



Research Report
Independent Variety Trials 2005

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1.1 Contents

1.	Summary for Growers	3
1.1	Project Aims	3
1.2	Work Undertaken and Findings.....	4
1.3	Conclusions	6
2.	Experimental Report	7
2.1	Introduction	7
2.2	Materials and Methods	8
2.2.1	Control Varieties.....	8
2.2.2	Varieties in Trial	9
2.2.3	IVT Test Methods.....	10
2.2.3.1	Foliage late blight in the field, 2005	10
2.2.3.2	Skin spot, 2005.....	10
2.2.3.3	Silver scurf, 2005	11
2.2.3.4	Black dot, 2005	11
2.2.3.5	Black scurf, 2005	12
2.2.4	NL Tests	12
2.2.5	Statistical Analysis.....	13
2.3	Results	13
2.3.1	IVT Tests	13
2.3.1.1	Foliage late blight (Field).....	13
2.3.1.1.1	2005 Trial	13
2.3.1.1.2	Summary of 2004/05 Trial	14
2.3.1.2	Black scurf	16
2.3.1.2.1	2005 Trial.....	16
2.3.1.2.2	Summary of 2004/05 Trials	17
2.3.1.3	Black dot.....	18
2.3.1.3.1	2005 Trial	18
2.3.1.3.2	Summary of 2004/05 Trial	19
2.3.1.4	Silver scurf	20
2.3.1.4.1	2005 Trial	20

2.3.1.4.2	Summary of 2004/05 Trials	21
2.3.1.5	Skin spot	22
2.3.1.5.1	2005 Trial	22
2.3.1.5.2	Summary of 2004/05 Trial	23
2.3.2	NL Tests	23
2.3.2.1	Tuber late blight	23
2.3.2.2	Blackleg	24
2.3.2.3	Common scab	25
2.3.2.4	Powdery scab	26
2.3.2.5	Dry rot	26
2.3.2.5.1	<i>F. solani</i> var. <i>coeruleum</i>	27
2.3.2.5.2	<i>F. sulphureum</i>	28
2.3.2.6	External damage (splitting)	29
2.3.2.7	Internal damage (bruising)	29
2.3.2.8	Potato cyst nematode.....	30
2.4	Discussion and Conclusions	31
2.5	References.....	33

1.2 TABLES

Table 1. Summary of varietal ratings (1=low, 9=high) for resistance to diseases, pests and defects.

Table 2. Varieties in IVT in 2005

Table 3. Mean % (angular transformation) Area under Disease Progress in foliage late blight field test over 2 years.

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

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

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

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

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

Table 9. Mean % (angular transformation) plants affected by blackleg (*Erwinia catorovora* var. *atroseptica*)

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

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

Table 12. Mean % (angular transformation) tubers affected by splitting after applying standard force

Table 13. Mean depth (mm) of bruise at point of impact of standard force

Table 14. 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.

Table 15. Comparison of the results (% (angular transformation) rotting) of 2004 test at NIAB and 2005 test at SASA for varietal susceptibility to species of dry rot causing *Fusarium*.

1.3 FIGURES

Fig. 1. Development of late blight in the field test at Ayr, 2005.

Fig. 2. Development of black scurf on daughter tubers derived from test tubers planted in infested compost.

Fig. 3. Development of black dot on daughter tubers derived from test tubers planted in infested compost

Fig 4. Development of silver scurf on daughter tubers derived from test tubers planted in infested compost.

Fig 5. Development of skin spot on daughter tubers derived from test tubers inoculated with *Polyscytalum pustulans*.

Fig. 6. Development of rots caused by *Fusarium solani* var. *coeruleum* after inoculation in January 2006

Fig. 7. Development of rots caused by *Fusarium sulphureum* after inoculation in January 2006.

1. SUMMARY FOR GROWERS

1.1 Project Aims

In order to comply with both national and European Community legislation for the marketing of seed potatoes, all potato varieties must be placed on the official National List (NL) of a Member State. When this is achieved, the variety is automatically entered on to the Common Catalogue which is, in effect, an EC National List. Part of the NL testing involves assessing a new variety for Value for Cultivation or Use. In the UK, this testing is largely concentrated on assessing varietal performance for susceptibility to diseases, pests and some tuber quality characteristics considered to be of most importance in UK potato

production. After a review of the Independent Variety Trials (IVT) programme, industry, through the British Potato Council (BPC), concluded that additional tests for some other diseases were also desirable in order to provide growers with the fullest information on the performance of new varieties before large scale production occurred. In addition, potato varieties on the Common Catalogue which are being developed for GB production, were also to be tested to provide independent data on these varieties for GB growers. It was also decided that IVT tests would be conducted over 2 years and not 3 years as previously, and that industry alone would be responsible for conducting field trials to assess varietal performance with respect to yield and usage quality.

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

1.2 Work Undertaken and Findings

In 2005, tests were conducted on 4 varieties undergoing their 2nd year of UK NL testing, 7 varieties which had completed UK NL tests and 5 Common Catalogue varieties (see Table 2). SASA conducted a test to determine susceptibility to foliage late blight at a site near Ayr. Pot tests for black dot and black scurf were conducted by SAC and tests for silver scurf and skin spot by SASA. The Common Catalogue varieties were also tested by SASA for susceptibility to tuber late blight, common scab, powdery scab, blackleg, 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.

A new website presenting the 2005 test results in an Excel or PDF format was created for access by BPC levy payers. Susceptibility/resistance was rated on 1-9 scale. Table 1 summarises the test results for 2005 but underlined ratings based on one year's test results should be regarded as provisional.

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

	Annabelle	Almera	Arrow	Elisabeth	Vivaldi	95CO44-060	86-F-2.3	97-HIG-127.2	97-HIG-132.5	Moulin Rouge	Sunrise	Pixie	Vales Emerald	Vales Everest	Bambino	Bonnie
	1/2E	2E	1E	1E	EM	LM	LM	LM	LM	EM	2E	2E	1E	LM	EM	EM
Maturity	1/2E	2E	1E	1E	EM	LM	LM	LM	LM	EM	2E	2E	1E	LM	EM	EM
Foliage late blight (lab)	<u>4</u>	<u>3</u>	<u>5</u>	<u>3</u>	<u>3</u>	5	4	4	6	4	4	4	4	5	6	4
Tuber late blight*	<u>2</u>	<u>4</u>	<u>6</u>	<u>1</u>	<u>6</u>	5	5	4	7	4	3	5	4	4	5	3
Common scab	<u>5</u>	<u>5</u>	<u>5</u>	<u>4</u>	<u>5</u>	3	6	7	7	6	7	4	4	4	6	4
Powdery scab	<u>5</u>	<u>3</u>	<u>6</u>	<u>5</u>	<u>6</u>	7	7	5	8	7	2	8	7	6	8	4
Blackleg (<i>E.c.</i> subsp. <i>atroseptica</i>)	<u>5</u>	<u>6</u>	<u>5</u>	<u>7</u>	<u>5</u>	8	7	6	7	6	2	8	7	4	9	7
External damage	<u>4</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>6</u>	6	3	8	6	1	5	9	7	7	2	3
Internal damage	<u>7</u>	<u>5</u>	<u>7</u>	<u>6</u>	<u>5</u>	6	6	5	4	4	2	5	6	4	5	4
Dry rot – <i>Fusarium coeruleum</i>	<u>6</u>	<u>7</u>	<u>5</u>	<u>7</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>7</u>	<u>6</u>	<u>8</u>	<u>5</u>	<u>2</u>	<u>4</u>	<u>3</u>	<u>4</u>
Dry rot – <i>Fusarium sulphureum</i>	<u>6</u>	<u>6</u>	<u>3</u>	<u>7</u>	<u>2</u>	<u>7</u>	<u>1</u>	<u>7</u>	<u>2</u>	<u>3</u>	<u>7</u>	<u>7</u>	<u>5</u>	<u>1</u>	<u>4</u>	<u>6</u>
PCN Ro-1	9	9	9	9	2	8	2	9	3	2	3	8	2	5	9	9
PCN Pa 2/3	2	2	3	2	3	6	2	4	2	2	3	3	2	6	2	2
PCN Pa 1	NT	NT	NT	NT	5	NT	NT	4	NT	NT	NT	NT	NT	8	NT	NT
Foliage late blight (field)	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>6</u>	3	<u>3</u>	<u>4</u>	3	<u>3</u>	<u>4</u>	<u>3</u>	<u>4</u>	<u>4</u>	<u>4</u>
Skin spot	<u>8</u>	<u>8</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>4</u>	8	<u>8</u>	<u>5</u>	7	<u>7</u>	<u>6</u>	<u>4</u>	<u>4</u>	6	6
Silver scurf	<u>6</u>	<u>8</u>	<u>6</u>	<u>5</u>	<u>5</u>	<u>5</u>	7	<u>3</u>	<u>4</u>	<u>5</u>	<u>8</u>	<u>5</u>	<u>1</u>	<u>4</u>	<u>4</u>	7
Black scurf	<u>5</u>	<u>6</u>	<u>8</u>	<u>6</u>	<u>5</u>	<u>3</u>	8	<u>2</u>	<u>5</u>	<u>7</u>	<u>5</u>	<u>3</u>	<u>2</u>	<u>6</u>	<u>6</u>	<u>5</u>
Black dot	<u>9</u>	<u>3</u>	<u>6</u>	<u>3</u>	<u>8</u>	<u>5</u>	4	<u>5</u>	<u>4</u>	<u>6</u>	<u>5</u>	<u>2</u>	<u>2</u>	<u>2</u>	5	<u>7</u>

*1st early Varieties and 2nd early/maincrop varieties were assessed separately and scores should not be compared.

NT = Not tested, assumed to be susceptible based on Pa2/3 reaction

1.3 Conclusions

The applications to enter the proposed varieties 95C044-060, 86-F-2.3 and 97-HIG-127.2 on the UK National List were withdrawn in May, 2006 and these varieties will, therefore, not enter commercial production.

In summary, the findings for the remaining test varieties, with final ratings in bold, were as follows:

97-HIG-132.5

Resistant to: **tuber late blight, common scab, powdery scab, blackleg, dry rot-*F. coeruleum*.**

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

Moulin Rouge

Resistant to: **powdery scab**, skin spot, black scurf.

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

Sunrise

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

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

Pixie

Resistant to: **powdery scab, blackleg, external damage**, dry rot-*F. sulphureum*, **PCN Ro1.**

Susceptible to: **PCN Pa 2/3 and 1**, black scurf, black dot.

Vales Emerald

Resistant to: **powdery scab, blackleg, external damage.**

Susceptible to: foliage late blight, dry rot-*F. coeruleum*, **PCN Pa 2/3 and 1**, silver scurf, black scurf, black dot.

Vales Everest

Resistant to: **external damage, PCN Pa 2/3 and 1.**

Susceptible to: dry rot- *F. sulphureum*, black dot.

Bambino

Resistant to: **powdery scab, blackleg, PCN Ro 1.**

Susceptible to: **external damage**, dry rot- *F. coeruleum*, **PCN Pa 2/3 and 1.**

Bonnie

Resistant to: **blackleg, PCN Ro 1**, silver scurf, black dot.

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

Annabelle

Resistant to: internal damage, **PCN Ro1**, skin spot, black dot.

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

Almera

Resistant to: dry rot-*F. coeruleum*, **PCN Ro1**, skin spot, silver scurf.

Susceptible to: foliage late blight, powdery scab, black dot.

Arrow

Resistant to: internal damage, **PCN Ro1**, skin spot, black scurf.

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

Elisabeth

Resistant to: blackleg, dry rot-*F. coeruleum* and *F. sulphureum*, **PCN Ro1**, skin spot.

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

Vivaldi

Resistant to: skin spot, black dot.

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

2. EXPERIMENTAL REPORT

2.1 INTRODUCTION

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

For National List purposes, the diseases and pests prioritised as being of national importance were foliage late blight, tuber late blight, blackleg (*Erwinia carotovora* var. *atroseptica*) and potato cyst nematodes (*Globodera rostochiensis* pathotype Ro1 and *Globodera pallida* pathotypes Pa2/3 and Pa1). The characters agreed as being of less significance nationally but important to industry were powdery scab, common scab, dry rot - *Fusarium solani* var. *coeruleum*, dry rot - *F.sulphureum*, potato virus Y^o, potato leafroll virus, external damage (splitting) and internal damage (bruising). In addition, unreplicated assessments of tuber yield, and external and internal tuber defects were to be made in order to comply with the requirements of the EU Directive 72/180/EEC and 02/8/EC. The consultation also agreed that varieties entered for IVT testing could be incorporated into NL tests. In 2005, a 3 year contract to conduct a revised IVT programme was awarded to a consortium of SASA, SAC, BioSS and SCRI. The tests to be conducted for IVT purposes were foliage late blight in the field (SASA), black scurf (SAC), black dot (SAC), silver scurf (SASA) and skin spot (SASA). In addition, SASA would test Common Catalogue varieties entered for IVT for all NL characters, except PVY and leafroll. Tests were to be conducted over 2 years instead of 3 years.

2.2 MATERIALS AND METHODS

2.2.1. Control Varieties

The control varieties were reviewed as to their suitability in providing a wide range of susceptible and resistant reactions within the various maturity groups. An additional objective was to have as many of same reference varieties as possible in all tests. The technical basis for selecting the reference varieties was the Pocket Guide to Varieties of Potatoes 2005 (NIAB, Cambridge 2004). The following changes were adopted:

Foliage late blight:	Orla to replace Premiere as 1 st early resistant variety
Black scurf:	Duke of York (1 st early susceptible), Lady Christl (1 st early resistant) and Cara (maincrop, resistant) were adopted to replace Romano, Fianna, Pentland Squire and Saturna.
Black dot:	Lady Christl (1 st early, susceptible) and Cara (maincrop, moderately resistant) were adopted to replace Romano, King Edward, Sante and Saturna.
Silver scurf:	Lady Christl (1 st early, susceptible) was adopted and King Edward, Sante and Saturna deleted.
Skin spot:	Saturna was deleted as a control variety.

2.2.2 Varieties in Trial (Table 2)

In line with the policy established by BPC, of the varieties submitted for UK National List Trials, only those varieties entering the 2nd year of testing or those that had completed NL testing were considered for entry to the IVT programme. In addition, 5 Common Catalogue varieties were identified for inclusion in the test programme.

Table 2. Varieties in IVT in 2005

Variety	Breeder/Agent	Maturity	Stage of testing prior to 2005	
			NL	IVT
<u>UK National List</u>				
95 CO44-060	Cygnets PB	E.Maincrop	1	0
86-F-2.3	Higgins	Maincrop	1	1
97-HIG-127.2	Higgins	Maincrop	1	0
97-HIG-132.5	Higgins	Maincrop	1	0
Bonnie	Cygnets PB	Maincrop	2	1
Pixie	Doig	E.Maincrop	2	0
Vales Emerald		1 st Early	2	0
	Greenvale			
Vales Everest	Greenvale	Maincrop	2	0
Bambino	Cygnets PB	Maincrop	2	1
Moulin Rouge	Higgins	E.Maincrop	Completed	1
Sunrise	Doig	Maincrop	Completed	0
<u>Common Catalogue</u>				
Annabelle	HZPC	2 nd Early	-	-
Vivaldi	HZPC	E.Maincrop	-	-
Arrow	Agrico	1 st Early	-	-
Almera	Agrico	E.Maincrop	-	-
Elisabeth	Agrico	1 st Early	-	-

Susceptibility tests for dry rot (*F. solani* var. *coeruleum* and *F. sulphureum*) were also conducted on the following NL varieties because they had not been tested under the previous NL programme: Sunrise, Pixie, Moulin Rouge, Vales Emerald, Vales Everest, Bonnie and Bambino.

As a plant health precaution, all seed tubers from non-UK sources were tested for brown rot (*Ralstonia solanaceum*) and ring rot (*Clavibacter michiganensis* subsp. *sepedonicus*).

2.2.3 IVT Test Methods

The responsible test centres prepared standardised protocols for each test. The methodologies chosen were broadly similar to those employed by the previous contractor in order to provide some continuity in the testing. For skin blemish diseases, it was decided to test tuber resistance by either planting uninoculated tubers in infested compost in pots or by inoculating tubers and planting them in unamended compost in pots. The reaction of the varieties was then to be assessed by recording the severity of disease on the daughter tubers after appropriate incubation. For foliage late blight in the field, test tubers were to be planted in small plots, surrounded by plants of a susceptible variety

which were to be inoculated with a known isolate of *Phytophthora infestans*. The development of late blight on test plants was to be recorded on at least 3 occasions.

2.2.3.1 **Foliage Late Blight in the field, 2005:** the test tubers were planted in plots of 2 tubers at Yonderton Farm, Dalrymple, By Ayr. The 2nd early/maincrop experiment was planted on 12 May and 1st early experiment on 8 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 (1.2.3.4.6.7.8.10.11) of *P. infestans* were laid out along the adjacent rows of King Edward on 7 July. On 29 July, 2 August and 9 August, % 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.

2.2.3.2 **Skin spot, 2005:** test tubers were dipped 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. Pots were placed outdoors in peat beds on 11 May and watered by drip irrigation into each pot. The layout was randomised block with 6 replications. The haulm was killed by applying diquat dibromide (Reglone) on 10 August at the half the manufacturer's recommended rate. The pots were held at *c.* 10⁰C for 9 days before harvesting. The tubers were then stored in cardboard boxes at 4-6⁰C until the last week in February. The % surface area affected by skin spot was recorded in 5 categories.

2.2.3.3 **Silver scurf, 2005:** test tubers were dipped for 0.5 min in a suspension of macerated spores and mycelia and planted in pots containing Bulrush compost. Pots were placed in a polytunnel on 14 April. The layout was a randomised block design with 6 replications. Haulms were allowed to senesce naturally. Tubers were harvested on 1 September. The produce of each pot was placed in separate cardboard box and incubated at 12-15⁰C and high humidity until silver scurf lesions had developed sufficiently. In January, 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.

In addition, 20 excess daughter tubers from each unreplicated variety plot used to multiply test tubers for damage and dry rot tests were selected in January. The severity of silver scurf on the tubers was assessed as described above.

2.2.3.4 **Black dot, 2005:** Petri dishes containing potato dextrose agar (PDA) were inoculated with three isolates of *C. coccodes*. When, after one week, the colonies had reached the edge of the dishes, the cultures were macerated using a liquidiser. The suspension was added to Bulrush compost at the rate of 1 petri dish of *C. coccodes* per 8 kg compost in a cement mixer and mixed for 10 minutes. Test tubers were planted on 16th May in 15 cm diameter pots filled with amended compost which were set in individual watering saucers and then placed in a polytunnel in a randomised block design with 6 replications. Pots were watered every 2 days so that the compost was kept damp but not over-watered. Haulms were allowed to senesce naturally. Tubers were harvested on 25th 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 in a cold store. The % surface area affected by black dot was then assessed on the 1st November.

2.2.3.5 **Black scurf, 2005:** Petri dishes containing PDA were inoculated with three isolates of *R. solani* AG-3. When, after 1 week, the colonies had reached the edge of the agar plate, the cultures were macerated in a liquidiser and added to compost in a cement mixer at a rate of 1 dish per 8 kg of Bulrush compost. On 2nd June, a single seed tuber of each variety was planted in a 15 cm diameter pot which was placed in an individual watering saucer. Pots were laid out in a polytunnel in a randomised block design with 6 replicates. Plants were grown and maintained as in Section 2.2.2.4. All daughter tubers from each pot were harvested on 30th September, after symptoms of black scurf were seen on the susceptible reference varieties. The % surface area covered by black scurf was assessed on 5th October 2005.

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”. The methods are summarised below:

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

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

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

Blackleg: test tubers are inoculated at the heel end with *Erwinia carotovora* subsp. *atroseptica* 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 12-15⁰C. 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 4-6⁰C and the incidence of splitting at the point of impact is recorded. Tubers for the bruising test are stored at 9-11⁰C and the depth of damage at point of impact measured.

2.2.5. Statistical analysis

Most of the data was recorded as percentages and was angularly transformed before conducting an individual trial analysis of variance. Over-trial variety means were calculated using REML from transformed trial means and 1-9 ratings derived by linear interpolation using varieties with known consistent susceptible and resistant reactions as fixed reference points.

2.3 RESULTS

2.3.1 IVT Tests

2.3.1.1 Foliage late blight (field)

2.3.1.1.1 2005 Trial (Fig.1a and b)

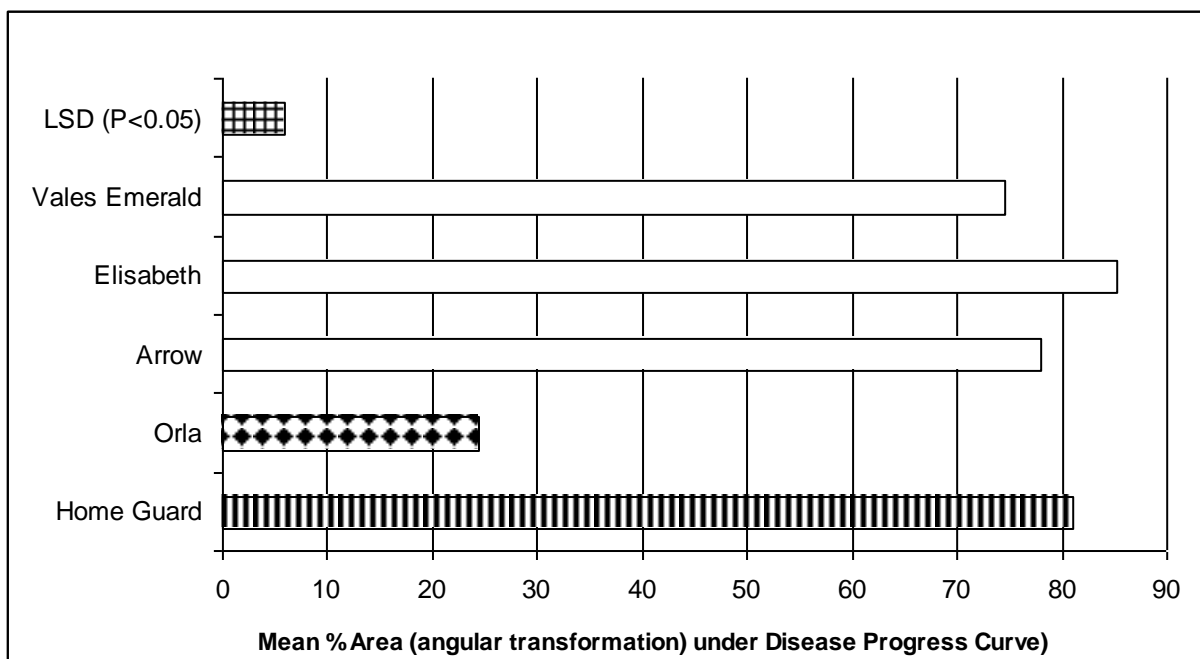
Late blight progressed fairly rapidly on the susceptible varieties during the period of assessment and development was particularly rapid on the 1st early varieties. Orla, the 1st early resistant reference variety, exhibited good resistance, rated as 6. The 3 test varieties were all as susceptible as Home Guard (3). In the 2nd early/maincrop trial, 11 out of 13 test varieties were as susceptible as Bintje and Russet Burbank (3) or were slightly more resistant (4). 97-HIG-132.5 was less resistant than Cara (6) and 95CO44-060 was slightly more resistant. None of the test varieties were as resistant as Stirling (8).

2.3.1.1.2 Summary of 2004/05 Trials (Table 3)

The most striking result was the difference in the reaction of Cara and Stirling over the 2 years. In 2004 test at Cambridge, Cara was more resistant than Stirling but, in 2005 at Ayr, the pattern was reversed. There is no obvious explanation for this as it is understood that the same isolate was used in both years. All test varieties were relatively susceptible, scoring 3 or 4. The reaction of Bambino and Bonnie was less susceptible in 2004 than in 2005.

Fig. 1 Development of late blight in the field test at Ayr, 2005.

a) 1st early varieties



b) 2nd early/maincrop varieties

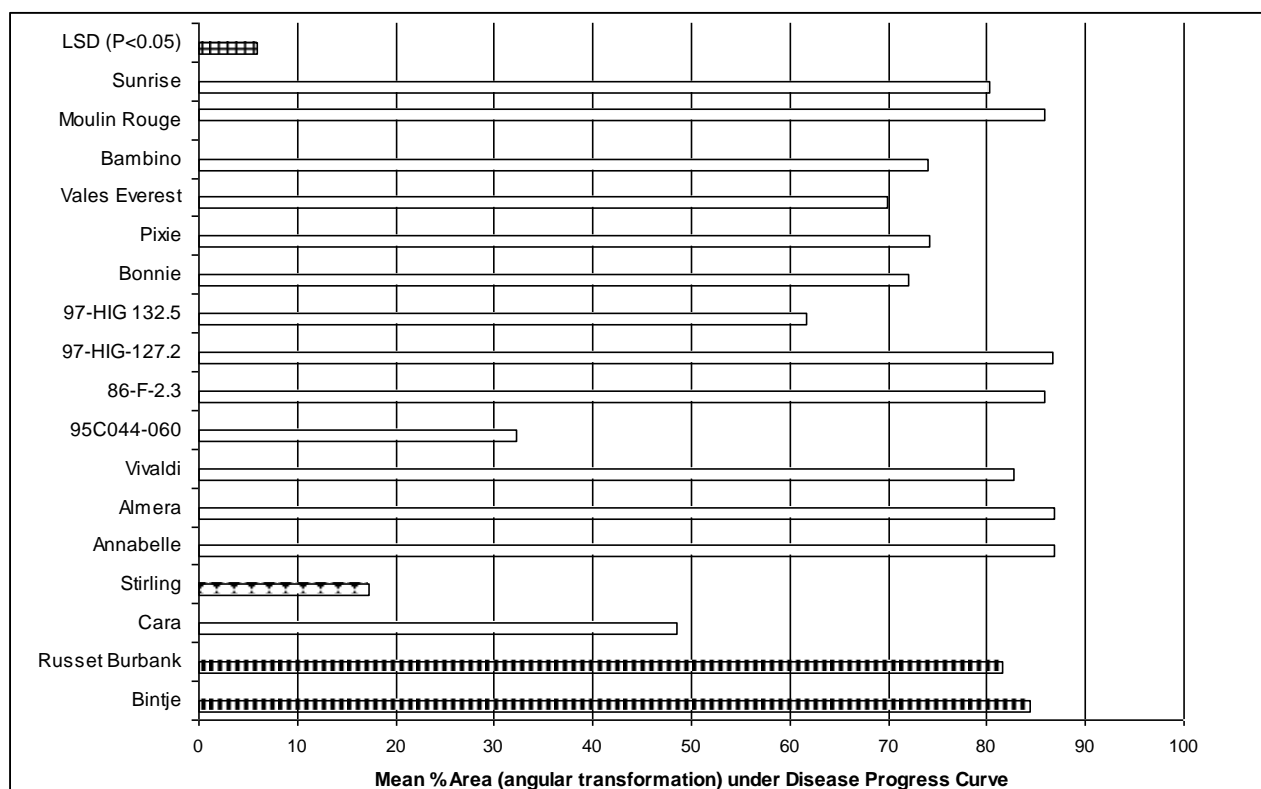


Table 3. Mean % (angular transformation) Area under Disease Progress in foliage late blight field test over 2 years.

Variety	Test Year		Final 1-9 rating
	2004	2005	
Bintje	58.8	84.4	3
Russet Burbank	51.8	81.6	3
Cara	16.3	48.9	7
Stirling	42.8	17.2	7
86-F.2.3	59.3	85.8	3
Moulin Rouge	58.9	85.8	3
Bambino	38.0	74.0	4
Bonnie	42.3	72.0	4
LSD (P<0.05)	-	6.0	

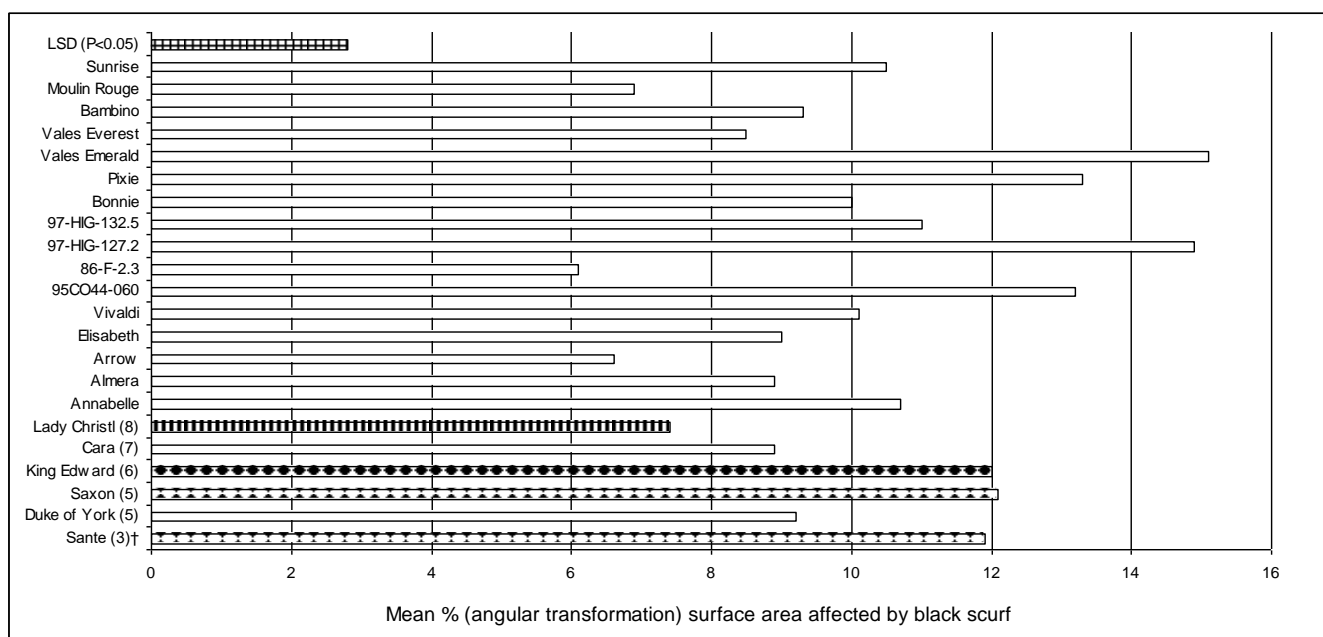
2.3.1.2. **Black scurf**

2.3.1.2.1 2005 Trial (Fig. 2)

A wide range of disease severity was obtained in the test, giving good discrimination amongst the varieties. As expected, Lady Christl and Cara were the most resistant of the selected reference varieties. However, the disease scores of Saxon and King Edward were

similar to that of the susceptible variety Sante (3) and, therefore, not as resistant as indicated by the published ratings. Three varieties, Arrow, Moulin Rouge and 86-F-2.3 were as or more resistant than Lady Christl (8). Four varieties were more susceptible than Sante. These were 95CO44-060, 97-HIG-127.2, Pixie and Vales Emerald.

Fig. 2. Development of black scurf on daughter tubers derived from test tubers planted in infested compost.



† rating of the variety as published in NIAB Pocket Guide to Varieties of Potato, 2005

2.3.1.2.2 Summary of 2004/2005 Trials (Table 4)

The least significant difference (LSD) for 2004 test was almost double that for the 2005 test. There was also a considerable difference between the 2004 and 2005 results for all 4 test varieties and these will be tested again in 2006, in order to provide additional data for deriving the final 1-9 ratings. The ratings for test varieties presented in Table 1 are based on the results of 2005 test only and are, therefore, provisional. The disease scores for Sante, Saxon and King Edward were in reasonable agreement over the 2 years but, as discussed above, those for Saxon and King Edward were not in agreement with published ratings.

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

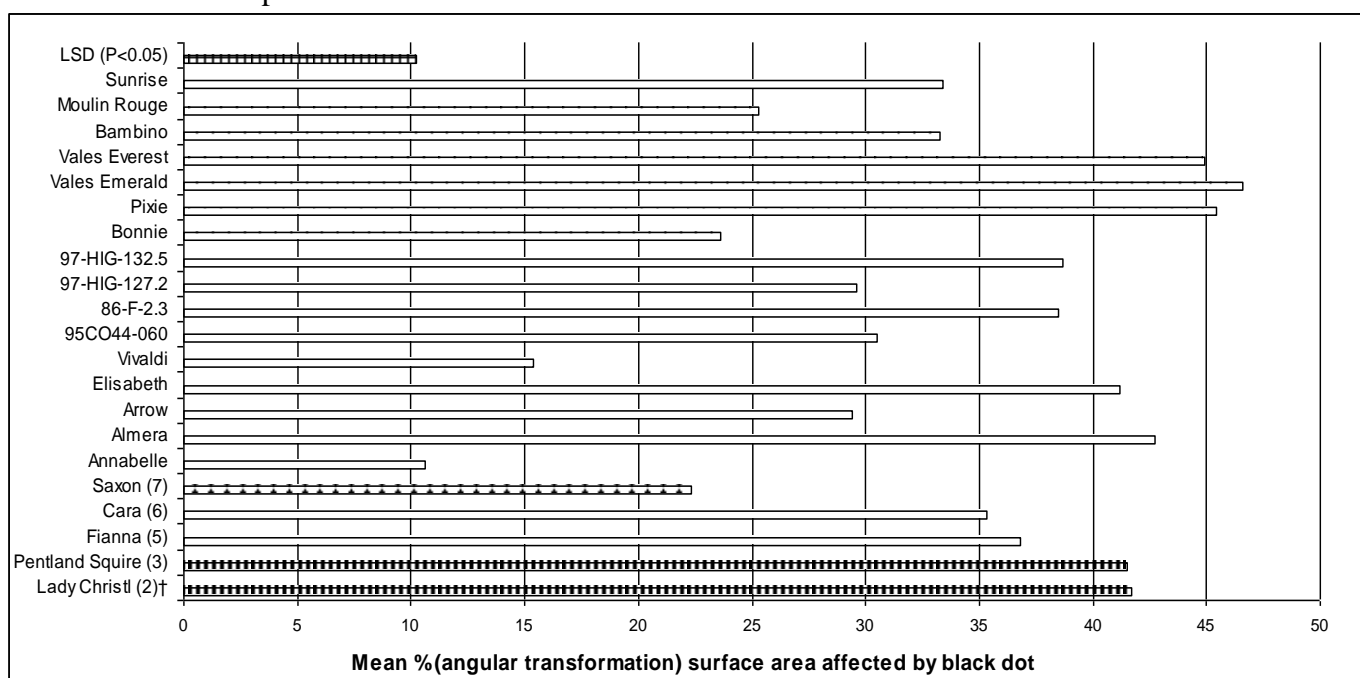
Variety	Test Year		Final 1-9 rating
	2004	2005	
Sante	17.3	11.9	2
Duke of York	-	9.2	3
Saxon	20.6	12.1	1
King Edward	15.6	12.0	3
Cara	-	8.6	3
Lady Christl	-	7.4	4
86-F-2.3	21.5	6.0	3
Moulin Rouge	18.1	6.9	4
Bambino	17.3	9.3	3
Bonnie	16.6	10.0	3
LSD (P<0.05)	5.0	2.8	

2.3.1.3. Black dot

2.3.1.3.1 2005 Test (Fig. 3)

Good discrimination was achieved amongst the reference varieties with Lady Christl and Pentland Squire being most susceptible and Saxon most resistant. Five varieties (Elisabeth, Almera, Pixie, Vales Emerald and Vales Everest) were identified as being as susceptible as Lady Christl. Annabelle and Vivaldi were more resistant than Saxon and Bonnie was similar to Saxon.

Fig. 3. Development of black dot on daughter tubers derived from test tubers planted in infested compost.



† rating of variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2005

2.3.1.3.2 Summary of 2004/2005 Trials (Table 5)

The LSD was slightly smaller for the 2005 than for the 2004 test. In 2005, Saxon was significantly more resistant than Fianna which in turn was more resistant than Pentland Squire but there was no difference between these varieties in 2004. Furthermore, as the results for Bonnie and Moulin Rouge differed between the 2 years, the ratings presented in Table 5 for these varieties should, therefore, be treated as provisional.

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

Variety	Test Year		Final 1-9 rating
	2004	2005	
Lady Christl (2) [†]	-	41.7	2
Pentland Squire (3)	52.0	41.5	3
Fianna (5)	50.7	36.7	4
Cara (6)	-	35.3	4
Saxon (7)	49.3	22.3	7
86-F-2.3	49.7	38.5	4
Moulin Rouge	42.8	25.3	8
Bambino	48.0	33.3	5
Bonnie	45.1	23.6	8
LSD (P<0.05)	12.8	10.2	

[†]rating of the variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2005

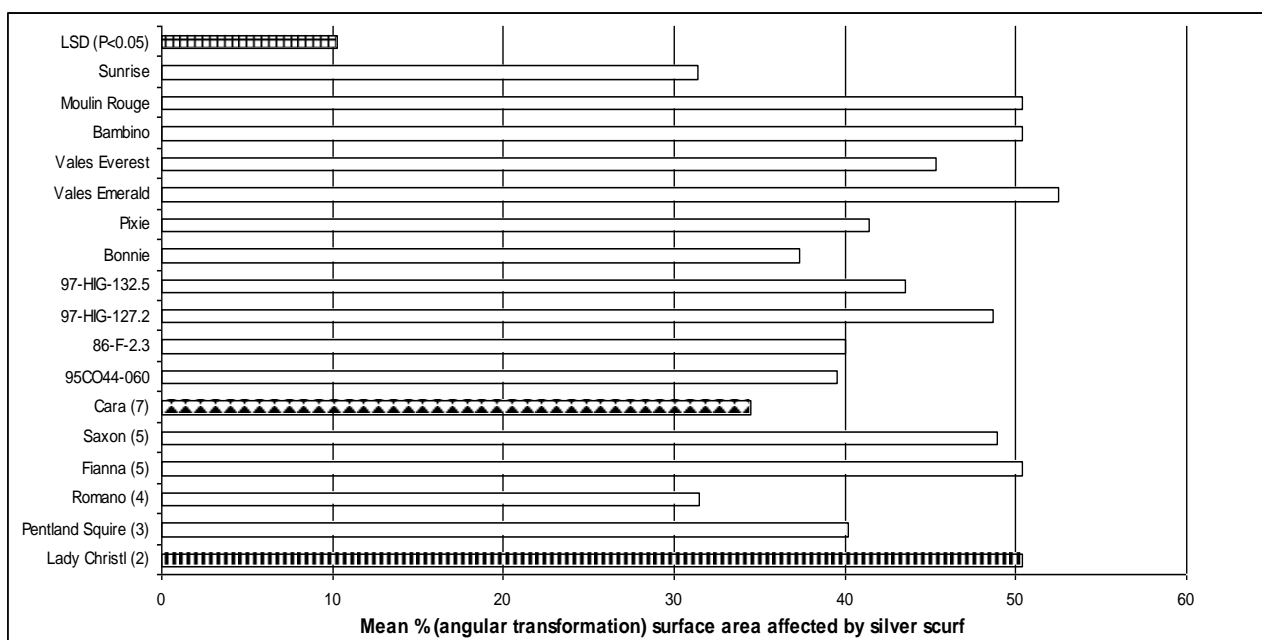
2.3.1.4. **Silver scurf**

2.3.1.4.1 2005 test (Fig. 4)

Symptom development in this test was surprisingly slow and often very variable amongst tubers within a plot. Common scab and black scurf were sometimes present, possibly affecting the accuracy of the assessment of silver scurf.

Although there were differences amongst the reference varieties, these were not consistent with the published ratings, particularly for Romano which appeared to be more resistant, and for Saxon and Fianna which were more susceptible. Of the test varieties, Almera and Sunrise were the most resistant and Vales Emerald, Moulin Rouge and Bambino were the most susceptible. However, the correlation between these test results and the severity of silver scurf on the naturally infected tubers from multiplication plot was low ($r=0.22$, 20df).

Fig 4. Development of silver scurf on daughter tubers derived from test tubers planted in infested compost.



†rating of variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2005

2.3.1.4.2 Summary of 2004/2005 Trials (Table 6)

As in the other tests, the LSD was slightly smaller in 2005 test than in 2004. Bonnie and 86-F-2.3 showed resistance. The results for Moulin Rouge and Bambino were somewhat variable over the 2 years. The correlation between the 2 years results was very low ($r=-0.02$, 7df). By contrast, however, the correlation between 2004 results and those recorded on naturally infected tubers from the multiplication plots was quite high ($r=0.60$, 7df).

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

Variety	Test Year		Final 1-9 rating
	2004	2005	
Lady Christl (2)†	-	50.4	2
Pentland Squire (3)	52.8	40.2	4
Romano (4)	37.4	31.4	9
Fianna (5)	47.8	50.4	3
Saxon (5)	40.2	48.9	5
Cara (7)	43.8	34.5	7
86-F-2.3	37.1	40.0	7
Moulin Rouge	38.9	50.4	5
Bambino	42.8	50.4	4
Bonnie	40.4	37.3	7
LSD (P<0.05)	12.5	10.3	

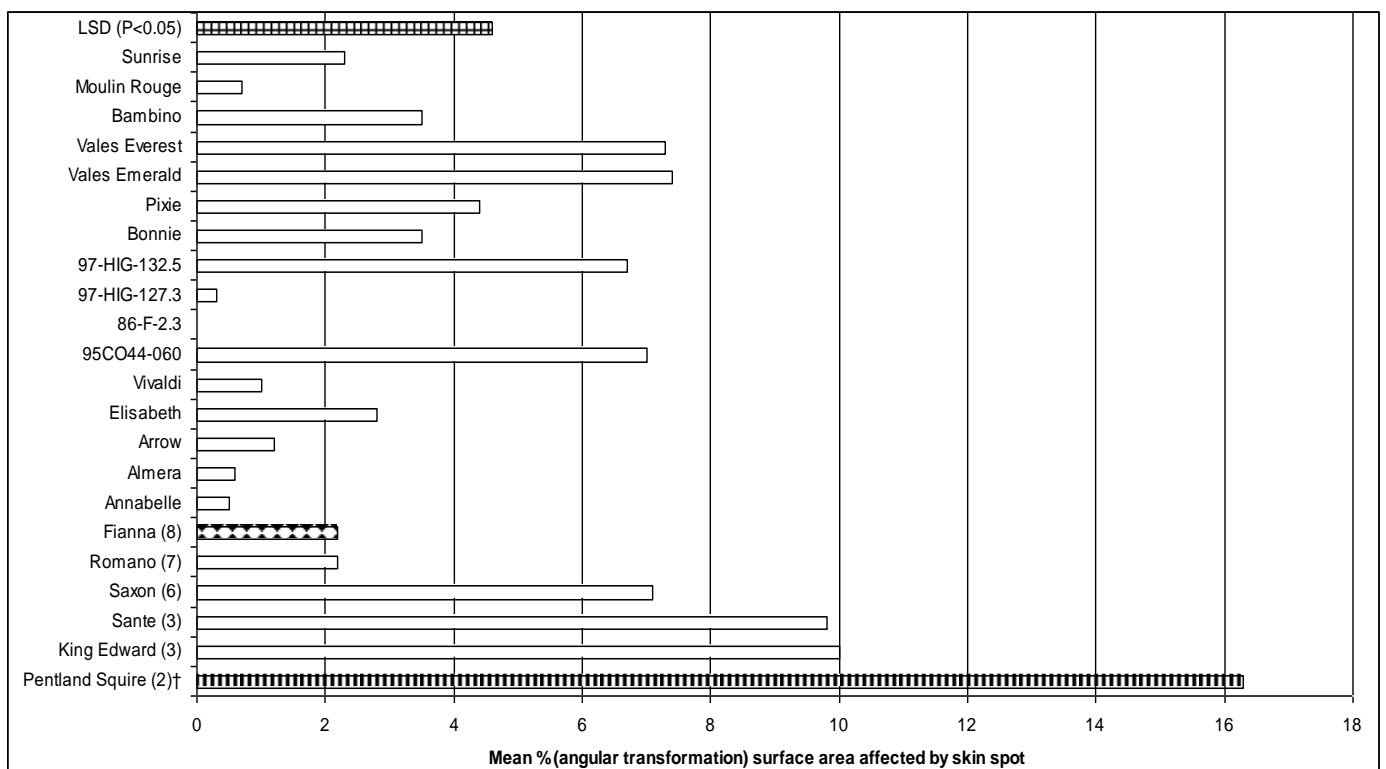
†rating of the variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2005

2.3.1.5. Skin spot

2.3.1.5.1 2005 Test (Fig. 5)

Pentland Squire was the most susceptible of the reference varieties followed by King Edward and Sante. Fianna and Romano were equally resistant. Nine out of 16 test varieties showed resistance as good as or better than that of Fianna and Romano. 94CO44-060, Vales Emerald and Vales Everest were among the most susceptible but these were slightly more resistant than King Edward or Sante.

Fig 5. Development of skin spot on daughter tubers derived from test tubers inoculated with *Polyscytalum pustulans*.



†rating of variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2005

2.3.1.5.2 Summary of 2004/2005 Trials (Table 7)

In 2004 test, Pentland Squire and Sante showed similar susceptibility but King Edward appeared to be relatively resistant. This pattern did not occur in 2005 test. 86-F-2.3 was very resistant, rated as 8. The other 3 varieties also showed moderately high resistance, being rated as 6 or 7.

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

Variety	Test Year		Final 1-9 rating
	2004	2005	
Pentland Squire (2) [†]	19.1	16.3	3
King Edward (3)	6.7	10.0	5
Sante (3)	22.6	9.8	3
Saxon (6)	3.8	7.1	6
Romano (7)	4.0	2.2	7
Fianna (8)	0.2	2.2	8
86-F-2.3	1.3	0	8
Moulin Rouge	6.8	0.7	7
Bambino	9.0	3.5	6
Bonnie	8.6	3.5	6
LSD (P<0.05)	7.2	4.6	

[†]rating of the variety as published in NIAB Pocket Guide to Varieties of Potatoes, 2005

2.3.2. NL Tests

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

Separate tests were conducted for 1st early and for 2nd early/maincrop varieties in order to ensure that testing covered a range of tuber maturities. In the 1st early trial, Home Guard, was susceptible and Orla was resistant, rated as 8 (Table 8). Of the 2 test varieties, Elisabeth was very susceptible with all tubers being infected and Arrow was only slightly less susceptible than Home Guard. In the 2nd early/maincrop trial, 97-HIG-132.5 was the most resistant of the 4 varieties completing NL trials, rated as 6. The others were rated as 3 or 4. Based on one year of testing, Vivaldi appeared to be the most resistant of the 3 common catalogue varieties with Annabelle being as susceptible as Bintje.

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

Variety	2005	Mean of 2 years	Final 1-9 rating
Home Guard	59.2	63.9	2
Orla	9.2	6.5	8
Stirling	0	10.6	8
Arrow	45.3	-	-
Elisabeth	90.0	-	-
LSD P<0.05	12.3	-	-
Bintje	74.9	75.8	1
Stirling	3.2	10.6	8
95C044-060	34.8	43.4	4
86-F-2.3	24.1	47.2	4
97-HIG-127.2	34.8	56.7	3
97-HIG-132.5	8.0	26.8	6
Annabelle	76.7	-	-
Almera	55.9	-	-
Vivaldi	23.6	-	-
LSD (P<0.05)	18.7	18.4	-

2.3.2.2 **Blackleg** (*Erwinia carotovora* var. *atroseptica*) (Table 9)

There was a clear difference between the susceptible and resistant reference varieties. Both Cultra and Ailsa were rated as 8 over 2 years of testing and the susceptible reference varieties, Estima, Concurrent and Morene, were rated as 3 or 4. All of the 4 NL varieties showed good resistance to blackleg with 95C044-060 being the best. However, Elisabeth appeared to be more resistant than any of the NL varieties. Vivaldi and Annabelle were similar to Concurrent and Morene.

Table 9. Mean % (angular transformation) plants affected by blackleg (*Erwinia carotovora* var. *atroseptica*)

Variety	2005	Mean of 2 years	Final 1-9 rating
Concurrent	44.8	59.3	3
Estima	51.1	51.8	4
Morene	43.5	49.5	4
Cultra	15.9	14.6	8
Ailsa	15.9	15.1	8
95C044-060	36.9	18.1	8
86-F-2.3	36.9	28.0	7
97-HIG-127.2	55.1	34.9	6
97-HIG-132.5	38.6	28.3	7
Annabelle	40.5	-	-
Almera	36.6	-	-
Arrow	42.1	-	-
Elisabeth	23.2	-	-
Vivaldi	43.7	-	-
LSD (P<0.05)	23.4	15.9	-

2.3.2.3 Common Scab (Table10)

The most susceptible of the reference varieties was Maris Piper rated as 2 and the most resistant was Pentland Crown rated as 7. In 2005 trial, the LSD was 28.6% of the range of values in the test. Of the NL varieties, 97-HIG-127.2 and 97-HIG-132.5 were as resistant as Pentland Crown but 95CO44-060, rated as 3, was almost as susceptible as Maris Piper. Elisabeth was as susceptible as 95CO44-060. Vivaldi, Almera and Arrow showed moderate resistance.

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

Variety	2005	Mean of 2 years	1-9 rating
Maris Peer	8.7	30.6	4
Estima	10.8	23.2	5
Maris Bard	17.8	31.0	4
Home Guard	9.3	27.0	4
Maris Piper	29.0	43.0	2
Desiree	16.6	36.1	3
Pentland Crown	6.5	10.8	7
95CO44-060	17.6	39.4	3
86-F-2.3	13.2	19.6	6
97-HIG-127.2	9.9	12.3	7
97-HIG-132.5	4.8	10.2	7
Annabelle	8.5	-	-
Almera	14.2	-	-
Arrow	13.7	-	-
Elisabeth	17.2	-	-
Vivaldi	11.1	-	-
LSD (P<0.05)	6.7	10.1	

2.3.2.4 Powdery Scab (Table 11)

The LSD in 2005 trial covered 27.0% of the range of test mean values. Although Accent has been rated as 6 (NIAB Pocket Guide to Varieties of Potatoes), the variety was as susceptible as Estima in 2004 and 2005 tests at SASA. Also, in NL trials, the susceptible maincrop varieties have been more resistant than both 1st and 2nd early reference varieties, Accent and Estima. Sante was the most resistant of the reference varieties. All of the NL varieties were maincrops and, of these, 97-HIG-127.2 was more susceptible than Cara or Pentland Crown and 97-HIG-132.5 almost as resistant as Sante. Of the Common Catalogue varieties, Almera, a maincrop, was as susceptible as Estima. Annabelle, a maincrop, and Elisabeth, 1st early, were moderately susceptible. There was

some evidence that Annabelle and Almera may be also susceptible to cankerous powdery scab (data not shown).

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

Variety	2005	Mean of 2 years	1-9 rating
Accent	41.5	39.9	2
Estima	31.7	35.5	3
Cara	13.3	12.8	7
Pentland Crown	12.9	9.9	7
Sante	8.0	6.8	8
95CO 44-060	13.8	11.7	7
86-F-2.3	16.7	12.1	7
97-HIG-127.2	20.5	24.4	5
97-HIG-132.5	13.3	9.4	8
Annabelle	22.3	-	-
Almera	32.1	-	-
Arrow	19.1	-	-
Elisabeth	22.6	-	-
Vilvadi	17.1	-	-
LSD (P<0.05)	6.4	9.6	-

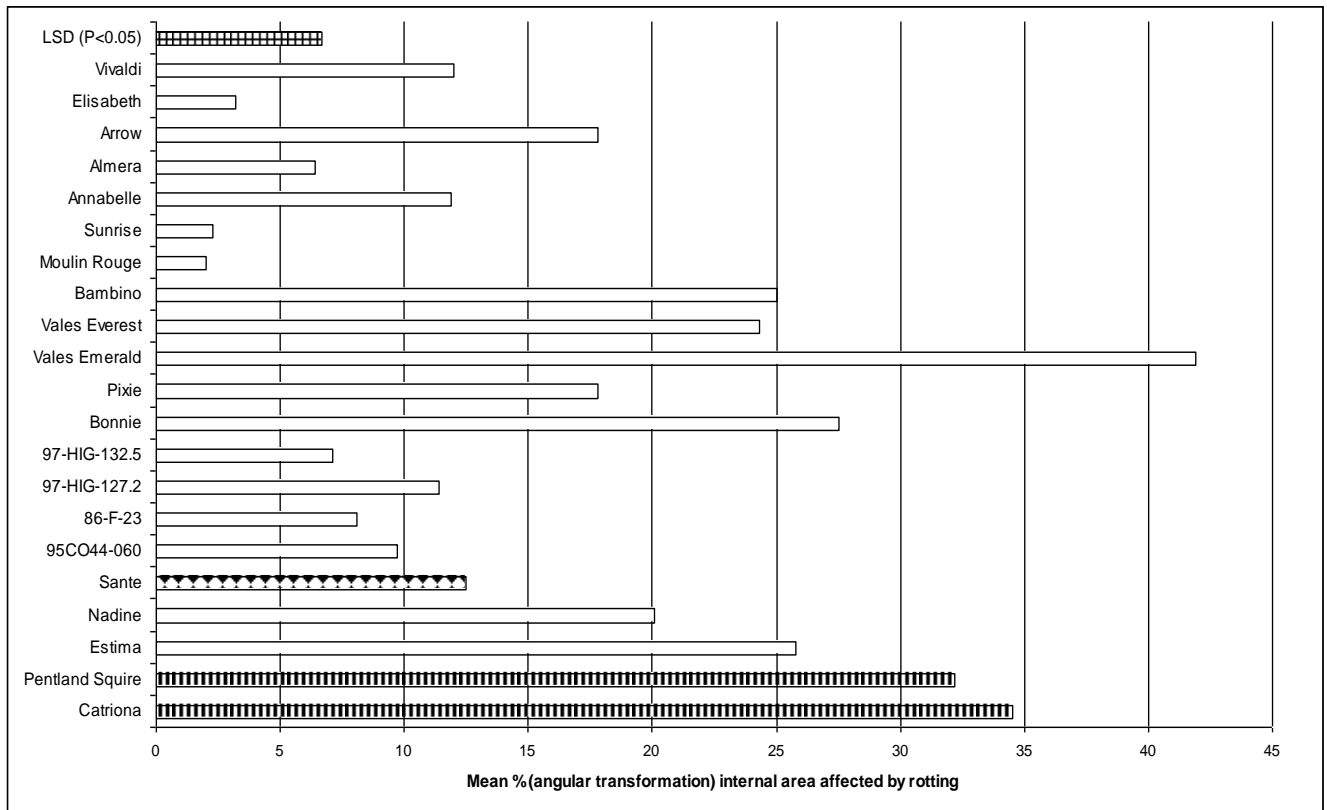
2.3.2.5 Dry rot (*Fusarium* spp.)

Because 2005 was the first year of testing for dry rot in NL Trials, there are only one year's test results available. The number of successful infections was also recorded in addition to assessing % internal area affected by rotting after cutting tuber through the wound.

2.3.2.5.1 *F. solani* var. *coeruleum* (Fig. 6)

Catriona and Pentland Squire reacted in accordance with their known susceptible reaction. Sante was the most resistant of the reference varieties, rated as 6. Nine out of 16 test varieties appeared to be at least as resistant or more resistant than Sante. Vales Emerald was the only variety to be more susceptible than Catriona. Overall, the mean area of rotting per tuber was more closely correlated ($r=0.95$, 19df) with % number of successful infections than with the mean area of rotting per successful infection ($r=0.65$, 19df).

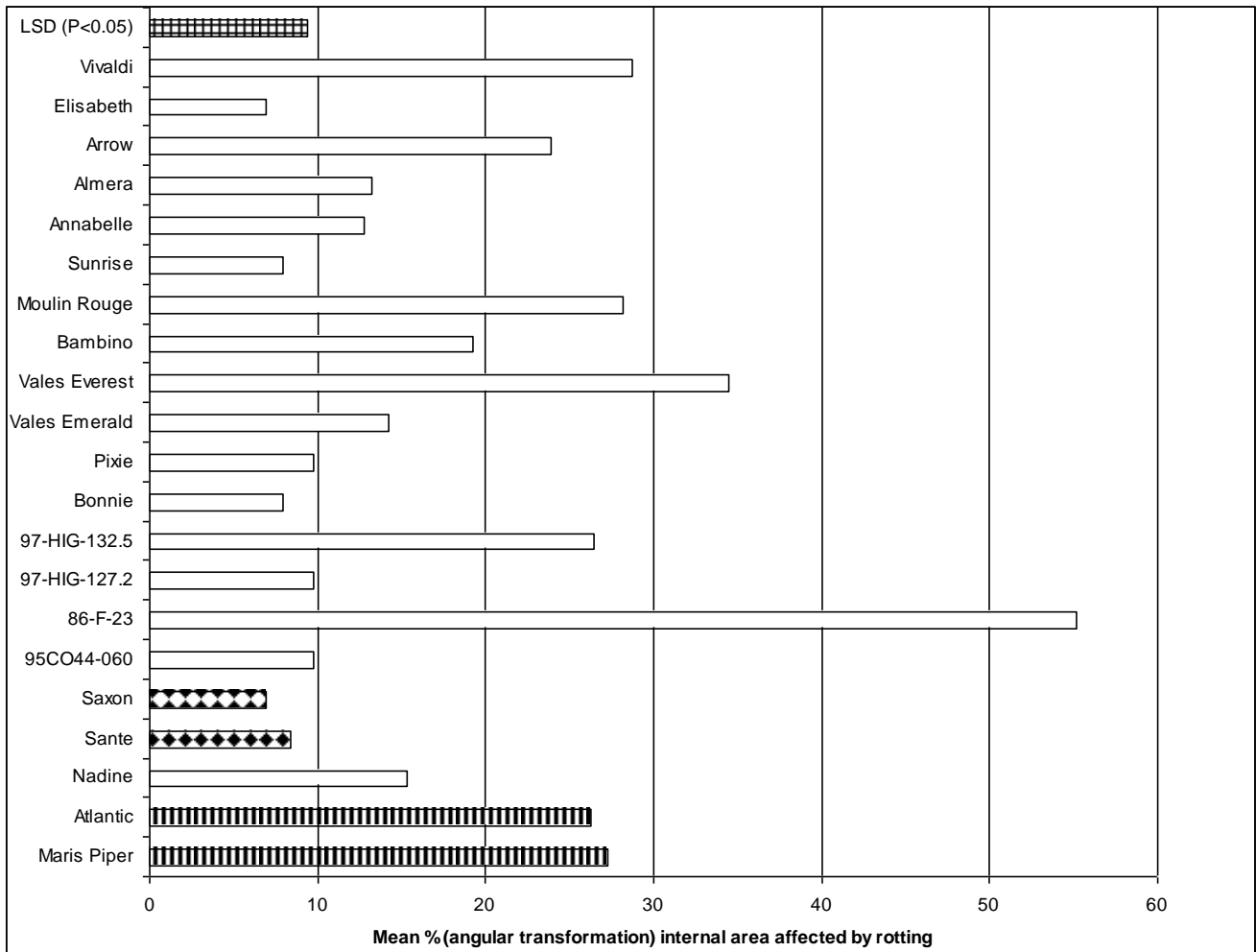
Fig. 6. Development of rots caused by *Fusarium solani* var. *coeruleum* after inoculation in January 2006



2.3.2.5.2 *F.sulphureum* (Fig. 7)

Good discrimination was achieved amongst the reference varieties with Maris Piper and Atlantic being susceptible (2) and Saxon and Sante rated as resistant (7). Six varieties were rated as resistant as Saxon and Sante. Moulin Rouge and 97-HIG-32.5 appeared to be susceptible as Atlantic but Vales Everest and, particularly, 86-F-2.3 were more susceptible. Overall, the mean area of rotting per tuber was moderately correlated ($r=0.74$, 19df) with the % number of successful infections but showed a low correlation ($r=0.33$, 19df) with the mean size of rots per successful infection.

Fig 7. Development of rots caused by *Fusarium sulphureum* after inoculation in January 2006.



2.3.2.6 External Damage (splitting) (Table 12)

Ulster Sceptre was the most susceptible of the 1st early varieties and Russet Burbank was the most susceptible of the maincrop varieties. Of the NL varieties, 97-HIG-27.2 was highly resistant, rated as 8 and 86-F-2.3 was most susceptible, rated as 3. Of the Common Catalogue varieties, Vivaldi appeared to be very resistant but Elisabeth and Arrow appeared to be relatively susceptible.

2.3.2.7 Internal Damage (Bruising) (Table 13)

The range of ratings was smaller in the bruising test than in splitting test. Russet Burbank was relatively susceptible and, Maris Piper and Home Guard were relatively resistant, rated as 6 and 7 respectively. All of NL varieties showed moderate resistance. Vivaldi and

Almera were the most susceptible of Common Catalogue varieties and Annabelle was the most resistant of all the varieties tested, including the reference varieties.

Table 12. Mean % (angular transformation) tubers affected by splitting after applying standard force

Variety	2005	Mean of 2 years	Final 1-9 rating
Ulster Sceptre	52.0	45.0	3
Home Guard	6.0	10.2	7
Red Craigs Royal	20.0	37.8	4
Maris Peer	6.0	31.8	5
Russet Burbank	34.0	35.2	4
Record	2.0	21.2	6
Maris Piper	2.0	19.9	6
95CO44-060	0	23.4	6
86-F-2.3	16.3	45.2	3
97-HIG-127.2	0	1.8	8
97-HIG-132.5	8.0	17.3	6
Annabelle	30.0	-	-
Almera	28.0	-	-
Arrow	49.0	-	-
Elisabeth	46.0	-	-
Vivaldi	0	-	-
LSD (P<0.05)	-	34.3	-

Table 13. Mean depth (mm) of bruise at point of impact of standard force

Variety	2005	Mean of 2 years	Final 1-9 rating
Ulster Sceptre	6.0	6.5	5
Home Guard	4.0	3.6	7
Maris Peer	7.5	7.8	4
Red Craigs Royal	7.5	5.2	5
Russet Burbank	7.6	8.1	4
Record	7.8	6.9	5
Maris Piper	4.8	5.2	6
95CO44-060	7.3	5.7	6
86-F-2.3	4.1	5.4	6
97-HIG-127.2	7.4	6.7	5
97-HIG-132.5	6.6	7.7	4
Annabelle	3.0	-	-
Almera	5.9	-	-
Arrow	4.1	-	-
Elisabeth	4.1	-	-
Vivaldi	6.6	-	-
LSD (P<0.05)	-	2.2	-

2.3.2.8 Potato Cyst Nematode (Table 14)

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 95CO44-060, Bonnie, Pixie and Bambino. Multiplication of Ro1 on Vales Everest was inhibited to a limited extent and such resistance may be considered to be partial.

Two varieties expressed some resistance to Pa pathotypes but not the full resistance occurring with Hi gene for Ro1 which limits cyst multiplication to no more than the original population. The multiplication of Pa on Vales Everest and 95CO-44-060 was 6 and 8% of that on the susceptible reference varieties, Desiree and Maris Piper.

Table 14. Multiplication of cysts of 3 pathotypes of potato cyst nematode (*Globodera rostochiensis*) pathotype 1, *G. pallida* pathotypes 2/3) on test varieties expressed as 1-9 rating.

Variety	Ro1	Pa 2/3	Pa1
Estima	2 (S) [†]		
Desiree	2 (S)	2	
Maris Piper	9 (R)	2	
95CO44-060	8 (R)	6	5
86-F-2.3	2(S)	2 (S)	
97-HIG-127.2	9 (R)	4	4
93-HIG-132.5	3 (S)	2 (S)	
Bonnie	9 (R)	2 (S)	
Pixie	8 (R)	3 (S)	
Vales Emerald	2 (S)	2 (S)	
Vales Everest	5	6	8
Bambino	9 (R)	2 (S)	
Moulin Rouge	2 (S)	2 (S)	
Sunrise	3 (S)	3 (S)	
Annabelle	9 (R)	2 (S)	
Almera	9 (R)	2 (S)	
Arrow	9 (R)	3 (S)	
Elisabeth	9 (R)	2 (S)	
Vivaldi	2 (S)	3 (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, despite the short interval available to organise and set up the test programme in 2005. A good spread of varietal reactions was achieved

in the tests although, as recorded in previous reports (Kerr & Parish, 2005), some tests appeared to provide less discrimination amongst varieties than others e.g. black scurf, silver scurf. In addition, there also appeared to be relatively poor correlations amongst the varietal rankings over the 2 years of testing, even though discrimination appeared to be good e.g. black dot. Additional tests on the varieties exhibiting the most variable reactions will be undertaken in 2006 to assess whether this is related to inherent variability in the tests or between the test centres. Modifications are also being introduced for the silver scurf test in order to ensure better symptom development and expression.

The 4 varieties which completed IVT in 2005 were 86-F-2.3, Moulin Rouge, Bambino and Bonnie. In summary, the key findings for these varieties, with final ratings shown in bold, are as follows:

86-F-2.3

High resistance to: **powdery scab, blackleg**, black scurf, silver scurf and skin spot.

Susceptibility to: **external damage (splitting)**, dry rot - *F.sulphureum*, **PCN all pathotypes**, foliage late blight.

Moulin Rouge

High resistance to: **powdery scab**, skin spot, black scurf.

Susceptibility to: **external damage**, dry rot – *F.sulphureum*, **PCN all pathotypes**, foliage late blight.

Bambino

High resistance to: **powdery scab, black leg, PCN Ro1**.

Susceptibility to: **external damage**, dry rot – *F.coeruleum*, **PCN Pa**.

Bonnie

High resistance to: **blackleg, PCN Ro1**, silver scurf, black dot.

Susceptibility to: **tuber late blight, external damage, PCN Pa**.

Foliage late blight

The 2 year rankings in IVT field foliage late blight test for these 4 varieties were in general agreement with the rankings obtained in NL test which involves inoculation of a standard age of glasshouse-grown plants (Table 1). The differences were no greater than 1 score. For the other varieties tested for 1 year, the provisional rankings were in reasonable agreement with no difference being greater than 2 score points. This indicates that the test of pot grown plants provides a reasonable indication of varietal reaction in the field, in spite of not taking account of factors which operate in the field such as inoculum production, plant maturity. Stewart *et al.*(1983) recorded a similar general correlation between field and glasshouse test but warned that susceptible varieties tended to be under-scored in the glasshouse test and resistant varieties over-scored.

Dry rot

In the NL test, tubers were inoculated at standardised wounds and the size of rots was assessed, thus taking account of both resistance to infection and to rot expansion. With both species of *Fusarium*, the correlation analysis indicated that resistance to infection was the most important of these 2 parameters. Varietal resistance to the growth of rots appeared to be much less important for *F. sulphureum* than for *F. coeruleum*. A comparison of the results of 2004 and 2005 tests (Table 15) reveals that there was reasonable agreement in the ranking of varieties over the 2 years for *F. coeruleum*, except for Moulin Rouge which was more resistant in 2005. With *F. sulphureum*, however, none of the 4 test varieties differed significantly from Maris Piper in the 2004 test but, in the 2005 test, Sunrise was much more resistant than Maris Piper, Bambino also appeared to show some resistance and 86-F-2.3 was more susceptible than Maris Piper.

Table 15. Comparison of the results (% (angular transformation) rotting) of 2004 test at NIAB and 2005 test at SASA for varietal susceptibility to species of dry rot causing *Fusarium*.

Species	Variety	2004	2005
<i>F.coeruleum</i>	Pentland Squire	49.8	32.2
	Sante	-	12.5
	86-F-2.3	13.8	8.1
	Moulin Rouge	17.2	2.0
	Bambino	51.9	25.0
	Bonnie	41.9	27.5
	LSD (P<0.05)	11.0	6.7
<i>F.sulphureum</i>	Maris Piper	18.8	27.3
	Sante	-	8.4
	86-F-2.3	14.9	55.2
	Moulin Rouge	14.0	28.2
	Bambino	16.7	19.2

Bonnie	16.7	7.9
LSD (P<0.05)	8.7	9.4

2.5 References

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