



# **Research Project Report**

# **Independent Variety Trials**

# **2015**

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## 1. SUMMARY

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 onto 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 (VCU). 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 Potato Council (now AHDB Potatoes), 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 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 the UK National List VCU 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 Limited (JHL)) 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. A 1 year extension was given for 2014 to complete trialling of varieties that commenced IVT in 2013. An additional test to determine susceptibility to potato mop top virus (spraing) was included in the programme from 2011. In 2012, the black scurf test was discontinued due to a high level of variability in the test data, resulting in inconsistent resistance ratings for this pathogen. As part of the programme, SASA have evaluated Common Catalogue varieties entered for IVT for all NL characters, except potato viruses (Y<sup>o</sup>, Y<sup>N</sup>, A and leafroll) and laboratory test for foliar late blight. A new 4 year contract was awarded to the consortium with the new programme commencing April 2015.

### Work Undertaken and Findings

In 2015, tests were conducted on 12 varieties which had completed UK NL tests and 8 Common Catalogue varieties. SASA conducted a test to determine susceptibility to foliage late blight at a site near Ayr which is operated in conjunction with JHL. Pot tests for silver scurf and skin spot were conducted by SASA. A pot test for black dot and a field trial for mop top (spraing) were conducted by SRUC. 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). All tests were completed satisfactorily.

Susceptibility/resistance was rated on a 1-9 scale. As 2015 was the start of a new IVT programme all candidates in this report have only completed one year of testing and

all results are provisional. Tables 1a and 1b presents the ratings for varieties after the first year of testing in the new programme in 2015.

**Table 1a.** Summary of ratings (1=low, 9=high) for resistance to diseases, pests and defects for varieties completing one year of the IVT programme. Scores are based on over-years analysis of IVT 2005-2015 and NL from 1981 except for late blight\* and PCN\*\*. Provisional ratings are shown in italics; varieties that have completed UK NL testing have a final score in bold.

\* late blight: analysis covered only the period of testing with a 13\_A2 genotype.

\*\* PCN Ro1 and Pa2/3 are tested in year 1 and if resistance is found the test is repeated in year 2. Scores in the table are presented using a 1-9 scale as determined by the EU PCN Directive (2007/33/EC).

Results in individual test tables (Tables 3-15) are based on 1 year only and scores may vary slightly from data in this table which is based on an over years analysis.

	Sorrento	Golden Beauty	Golden Sun	05.Z.39 A 35	Cammeo	Raleigh	04C126-005	Reiver	06.Z.266 A 4	06.Z.266 A 15	99C078-005	06.6860.2
Maturity	M	M	LM	EM	EM	2E	EM	EM	M	M	EM	EM
Foliage late blight (field)	7	6	6	4	5	3	5	6	7	7	5	5
Black dot	6	3	1	2	4	7	3	5	5	5	6	4
Silver scurf	7	5	7	5	5	7	6	6	5	4	4	5
Skin spot	3	8	1	9	4	2	3	7	7	5	5	3
Mop top	7	7	7	4	4	4	7	7	5	7	6	7
Foliage late blight (lab) ^	7	5	4	3	5	4	4	4	2	2	4	4
Tuber late blight	6	5	3	6	4	3	2	4	2	5	2	4
Blackleg- <i>Pectobacterium atrosepticum</i>	6	9	9	7	5	3	8	6	5	6	8	4
Powdery scab	8	6	5	5	1	7	6	7	7	7	7	6
Common scab	7	6	6	3	5	7	4	4	9	9	6	4
Dry rot – <i>Fusarium coeruleum</i>	3	4	6	8	6	7	8	8	8	8	6	7
Dry rot – <i>Fusarium sulphureum</i>	6	4	1	1	1	1	2	2	8	1	7	5
PCN Ro-1	2	2	2	9	2	8	2	8	2	2	9	2
PCN Pa 2/3	2	3	6	5	2	2	2	3	2	2	2	2
External damage (splitting)	7	7	7	7	2	2	7	5	6	7	7	5
Internal damage (bruising)	4	3	5	5	6	3	4	5	6	4	5	4

^ = 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 varieties completing one year of the IVT programme. Scores are based on over-years analysis of IVT 2005-2015 and NL from 1981 except for late blight\* and PCN\*\*. Provisional ratings are shown in italics; varieties that have completed UK NL testing have a final score in bold.

\* late blight: analysis covered only the period of testing with a 13\_A2 genotype.

\*\* PCN Ro1 and Pa2/3 are tested in year 1 and if resistance is found the test is repeated in year 2. Scores in the table are presented using a 1-9 scale as determined by the EU PCN Directive (2007/33/EC).

Results in individual test tables (Tables 3-15) are based on 1 year only and scores may vary slightly from data in this table which is based on an over years analysis.

	Captain	Constance	Emily	Fandango	Georgina	Heraclea	Imagine	Performer
Maturity	M	M	EM	EM	M	EM	EM	M
Foliage late blight (field)	3	4	5	4	4	3	4	3
Black dot	5	3	2	6	3	4	6	6
Silver scurf	8	8	7	8	7	7	8	5
Skin spot	8	3	6	5	3	6	6	4
Mop top	6	6	7	7	7	6	6	5
Foliage late blight (lab) ^	-	-	-	-	-	-	-	-
Tuber late blight	3	1	2	4	2	4	2	2
Blackleg- <i>Pectobacterium atrosepticum</i>	2	6	8	4	3	2	5	1
Powdery scab	6	4	6	6	4	5	5	3
Common scab	4	8	6	6	6	4	3	8
Dry rot – <i>Fusarium coeruleum</i>	5	6	1	5	6	7	6	7
Dry rot – <i>Fusarium sulphureum</i>	1	1	1	1	4	1	6	6
PCN Ro-1	8	2	7	7	8	4	8	3
PCN Pa 2/3	2	3	2	2	2	4	3	9
External damage (splitting)	3	1	6	6	4	6	6	6
Internal damage (bruising)	5	5	5	5	6	6	7	4

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

## **Conclusions**

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

\* For PCN Pa 2/3 and 1, a score of 4 or more has significant valuable resistance; a score or 3 or less is regarded as susceptible.

### **Sorrento**

Resistant to: *foliage late blight*, *silver scurf*, *mop top (spraing)*, **powdery scab**, **common scab**, and **external damage**

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

### **Golden Beauty**

Resistant to: *skin spot*, *mop top (spraing)*, **blackleg** and **external damage**

Susceptible to: *black dot*, **PCN Ro1**, **PCN Pa 2/3 and 1** and **internal damage**

### **Golden Sun**

Resistant to: *silver scurf*, *mop top (spraing)*, **blackleg**, **PCN Pa 2/3 and 1** and **external damage**

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

### **05.Z.39 A 35**

Resistant to: *skin spot*, **blackleg**, **dry rot – *F. coeruleum***, **PCN Ro1**, **PCN Pa 2/3 and 1** and **external damage**

Susceptible to: *black dot*, **common scab** and **dry rot – *F. sulphureum***

### **Cammeo**

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

### **Raleigh**

Resistant to: *black dot*, *silver scurf*, **powdery scab**, **common scab**, **dry rot – *F. coeruleum*** and **PCN Ro1**

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

### **04C126-005**

Resistant to: *mop top (spraing)*, **blackleg**, **dry rot – *F. coeruleum*** and **external damage**

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

### **Reiver**

Resistant to: *skin spot*, *mop top (spraing)*, **powdery scab**, **dry rot – *F. coeruleum*** and **PCN Ro1**

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

### **06.Z.266 A 4 (Mayan Rose – proposed name)**

Resistant to: *foliage late blight*, *skin spot*, **powdery scab**, **common scab**, **dry rots** – *F. coeruleum* and *F. sulphureum*

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

#### **06.Z.266 A 15 (Scapa – proposed name)**

Resistant to: *foliage late blight*, *mop top (spraying)*, **powdery scab**, **common scab**, **dry rot** – *F. coeruleum* and **external damage**

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

#### **99C078-005**

Resistant to: **blackleg**, **powdery scab**, **PCN Ro1** and **external damage**

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

#### **06.6860.2**

Resistant to: *mop top (spraying)* and **dry rot** – *F. coeruleum*

Susceptible to: *skin spot* and **PCN Ro1** and **PCN Pa 2/3 and 1**

#### **Captain**

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

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

#### **Constance**

Resistant to: *silver scurf* and *common scab*

Susceptible to: *black dot*, *skin spot*, *tuber late blight*, *dry rot* – *F. sulphureum*, *PCN Ro1*  
and *PCN Pa 2/3 and 1* and *external damage*

#### **Emily**

Resistant to: *silver scurf*, *mop top (spraying)*, *blackleg* and *PCN Ro1*

Susceptible to: *black dot*, *tuber late blight*, *dry rots* – *F. coeruleum* and *F. sulphureum*  
and *PCN Pa 2/3 and 1*

#### **Fandango**

Resistant to: *silver scurf*, *mop top (spraying)* and *PCN Ro1*

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

#### **Georgina**

Resistant to: *silver scurf*, *mop top (spraying)* and *PCN Ro1*

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

#### **Heraclea**

Resistant to: *silver scurf* and *dry rot* – *F. coeruleum* and *PCN Pa 2/3 and 1*

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

#### **Imagine**

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

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

#### **Performer**



Resistant to: *common scab*, *dry rot* – *F. coeruleum* and *PCN Pa 2/3 and 1*  
Susceptible to: *foliage late blight*, *tuber late blight*, *blackleg*, *powdery scab* and *PCN Ro1*

## 2. 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 AHDB Potatoes 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 Yo\*, potato leafroll 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.

\* It was agreed to extend the NL programme from 2009 onwards to test for two additional potato viruses, these were virus A and virus Y<sup>N</sup>.

In 2005, a 3 year contract to conduct a revised IVT programme was awarded to a consortium of SASA, SAC, BioSS and MRS. 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). From 2011, an additional test was included in the programme this was potato mop top virus (spraing) (SAC). SASA have tested Common Catalogue varieties entered for IVT for all NL characters, except potato viruses (Y<sup>o</sup>, Y<sup>N</sup>, A and leafroll) and laboratory tests for foliar late blight. Tests were to be conducted over a 2 year period.

In 2012, the black scurf test was discontinued due to a high level of variability in the test data, resulting in inconsistent resistance ratings for this pathogen.

A new contract for the IVT programme was awarded to the consortium in 2015, the current IVT specific tests are field foliage blight, silver scurf and skin spot which are conducted at SASA and black dot and mop top (spraing) which are conducted at SAC. This report summarises all the testing conducted over the 2015-2016 season.

### 3. MATERIALS AND METHODS

#### 3.1 Standard Varieties

The standard varieties used in 2014 were reviewed and retained in 2015. The varieties used in each test are listed below with, in brackets, their foliage maturity and the susceptibility rating. Foliage late blight ratings are taken from work conducted by Lees *et al.* (2012), the other test ratings are as published in NIAB TAG Pocket Guide to Varieties of Potatoes, 2014:

Foliage late blight:	Home Guard [1E, 4], Bintje [M, 3], Russet Burbank [M, 3], Valor [M, 6], Cara [M, 6], Sarpo Mira [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: virus (spraing)	Cara [M, 3], Nicola [M, 4], Valor [M, 6], Saturna [M, 7], Maris Piper [M, 5]

#### 3.2 Varieties in Trial

A new test programme commenced in 2015 and all varieties in this report have completed one year of testing. 12 varieties were tested through the UK National List route and 8 varieties were tested through the Common Catalogue route. The varieties tested are listed in Table 2.

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. *sepedonicus*) and *Dickeya* spp. bacteria. Tests on all candidates were negative.

**Table 2.** Varieties in IVT in 2015**UK National List**

				<b>stage of test 2015</b>	
<b>AFP</b>	<b>Variety</b>	<b>Breeder/Agent</b>	<b>Maturity</b>	<b>NL</b>	<b>IVT</b>
4/802	Sorrento	MRS/Greenvale	M	completed	1
4/804	Golden Beauty	PepsiCo/MRS	M	completed	1
4/805	Golden Sun	PepsiCo/MRS	EM	completed	1
4/809	05.Z.39 A 35	MRS (Taypack)	M	completed	1
4/816	Cammeo	Caithness Pot Holding BV/Caithness Pot Exports Ltd	EM	2	1
4/817	Raleigh	Caithness Varieties Ltd	2E	2	1
4/818	04C126-005	Cygnnet PB Ltd	EM	2	1
4/819	Reiver	JHI/MRS Ltd	EM	2	1
4/820	06.Z.266 A 4 (Mayan Rose – proposed name)	JHI/MRS Ltd (Greenvale)	M	2	1
4/821	06.Z.266 A 15 (Scapa – proposed name)	JHI/MRS Ltd (Greenvale)	M	2	1
4/823	99C078-005	Cygnnet PB Ltd	EM	2	1
4/824	06.6860.2	Cullen Allen Ltd	EM	2	1

**Common Catalogue**

				<b>stage of test 2015</b>	
<b>AFP</b>	<b>Variety</b>	<b>Breeder/Agent</b>	<b>Maturity</b>	<b>NL</b>	<b>IVT</b>
n/a	Captain	Germicopa UK	M	1	1
n/a	Constance	Agrico	M	1	1
n/a	Emily	Cullen Allen Ltd	EM	1	1
n/a	Fandango	IPM Potato Group	EM	1	1
n/a	Georgina	Branston Ltd	M	1	1
n/a	Heraclea	HZPC	EM	1	1
n/a	Imagine	IPM Potato Group	EM	1	1
n/a	Performer	Agrico	M	1	1

**IVT Test Methods**

The test methods used were those agreed and set out in the standard protocols prepared for the 2015 programme. Details of this year's tests are provided below:

**Foliage late blight in the field, 2015**

The test tubers were planted in plots of 2 tubers at Dalrymple, by Ayr on 18 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 10 August. On 24, 27, 31 August and 3, 7, 10, 14 September, 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.

### **Skin spot, 2015**

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 19 May. Pots were placed outdoors in peat beds and watered by drip irrigation into each pot. The layout was randomised block with 6 replications. The haulm was killed by applying diquat dibromide 2 September at half the manufacturer's recommended rate. The tubers were harvested into separate plastic boxes on 21 October and then stored at 5-8°C until the last week in March. The % surface area affected by skin spot was recorded in 5 categories and a surface infection index calculated (Boyd, 1957).

### **Silver scurf, 2015**

Petri dishes containing 2% malt extract agar were inoculated using two isolates of silver scurf which were grown for a minimum of 14 days, then macerated in 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 on 31 May and placed in a polytunnel; watering was 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 28 October into separate plastic boxes and washed so visible symptoms could be observed, the tubers were then stored at 12-15°C and high humidity until silver scurf lesions had developed sufficiently on the susceptible standard varieties. In mid-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.

### **Black dot, 2015**

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 13 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 12 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.

### **Potato mop top virus (spraing), 2015**

A plot in the Woodlands field at SAC Aberdeen previously contaminated with powdery scab / PMTV in 2009 was planted on the 5 June with varieties grown in single tuber randomised blocks with 6 replicates. The plots were irrigated during the season.

After harvest on the 6 November the tubers were placed in a cool store (c.18°C) for 3 weeks before placed in a cold store at 4°C. Tubers were assessed for visual symptoms of PMTV spraing after cutting on 2 December. All tubers from each of the 6 replicates were assessed individually. The results were expressed as the average percentage of the tubers showing symptoms.

### **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 2015”. 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°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°C and the incidence of splitting at the point of impact is recorded. Tubers for the bruising test are stored at 9-11°C and the depth of damage at point of impact measured.

### **Statistical analysis**

Most of the data was recorded as percentages and was 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 11 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 1 year 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.

## 4. RESULTS

Ring rot, brown rot and *Dickeya* bacteria were not found in tested seed potatoes.

### IVT Tests

For each IVT test there is a summary of varieties in the 1 year of trials, highlighting the performance of particular varieties. The 1-9 ratings listed for the varieties in the relevant test table are presented in italic font and are provisional scores after 1 year of testing. The names of the reference varieties are highlighted in bold font for each test.

#### **Foliage late blight (field)** (Table 3)

Due to wet weather the trial was not planted until 18<sup>th</sup> June. Infector plants were placed in the trial on the 10<sup>th</sup> August and the first assessment was conducted on 24<sup>th</sup> August where some late blight was recorded in the plots. Six further assessments were conducted at 3 or 4 day intervals. Initially development was slow before the late blight developed well throughout the trial.

The resistant reference variety Sarpo Mira was the most resistant in trial scoring an 8.0. The most resistant candidate varieties were 06.Z.266 A 4 (6.8), Sorrento (6.7) and 06.Z.266 A 15 (6.7). Performer was the most susceptible candidate in trial with a score of 2.8.

**Table 3.** Mean % (angular transformation) Area under Disease Progress in foliage late blight field test in 2012 and 2013 (2nd early/maincrop varieties)

<b>Variety</b>	<b>Test Year 2015</b>	<b>1-9 rating</b>
<b>BINTJE</b>	46.7	3.0
<b>CARA</b>	25.7	6.0
<b>RUSSET BURBANK</b>	43.9	3.4
<b>SARPO MIRA</b>	11.8	8.0
<b>VALOR</b>	28.6	5.6
SORRENTO	21.0	6.7
GOLDEN BEAUTY	30.1	5.4
GOLDEN SUN	28.8	5.6
05.Z.39 A 35	43.6	3.5
CAMMEO	35.0	4.7
RALEIGH	44.8	3.3
04C126-005	31.2	5.2
REIVER	28.4	5.6
06.Z.266 A 4	20.2	6.8
06.Z.266 A 15	21.0	6.7
99C078-005	35.5	4.6
06.6860.2	33.6	4.9
CAPTAIN	45.1	3.2
CONSTANCE	38.6	4.2
EMILY	35.5	4.6
FANDANGO	42.7	3.6
GEORGINA	42.4	3.6
HERACLEA	44.1	3.4
IMAGINE	43.5	3.5
PERFORMER	48.1	2.8
LSD (P0.05)	5.5	

**Black dot** (Table 4)

Raleigh was the most resistant candidate scoring 7.6; Golden Sun was the least resistant with a score of 2.7.

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

Variety	Test Year	
	2015	1-9 rating
CARA	23.3	7.0
FIANNA	30.3	6.1
LADY CHRISTL	41.0	4.8
P SQUIRE	55.6	3.0
SAXON	31.4	6.0
SORRENTO	26.8	6.6
GOLDEN BEAUTY	45.8	4.2
GOLDEN SUN	58.2	2.7
05.Z.39 A 35	52.5	3.4
CAMMEO	43.0	4.6
RALEIGH	18.2	7.6
04C126-005	45.3	4.3
REIVER	33.4	5.7
06.Z.266 A 4	35.6	5.5
06.Z.266 A 15	36.5	5.4
99C078-005	27.0	6.5
06.6860.2	43.7	4.5
CAPTAIN	33.5	5.7
CONSTANCE	48.0	3.9
EMILY	53.9	3.2
FANDANGO	25.5	6.7
GEORGINA	46.6	4.1
HERACLEA	38.5	5.1
IMAGINE	25.0	6.8
PERFORMER	25.9	6.7
LSD (P0.05)	19.5	



## Silver scurf (Table 5)

There were less symptoms overall in the trial than observed previously, however the susceptible reference variety Lady Christl was still the most susceptible in test scoring 2.0. Many of the candidates demonstrated some resistance to silver scurf with six candidates achieving a score of 7.0 or higher.

**Table 5.** Mean % (angular transformation) surface are affected by silver scurf.

Variety	Test Year 2015	1-9 rating
CARA	10.4	7.0
FIANNA	15.2	6.2
LADY CHRISTL	40.8	2.0
PENTLAND SQUIRE	24.5	4.7
ROMANO	23.7	4.8
SAXON	18.7	5.6
SORRENTO	13.7	6.5
GOLDEN BEAUTY	22.5	5.0
GOLDEN SUN	14.5	6.3
05.Z.39 A 35	21.4	5.2
CAMMEO	24.8	4.6
RALEIGH	10.3	7.0
04C126-005	16.3	6.0
REIVER	18.4	5.7
06.Z.266 A 4	22.3	5.0
06.Z.266 A 15	25.7	4.5
99C078-005	29.4	3.9
06.6860.2	23.7	4.8
CAPTAIN	8.8	7.3
CONSTANCE	9.4	7.2
EMILY	13.9	6.4
FANDANGO	8.8	7.3
GEORGINA	11.1	6.9
HERACLEA	10.1	7.0
IMAGINE	9.6	7.1
PERFORMER	22.6	5.0
LSD (P0.05)	4.3	

## Skin spot (Table 6)

There was good development of skin spot in the trial. Three varieties were very resistant with a score of 9.0; these were Golden Beauty, 05.Z.39 A 35 and Captain. Golden Sun and Raleigh were the most susceptible candidates with scores of 1.0 and 1.8 respectively.

**Table 6.** Mean % (log transformation [ $\log(\text{skin spot}\% + 0.1)$  where log is log to base 10]) surface area affected by skin spot.

Variety	Test Year	
	2015	1-9 rating
FIANNA	-0.5	9.0
KING EDWARD	0.7	2.2
PENTLAND SQUIRE	0.8	2.0
ROMANO	-0.2	7.0
SANTE	0.9	1.4
SAXON	0.2	5.0
SORRENTO	0.7	2.6
GOLDEN BEAUTY	-0.6	9.0
GOLDEN SUN	1.0	1.0
05.Z.39 A 35	-0.8	9.0
CAMMEO	0.3	4.6
RALEIGH	0.8	1.8
04C126-005	0.5	3.3
REIVER	-0.4	8.1
06.Z.266 A 4	-0.3	7.8
06.Z.266 A 15	0.2	5.2
99C078-005	0.1	5.7
06.6860.2	0.5	3.4
CAPTAIN	-0.6	9.0
CONSTANCE	0.6	3.2
EMILY	-0.1	6.7
FANDANGO	0.2	4.9
GEORGINA	0.6	3.1
HERACLEA	0.0	6.1
IMAGINE	-0.0	6.1
PERFORMER	0.4	4.1
LSD (P0.05)	0.4	

### Potato mop top virus (spraing) (Table 7)

Five candidates in the test scored 7.0 which is the same as the resistant reference variety Maris Piper. 05.Z.39 A 35 was the most susceptible candidate scoring 2.8, Raleigh also demonstrated susceptibility with a score of 3.0.

**Table 7.** Mean % (angular transformation) of tubers showing symptoms of potato mop top virus (spraing).

Variety	Test Year 2015	1-9 rating
CARA	30.4	3.3
NICOLA	11.2	5.6
VALOR	28.0	3.6
SATURNA	24.8	4.0
MARIS PIPER	0.0	7.0
SORRENTO	4.4	6.5
GOLDEN BEAUTY	5.0	6.4
GOLDEN SUN	2.3	6.7
05.Z.39 A 35	34.4	2.8
CAMMEO	26.8	3.8
RALEIGH	32.9	3.0
04C126-005	5.0	6.4
REIVER	0.0	7.0
06.Z.266 A 4	17.6	4.9
06.Z.266 A 15	-0.4	7.0
99C078-005	11.3	5.6
06.6860.2	0.0	7.0
CAPTAIN	8.7	5.9
CONSTANCE	10.6	5.7
EMILY	5.0	6.4
FANDANGO	-0.4	7.0
GEORGINA	-0.3	7.0
HERACLEA	9.4	5.9
IMAGINE	13.4	5.4
PERFORMER	23.9	4.1
LSD (P0.05)	15.6	

### **Early blight (*Alternaria solani* and *A. alternata*)**

An early blight test (*A. solani* and *A. alternata*) was proposed for the new IVT programme. Leaf samples from symptomatic plants were collected in 2014 and 2015. Analysis by the SASA potato pathology team found all samples were *A. solani*.

#### *A. solani*

Several *A. solani* isolates were trialled for use in the 2015 test but none produced a high enough spore count for the test. Some additional isolates were tested in early 2016 but again a high enough spore count could not be obtained for the test. As a result of this, no test data is available for the candidate varieties at the time of writing the report.

#### *A. alternata*

No UK isolates of *A. alternata* were obtained and therefore no trial was conducted in 2015.

### **NL Tests**

For each NL test there is a summary of varieties in the 1 year of trials, highlighting the performance of particular varieties. The 1-9 ratings listed for the varieties in the relevant test table are presented in italic font and are provisional scores after 1 year of testing. The names of the reference varieties are highlighted in bold font for each test.

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

No candidates demonstrated resistance to tuber late blight. The least susceptible candidate was Heraclea with a score of 3.8.

**Table 8.** Mean % (angular transformation) tubers affected by late blight (2<sup>nd</sup> early/maincrop varieties).

<b>Variety</b>	<b>Test Year</b>	
	<b>2015</b>	<b>1-9 rating</b>
<b>BINTJE</b>	78.2	<i>2.0</i>
<b>CARA</b>	35.8	<i>6.0</i>
<b>SARPO MIRA</b>	78.8	<i>1.9</i>
<b>VALOR</b>	39.7	<i>5.6</i>
CAPTAIN	75.1	<i>2.3</i>
CONSTANCE	90.0	<i>1.0</i>
EMILY	80.5	<i>1.8</i>
FANDANGO	64.6	<i>3.3</i>
GEORGINA	75.2	<i>2.3</i>
HERACLEA	59.1	<i>3.8</i>
IMAGINE	80.2	<i>1.8</i>
PERFORMER	82.2	<i>1.6</i>
LSD (P0.05)	12.0	

## Blackleg (Table 9)

Reference varieties are tested at 2 sites each year as part of the NL programme. SASA and NIAB (the other UK NL test centre) both conduct a field trial. Common catalogue varieties are only tested at SASA. The 1-9 score for the reference varieties is from SASA and NIAB in 2015. The 1-9 score for the candidate varieties are based on the 2015 SASA trial only.

Emily demonstrated resistance to blackleg scoring 8.1 which is slightly higher than resistant reference varieties Ailsa and Cultra (both 8.0). Performer was the most susceptible candidate in trial scoring 1.9.

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

Variety	Test Year		1-9 rating <sup>^</sup>
	2015 (SASA)	2015 (NIAB)	
<b>AILSA</b>	21.9	12.7	8.0
<b>CONCURRENT</b>	48.9	82.5	3.0
<b>CULTRA</b>	13.6	21.1	8.0
<b>ESTIMA</b>	34.7	57.2	5.0
<b>MORENE</b>	67.0	67.0	2.9
CAPTAIN	63.9		2.8
CONSTANCE	29.0		6.4
EMILY	12.3		8.1
FANDANGO	49.5		4.3
GEORGINA	51.4		4.1
HERACLEA	65.9		2.6
IMAGINE	42.9		4.9
PERFORMER	72.5		1.9
LSD (P0.05)	14.4	13.6	

<sup>^</sup>NL trial is conducted at 2 sites (SASA and NIAB); 1-9 rating for reference varieties uses data from 2 sites in 2015, 1-9 rating for candidate varieties uses data from SASA in 2015 only.

## Common scab (Table 10)

Reference varieties are tested at 2 sites each year as part of the NL programme. SASA conducts a pot test in the NL programme, NIAB (the other UK NL test centre) conduct a field trial. Common catalogue varieties are only tested at SASA. The 1-9 score for the reference varieties is from SASA and NIAB in 2015. The 1-9 score for the candidate varieties are based on the 2015 SASA trial only.

Performer and Constance were the most resistant candidates scoring 7.8 and 7.4 respectively. Imagine was the least resistant scoring 2.3.

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

Variety	Test Year		1-9 rating ^
	2015 (SASA)	2015 (NIAB)	
<b>DESIREE</b>	61.0	36.7	2.4
<b>ESTIMA</b>	50.0	31.3	4.4
<b>HOME GUARD</b>	55.3	34.7	3.3
<b>MARIS BARD</b>	52.7	24.1	5.0
<b>MARIS PEER</b>	49.4	27.7	4.9
<b>MARIS PIPER</b>	54.9	45.8	2.0
<b>PENTLAND CROWN</b>	36.0	24.6	7.0
CAPTAIN	49.9		3.9
CONSTANCE	35.8		7.4
EMILY	43.4		5.5
FANDANGO	41.3		6.1
GEORGINA	44.2		5.3
HERACLEA	50.3		3.8
IMAGINE	56.5		2.3
PERFORMER	34.3		7.8
LSD (P0.05)	8.6	7.4	

^NL trial is conducted at 2 sites (SASA and NIAB); 1-9 rating for reference varieties uses data from 2 sites in 2015, 1-9 rating for candidate varieties uses data from SASA in 2015 only.

### **Powdery scab** (Table 11)

The susceptible reference variety Estima was the most susceptible of the varieties in trial and resistant reference variety Sante was the most resistant of all varieties.

Emily, Captain and Fandango demonstrated some resistance, scoring 6.9, 6.5 and 6.1, respectively. No candidate was very susceptible to powdery scab.

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

<b>Variety</b>	<b>Test Year</b>	
	<b>2015</b>	<b>1-9 rating</b>
<b>ACCENT</b>	20.9	6.3
<b>CARA</b>	13.7	7.4
<b>ESTIMA</b>	42.1	3.0
<b>PENTLAND CROWN</b>	15.6	7.1
<b>SANTE</b>	10.2	8.0
CAPTAIN	19.7	6.5
CONSTANCE	30.3	4.8
EMILY	17.3	6.9
FANDANGO	22.0	6.1
GEORGINA	30.7	4.8
HERACLEA	26.4	5.5
IMAGINE	25.8	5.6
PERFORMER	35.5	4.0
LSD (P0.05)	4.9	

**Dry rot (*Fusarium* spp.)**  
*F. solani* var. *coeruleum* (Table 12)

The majority of candidates demonstrated some resistance to dry rot (*F. coeruleum*). Performer was highly resistant scoring 9.0. Only one candidate was very susceptible, this was Emily with a score of 1.0.

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

Variety	Test Year 2015	1-9 rating
NADINE	13.8	7.3
CATRIONA	41.6	1.4
ESTIMA	8.8	8.4
PENTLAND SQUIRE	26.5	4.6
SANTE	10.6	8.0
CAPTAIN	21.8	5.6
CONSTANCE	15.7	6.9
EMILY	67.7	1.0
FANDANGO	23.3	5.3
GEORGINA	17.2	6.6
HERACLEA	11.3	7.8
IMAGINE	17.9	6.4
PERFORMER	5.4	9.0
LSD (P0.05)	8.7	



*F. sulphureum* (Table 13)

Five candidates were very susceptible scoring between 1.0 or 1.4. No candidates were resistant with the best performing variety Imagine scoring 4.9.

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

<b>Variety</b>	<b>Test Year 2015</b>	<b>1-9 rating</b>
<b>SANTE</b>	9.8	8.0
<b>ATLANTIC</b>	30.7	4.6
<b>MARIS PIPER</b>	40.8	3.0
<b>NADINE</b>	31.1	4.6
<b>SAXON</b>	44.7	2.4
CAPTAIN	53.0	1.0
CONSTANCE	50.5	1.4
EMILY	60.4	1.0
FANDANGO	55.9	1.0
GEORGINA	36.9	3.6
HERACLEA	54.5	1.0
IMAGINE	29.3	4.9
PERFORMER	31.3	4.5
LSD (P0.05)	7.8	

### External damage (splitting) (Table 14)

No variety demonstrated resistance to splitting. The most susceptible variety Constance (2.1) recorded levels of splitting similar to the susceptible reference variety Russet Burbank (1.8).

**Table 14.** Mean % (angular transformation) tubers affected by splitting after applying standard force (2<sup>nd</sup> early/maincrop varieties)

Variety	Test Year 2015	1-9 rating
MARIS PEER	60.0	3.5
MARIS PIPER	38.0	4.7
RECORD	16.0	6.0
RED CRAIGS ROYAL	48.0	4.2
RUSSET BURBANK	88.0	1.8
CAPTAIN	58.0	3.6
CONSTANCE	84.0	2.1
EMILY	23.5	5.6
FANDANGO	28.0	5.3
GEORGINA	50.0	4.0
HERACLEA	30.0	5.2
IMAGINE	28.6	5.3
PERFORMER	28.0	5.3

LSD (P0.05)

**Internal damage (bruising)** (Table 15)

There was not a large variation in performance of the varieties with candidates scoring between 6.1 and 4.8.

**Table 15.** Mean depth (mm) of bruise at point of impact of standard force (2<sup>nd</sup> early/maincrop varieties)

<b>Variety</b>	<b>Test Year 2015</b>	<b>1-9 rating</b>
<b>MARIS PEER</b>	5.9	4.8
<b>MARIS PIPER</b>	3.9	6.0
<b>RECORD</b>	5.8	4.9
<b>RED CRAIGS ROYAL</b>	5.0	5.3
<b>RUSSET BURBANK</b>	7.4	4.0
CAPTAIN	5.4	5.1
CONSTANCE	5.7	5.0
EMILY	5.2	5.3
FANDANGO	4.7	5.5
GEORGINA	3.7	6.1
HERACLEA	4.2	5.8
IMAGINE	3.2	6.4
PERFORMER	6.0	4.8

LSD (P0.05)

### Potato Cyst Nematode (Table 16)

High level resistance to PCN (*G. rostochiensis* Ro1) is normally conferred by the major gene H1 and results in minimal multiplication of cysts on the potato. Varieties expressing this type of resistance to Ro1 in 2015 were Captain, Emily, Fandango, Georgina and Imagine.

The candidate Performer showed high resistance to *G. pallida*. Heraclea had a score of 4 and this still provides a valuable level of resistance due to the scarcity of resistance to *G. pallida* of varieties in commercial production in the UK.

**Table 16.** Multiplication of cysts of 3 pathotypes of potato cyst nematode (*Globodera rostochiensis* pathotype 1; *G. pallida* pathotypes 2/3 and 1) on test varieties, expressed as 1-9 rating as determined by the EU PCN Directive (2007/33/EC).

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)	6	6
VANTAGE	3	5	5
MORAG	3	3	3
VALES EVEREST	*	6	9 (R)
INNOVATOR	*	9 (R)	9 (R)
CAPTAIN	8	2	*
CONSTANCE	2	3	*
EMILY	7	2	*
FANDANGO	7	2	*
GEORGINA	8	2	*
HERACLEA	4	4	*
IMAGINE	8	3	*
PERFORMER	3	9	*

† S denotes fully susceptible reference cultivars

\* not tested

## 5. DISCUSSION

The full range of disease tests was completed on time with reasonable disease development in most tests. Less silver scurf was recorded in 2015 than in previous years in the programme but more skin spot was recorded in 2015 than some earlier years. The field foliage blight trial was planted in the middle of June and initially late blight was slow to develop but by the third assessment the disease had started to spread and several varieties succumbed quickly to the disease.

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. In the 5 years of testing the majority of varieties have demonstrated resistance. For the analysis, Maris Piper was used as the anchor point for resistance replacing Cara whose performance has been variable over the test years.

In the National List (NL) 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 in this report, 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 the one year 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 11 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, the 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 as the mechanism for publication of both NL and IVT. This database allowed SASA to publish variety information immediately from various trials as soon as it is finalised. In 2014 the site was re-launched as the Potato Council Variety Database. The site had not only a new look but additional features including a simplified search facility, the ability to compare two varieties on one screen and additional character sets (dormancy, dry matter, determinacy and cooking type). Variety data can be downloaded into Excel and

the site is mobile device-compatible. In line with the name change of Potato Council, the database was rebranded in 2015 as AHDB Potato Variety Database.

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