. There are two coloured flesh varieties under test; Violetta and Red Emmalie, it should be noted that the assessment of coloured flesh varieties is limited as spraing can be difficult to observe in these circumstances.

As reported in the R407 IVT report 2010, Sarpo Mira was the most resistant variety in the field foliage blight tests, but showed susceptibility to tuber blight in the test years of 2009 and 2010. The variety performed similarly in the 2011 blight trials. Such differences in reaction between foliage and tuber have been recorded in previous testing and confirm the necessity to ensure that more than one resistant variety is included in the test 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 two test years. This proposal has been adopted for NL analysis using data since 1981 and has been applied to IVT data for the last seven 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. ***Users of this data should bear in mind that the final rating of a variety should 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 breeders' information formerly presented in publications such as "Scotland - The Natural Home of Potatoes". This database allows SASA to publish variety information immediately from various trials as soon as it is finalised. To date, the database has been accessed 135,128 times up to July 2012.

The 14 varieties which completed IVT in 2011 were Victoria, Axona, Linton, Marvel, Tresdale, Clevna, Orwell, Lionheart, Pioneer, Chopin, Mustang, Orchestra, Ramos and Safari. In summary, the key findings for these varieties are as follows:

Victoria
Resistant to: **silver scurf, skin spot** and **dry rot - *F. coeruleum***

Susceptible to: **dry rot - *F. sulphureum***

Axona
Resistant to: **foliage late blight, black dot** and **silver scurf**

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

Linton
Resistant to: **silver scurf, blackleg** and **PCN Ro1**

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

Marvel (SM-01-81-01)
Resistant to: **dry rot – *F. coeruleum* and *F. sulphureum*, PCN Ro1** and **external damage**

Susceptible to: **skin spot, tuber late blight** and **internal damage**

Tresdale
Resistant to: **black dot, silver scurf, skin spot, blackleg** and **external damage**

Susceptible to: **common scab, dry rot - *F. sulphureum*** and **PCN Pa 2/3 and 1**

Clevna
Resistant to: **skin spot, blackleg, dry rot - *F. coeruleum*** and **external damage**

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

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

Susceptible to: **foliage late blight, tuber late blight, powdery scab, PCN Ro1** and **PCN Pa 2/3 and 1**

Lionheart (99C115-002)
Resistant to: **silver scurf, skin spot** and **dry *rot – F. coeruleum***

Susceptible to: **tuber late blight, dry rot – *F. sulphureum*, PCN Ro1** and **PCN Pa 2/3 and 1**

Pioneer
Resistant to: **blackleg, powdery scab, common scab** and **PCN Ro1**

Susceptible to: **foliage late blight, skin spot, dry rot – *F. sulphureum*** and **PCN Pa 2/3 and 1**

Chopin
Resistant to: **common scab, PCN Ro1, internal damage** and **external damage**

Susceptible to: **foliage late blight, skin spot, tuber late blight, dry rot – *F. coeruleum*** and **PCN Pa 2/3 and 1**

Mustang
Resistant to: **silver scurf, skin spot, dry rot – *F. coeruleum*, PCN Ro1, external damage** and **internal damage**

Susceptible to: **tuber late blight, blackleg, common scab, dry rot – *F. sulphureum*** and **PCN Pa 2/3 and 1**

Orchestra
Resistant to: **silver scurf, common scab** and **PCN Ro1**

Susceptible to: **foliage late blight, skin spot, tuber late blight, blackleg, dry rot – *F. coeruleum* and F. *sulphureum*** and **PCN Pa 2/3 and 1**

Ramos
Resistant to: **silver scurf, dry rot – *F. coeruleum*** and **PCN Ro1**

Susceptible to: **tuber late blight**

Safari
Resistant to: **silver scurf, blackleg** and **PCN Ro1**

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

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4. APPENDICES

4.1. Appendix 1: Transformation of skin spot data prior to statistical analysis

4.1.1. Introduction

This appendix considers one particular disease, skin spot, and the relative merits of alternative transformations of the susceptibility data prior to statistical analysis and the subsequent presentation of results on varietal resistance.

4.1.1.1. Current methodology

Each skin spot trial is laid out as a randomised block with six replicate pots of each variety containing a single inoculated tuber. At harvest all tubers greater than 15mm are stored at 5-8^{o}C until symptoms develop. Tubers are then scored for skin spot according to the methodology of Boyd (1957), from which an estimate of the percentage surface area affected for each pot's tubers is derived.

Currently, an angular transformation is applied to percentage skin spot data at the pot level. Analysis of transformed percentage data as a randomised block design for each trial separately gives variety means on the transformed scale. From a FITCON analysis (varieties and trials as fixed effects – which constitutes an additive model where the combined effect is the sum of the two individual effects) of the varieties X trials table of transformed means, over-trials variety means on the transformed scale are derived and least significant differences are computed. By fixing the scores on a (1-9) scale for two reference varieties (one susceptible and one resistant), scores for other varieties can be computed based on their respective over-trials means using linear interpolation. (This allows for year-to-year variation in the overall extent of disease challenge.)

4.1.1.2. Alternative methodologies

Possible alternatives to angular transformation are:

a) No transformation
b) Log (Skin spot % + const) where const>0 to deal with pots free from skin spot.

The rationale behind considering transformation of the data is:

a) There is a tendency for the variances of untransformed percentages to be functionally related to the mean, especially when percentages are close to either 0% or 100%. This violates a fundamental assumption of the statistical analysis – namely that the variance does not change with the mean.

b) The extent of varietal susceptibility may be proportional to the disease challenge. If this is so, then variety and trial effects are multiplicative rather than additive effects on the original (untransformed) scale.

An angular transformation is often applied as it should, on theoretical grounds, remove the relationship between the mean and the variance. It is usually successful to (at least) a limited extent in achieving this.

Log transformations are commonly applied in the biological sciences where the variance increases with the mean. Provided percentage data values do not materially exceed 50% a log transformation may also remove (or at least reduce) the relationship between the variance and the mean. However, as means increase beyond 50%, variances are expected on theoretical grounds to decrease while the log transformation is designed to deal with the opposite situation of the variances continuing to increase.

One very important advantage of a logarithmic transformation over an angular transformation arises when there are multiplicative effects in the dataset as multiplicative effects on the untransformed scale correspond to additive effects on a logarithmic scale.

4.1.2. Data

Skin spot data were available for six control/reference varieties (Fianna, King Edward, Pentland Squire, Romano, Sante and Saxon) in each of six years' trialling at SASA between 2005 and 2010.

4.1.3. Statistical methodology

Angular, $\log_{10}$(skin spot% + 1) and $\log_{10}$(skin spot% +0.1) transformations were applied to skin spot percentage data at the individual replicate (pot) level. Means for each of the six control/reference varieties in each trial were calculated from these transformed replicate values. Means based on untransformed data were also computed.

Varietal discrimination based on each of the three transformations outlined above and also without transformation was assessed and compared by analysis of variance of the matrices of 36 (six control / reference varieties by six years) means. Larger variance ratios indicate greater varietal discrimination than smaller variance ratios.

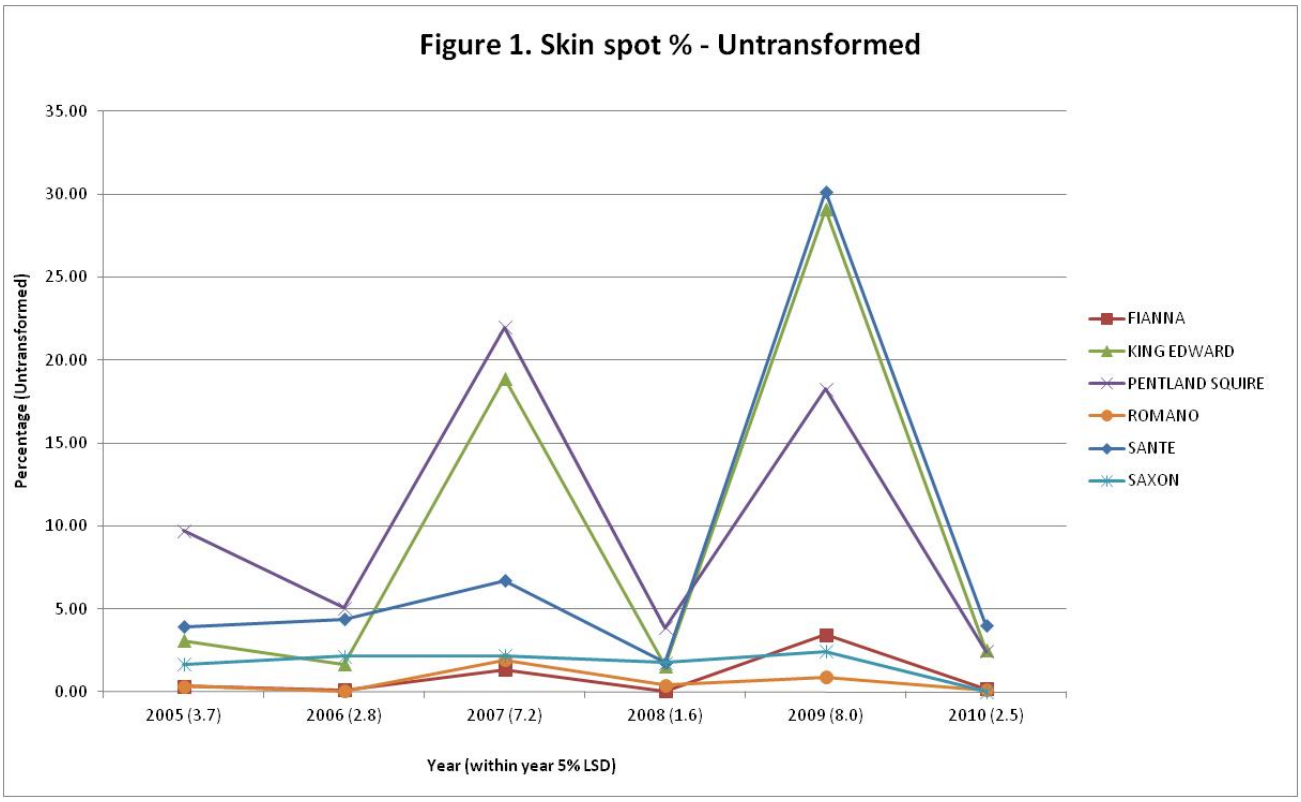
For each of the three transformations and also untransformed data graphs contrasting the skin spot profiles over the six years are shown.

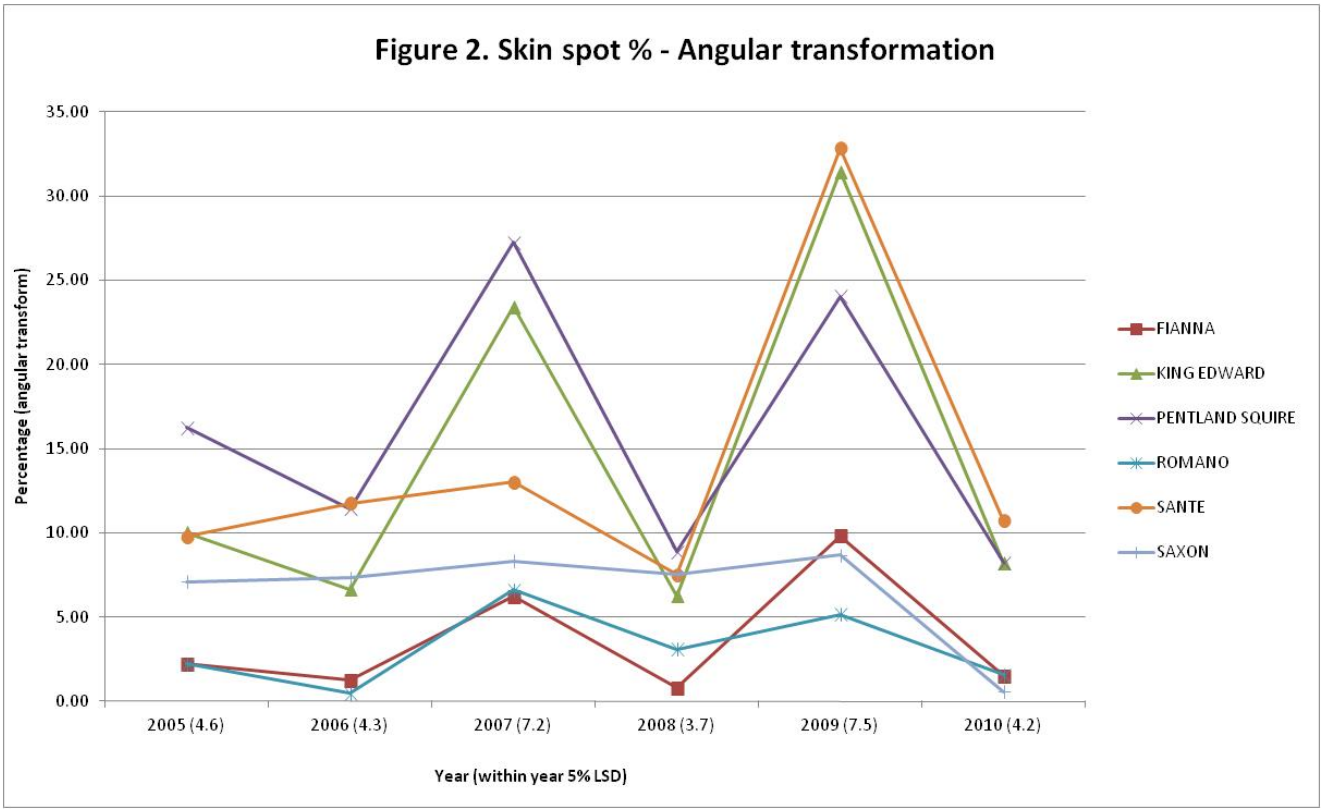
4.1.4. Results

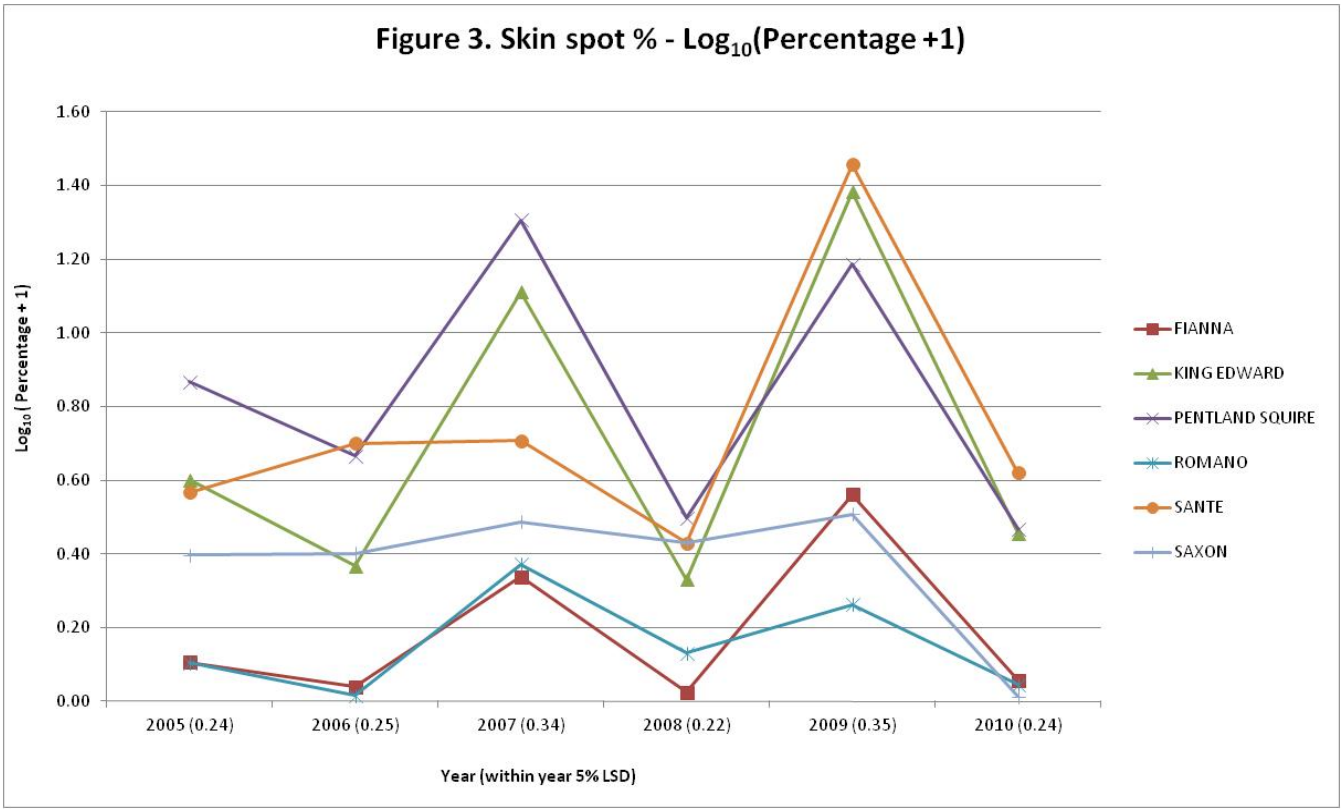
From the table below it is evident that the two largest varietal variance ratios were for log transformed data while the variance ratio was smaller for angular transformed data and smallest for untransformed data. This indicates a log transformation after the addition of the constant 0.1 gave the best discrimination.

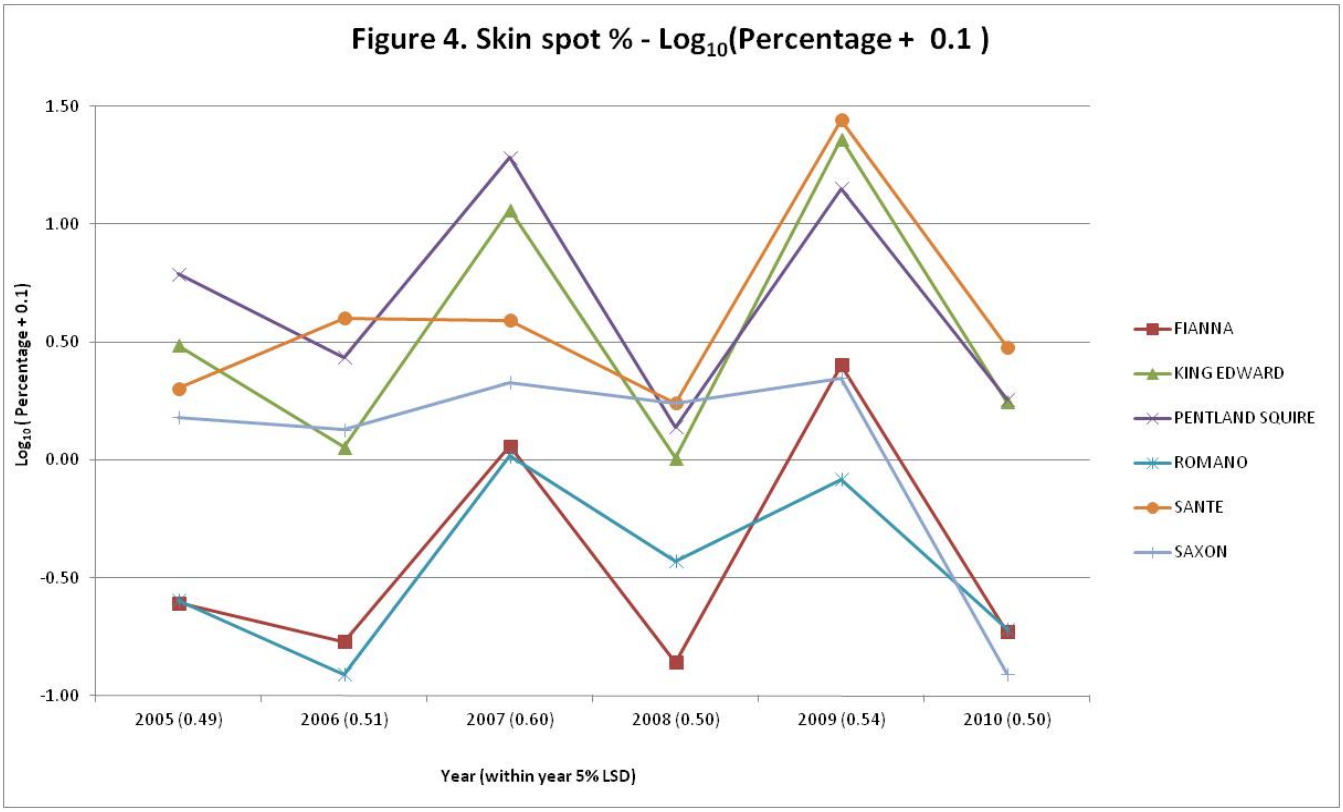
The varietal profiles over years from untransformed data (see Figure 1) were far from parallel to each other and therefore provide strong evidence that an additive model was inappropriate. The varietal profiles for the three transformations (see Figures 2-4) were closer to being parallel to each other. The profiles corresponding to a log transformation after the addition of the constant 0.1 were the closest of the four to being parallel.

	Untransformed	Angular	$Log_{10}(x+1)$	$Log_{10}(x+0.1)$
Trials V.R.	4.78	8.32	10.94	12.94
Varieties V.R.	3.87	9.45	15.67	21.10
Varieties P value	P=0.010	P<0.001	P<0.001	P<0.001
Fianna	0.91	3.63	0.19	-0.42
King Edward	9.47	14.32	0.71	0.54
Pentland Squire	10.22	16.02	0.83	0.68
Romano	0.62	3.18	0.16	-0.45
Sante	8.49	14.27	0.75	0.61
Saxon	1.70	6.59	0.37	0.05
SED	3.309	2.691	0.107	0.159
LSD (5%)	6.815	5.542	0.220	0.327









4.1.5. Conclusions

Comparison of varietal profiles over years based on untransformed data indicated that multiplicative effects were present in the data. Results suggested that a logarithmic transformation after the addition of a constant of 0.1 would better reflect the biological process of multiplicative effects than the current angular transformation while simultaneously improving varietal discrimination and addressing issues of relationships between the variance and the mean.

It is therefore recommended that skin spot data at the pot level is log transformed after adding a constant of 0.1 to all values prior to statistical analysis. A further review should be undertaken after this procedure has been in place for five years.

4.1.6. References

Boyd AEW. 1957. Field experiments on potato skin spot disease caused by *Oospora pustulans* Owen & Wakef. *Annals of Applied Biology* **45 :** 284-292