



# **Research Project Report**

# **Independent Variety Trials**

# **2014**

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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 (PCL), 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) (now Scotland's Rural College (SRUC), 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. 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 onwards. 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 tests for foliar late blight.

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. That year, an evaluation of a possible *Rhizoctonia* stem canker test was carried out. Further development of this test was continued in 2013 and 2014.

### Work Undertaken and Findings

In 2014, tests were conducted on 8 varieties which had completed UK NL tests and 6 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 JHI. 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. A trial assessing varietal resistance to *Rhizoctonia* stem canker was investigated at 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, except common scab, where results for 2013 were not published due to lack of discrimination between varieties and the 2014 blackleg trial where results were not published due to very low levels of blackleg recorded in the trial.

The NL test for common scab consists of a pot test at SASA and a field trial at the National Institute for Agricultural Botany (NIAB), which is the other UK NL test centre. The pot test for common scab has generally produced good symptoms over the years and reference varieties have performed consistently. Common catalogue varieties are only tested at SASA. There are usually more common scab symptoms observed in the pot trial than the field trial. In 2013 the reference variety Maris Piper performed as expected, but all other reference varieties had lower levels of common scab recorded than expected. The reference variety Desiree which usually has clearly defined common scab lesions had low levels of common scab and a high proportion of elephant hide symptoms which is caused by *Rhizoctonia solani*. Testing of Desiree tubers confirmed the presence of *R. solani* and competition from this may have affected the common scab levels. Each year a common scab isolate screening test is conducted using the susceptible reference variety Maris Piper in a polytunnel alongside the NL trial. Two isolates were used in the 2013 NL trial, and one of these isolates produced a lower number of symptoms than expected in the isolate screening trial in 2013. The low level of common scab symptoms in the 2013 NL test is possibly due to the isolates used in the trial. Two isolates were used in the 2014 trial and there was good discrimination between varieties. As common catalogue varieties are only tested at SASA, the result for the varieties completing the programme are based on 1 year (2014) of trials only.

The NL test for blackleg consists of a field test conducted at both SASA and NIAB. There is generally good development of blackleg in the trial. In 2014, there was substantially less blackleg observed in the NL trial than expected. Tubers inoculated for a blackleg demonstration with the same strains as the NL trial also failed to produce any blackleg symptoms. The performance of the trial was discussed with the bacteriology unit at SASA who provide the inoculum for the SASA trials. The unit checked the pectolytic activity of the strains provided for the trial and although pectolytic activity was demonstrated, a couple of the strains were weaker. For future years it has been agreed that a pathogenicity test will be conducted before providing the inoculum for the NL blackleg trial. As common catalogue varieties are only tested at SASA, the result for the varieties completing the programme are based on 1 year (2013) of trials only.

Susceptibility/resistance was rated on a 1-9 scale. Table 1 presents the final ratings for varieties completing the test programme in 2014.

**Table 1.** Summary of final varietal ratings (1=low, 9=high) for resistance to diseases, pests and defects for varieties completing the IVT programme based on over years' analysis of IVT 2005-2014 and NL from 1981 except for late blight\* and PCN\*\*.

\* 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 2 years only and scores may vary slightly from data in this table which is based on an over years' analysis.

|   | Pizazz | Ellie | 02M012-001 | Vizelle<br>(04C055-004) | Revie<br>(HG 99-97 1) | Strachan<br>(HG 05-3 A9) | Lorimer<br>(HG 05-3 A17) | Churchill<br>(01Z51 A 54) | Arsenal | Dolly | Edony | Gwenne | Ivory Russet | Venezia        |
|---|--------|-------|------------|-------------------------|-----------------------|--------------------------|--------------------------|---------------------------|---------|-------|-------|--------|--------------|----------------|
| Maturity  | 2E     | EM    | M          | 2E                      | EM                    | EM                       | EM                       | EM                        | M       | EM    | M     | EM     | 2E           | 2E             |
| Foliage late blight (field)                     | 4      | 5     | 5          | 4                       | 5                     | 4                        | 4                        | 5                         | 4       | 4     | 5     | 4      | 5            | 4              |
| Black dot                                       | 7      | 2     | 5          | 6                       | 5                     | 8                        | 4                        | 7                         | 2       | 9     | 3     | 2      | 9            | 6              |
| Black scurf *                                   |        |       |            |                         |                       |                          |                          |                           |         |       |       |        |              |                |
| Silver scurf                                    | 6      | 7     | 4          | 8                       | 8                     | 3                        | 4                        | 9                         | 7       | 9     | 8     | 9      | 9            | 4              |
| Skin spot                                       | 6      | 9     | 7          | 9                       | 6                     | 7                        | 7                        | 8                         | 3       | 4     | 3     | 7      | 7            | 9              |
| Mop top (spraing)                               | 7      | 9     | 9          | 9                       | 9                     | 9                        | 9                        | 9                         | 9       | 6     | 9     | 9      | 9            | 9              |
| Foliage late blight (lab) ^                     | 4      | 2     | 4          | 2                       | 2                     | 5                        | 4                        | 3                         | -       | -     | -     | -      | -            | -              |
| Tuber late blight                               | 2      | 2     | 3          | 2                       | 6                     | 6                        | 2                        | 7                         | 2       | 3     | 2     | 2      | 3            | 2              |
| Blackleg-<br><i>Pectobacterium atrosepticum</i> | 6      | 6     | 6          | 6                       | 5                     | 4                        | 5                        | 7                         | 4       | 6     | 7     | 7      | 3            | 3              |
| Powdery scab                                    | 5      | 6     | 4          | 6                       | 6                     | 4                        | 4                        | 4                         | 6       | 4     | 6     | 3      | 8            | 5              |
| Common scab                                     | 8      | 8     | 4          | 8                       | 5                     | 6                        | 6                        | 6                         | 4       | 4     | 4     | 3      | 6            | 3              |
| Dry rot –<br><i>Fusarium coeruleum</i>          | 4      | 3     | 7          | 5                       | 7                     | 6                        | 4                        | 6                         | 9       | 6     | 8     | 8      | 9            | 7              |
| Dry rot –<br><i>Fusarium sulphureum</i>         | 5      | 1     | 1          | 1                       | 1                     | 1                        | 4                        | 1                         | 1       | 7     | 8     | 8      | 3            | 1              |
| PCN Ro-1  | 2      | 9     | 8          | 9                       | 8                     | 2                        | 8                        | 2                         | 6       | 7     | 8     | 9      | 6            | 9              |
| PCN Pa 2/3                                      | 1      | 2     | 3          | 3                       | 2                     | 3                        | 3                        | 2                         | 9       | 2     | 3     | 2      | 4            | 2 <sup>#</sup> |
| External damage (splitting)                     | 5      | 7     | 7          | 1                       | 8                     | 7                        | 7                        | 6                         | 5       | 6     | 7     | 6      | 1            | 7              |
| Internal damage (bruising)                      | 7      | 4     | 4          | 5                       | 7                     | 3                        | 3                        | 6                         | 7       | 4     | 5     | 5      | 3            | 7              |

\* = the black scurf test has been discontinued, therefore no result is available for publication in this report

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

# = Venezia was not tested in year 2 as it scored less than a 3 in year 1 (2013). SASA nematologists recommended further testing should have been conducted after reviewing 2013 trial data for Venezia and the reference variety Morag. SASA nematologists have included Venezia in the 2015 trial.

## **Conclusions**

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

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

### **Pizazz**

Resistant to: **black dot, mop top (spraing), common scab, and internal damage**

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

### **Ellie**

Resistant to: **silver scurf, skin spot, mop top (spraing), common scab, PCN Ro1 and external damage**

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

### **02M012-001**

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

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

### **Vizelle (04C055-004)**

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

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

### **Revie (HG 99-97 1)**

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

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

### **Strachan (HG 05-3 A9)**

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

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

### **Lorimer (HG 05-3 A17)**

Resistant to: **skin spot, mop top (spraing), PCN Ro1 and external damage**

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

### **Churchill (01Z51 A 54)**

Resistant to: **black dot, silver scurf, skin spot, mop top (spraing), tuber late blight, and blackleg**

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

### **Arsenal**

Resistant to: **silver scurf, mop top (spraing), dry rot – *F. coeruleum*, PCN Pa 2/3 and 1 and internal damage**

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

### **Dolly**

Resistant to: **black dot, silver scurf, dry rot – *F. sulphureum* and PCN Ro1**

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

### **Edony**

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

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

### **Gwenne**

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

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

### **Ivory Russet**

Resistant to: **black dot, silver scurf, skin spot, mop top (spraing), powdery scab and dry rot – *F. coeruleum* scab and PCN Pa 2/3 and 1**

Susceptible to: **tuber late blight, blackleg, dry rot – *F. sulphureum*, and external and internal damage**

### **Venezia**

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

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



## 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 priorities. In consultation with industry stakeholders, it was also agreed that closer co-operation with the Independent Variety Trials funded by Potato Council 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, SRUC, BioSS and JHI. The tests to be conducted for IVT purposes were foliage late blight in the field (SASA), black scurf (SRUC), black dot (SRUC), silver scurf (SASA) and skin spot (SASA). From 2011, an additional test was included in the programme this was potato mop top virus (spraing) (SRUC). 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 2 years instead of 3 years.

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. In 2012 an evaluation of a possible *Rhizoctonia* stem canker test was carried out, testing was continued in 2013 and 2014.

This report summarises all the testing conducted over the 2013-2014 season.

## 3. MATERIALS AND METHODS

### 3.1 Standard Varieties

The standard varieties used in 2013 were reviewed and retained in 2014. 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]

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],<br>Fianna [M, 5], Saxon [2E, 5], Cara [M, 7]   |
| Skin spot:                         | Pentland Squire [M, 2], King Edward [M, 3], Sante [M, 3],<br>Saxon [2E, 6], Romano [2E, 7], Fianna [M, 8]  |
| Potato mop top:<br>virus (spraing) | Cara [M, 3], Nicola [M, 4], Valor [M, 6], Saturna [M, 7],<br>Maris Piper [M, 5]  |
| <i>Rhizoctonia:</i>                | Sante [M], Duke of York [1E], Saxon [2E], King Edward [M],<br>Cara [M], Lady Christl [1E]<br>As this was an evaluation of a potentially new assay no ratings<br>are available but the varieties used previously as standards for<br>the black scurf test were retained with the exception of Blue<br>Danube. |

### 3.2 Varieties in Trial

2014 saw a 1 year extension to the 3 year IVT contract to allow completion of tests on varieties that started the programme in 2013. 8 varieties were tested through the UK National List route and 6 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.

**Table 2.** Varieties in IVT in 2014**UK National List**

stage of test 2014

| <b>AFP</b> | <b>Variety</b>         | <b>Breeder/Agent</b>        | <b>Maturity</b> | <b>NL</b> | <b>IVT</b> |
|------------|------------------------|-----------------------------|-----------------|-----------|------------|
| 4/789      | Pizzaz (14RE09)        | Caithness Varieties Ltd     | 2E              | complete  | 2          |
| 4/791      | Ellie (G04TT107001)    | Germicopa SAS/<br>Branston  | EM              | complete  | 2          |
| 4/793      | 02M012-001             | Cygnet PB Ltd               | M               | complete  | 2          |
| 4/795      | Vizelle (04C055-004)   | Cygnet PB Ltd               | 2E              | complete  | 2          |
| 4/796      | Revie (HG 99-97 1)     | Higgins Agriculture         | EM              | complete  | 2          |
| 4/797      | Strachan (HG 05-3 A9)  | Higgins Agriculture         | EM              | complete  | 2          |
| 4/798      | Lorimer (HG 05-3 A17)  | Higgins Agriculture         | EM              | complete  | 2          |
| 4/800      | Churchill (01Z51 A 54) | JHI/McCain Food (GB)<br>Ltd | M               | complete  | 2          |

**Common Catalogue**

stage of test 2014

| <b>AFP</b> | <b>Variety</b> | <b>Breeder/Agent</b>            | <b>Maturity</b> | <b>NL</b> | <b>IVT</b> |
|------------|----------------|---------------------------------|-----------------|-----------|------------|
|            | Arsenal        | Agrico                          | M               | 2         | 2          |
|            | Dolly          | Germicopa UK                    | EM              | 2         | 2          |
|            | Edony          | Germicopa UK                    | M               | 2         | 2          |
|            | Gwenne         | Germicopa UK                    | EM              | 2         | 2          |
|            | Ivory Russet   | HZPC                            | EM              | 2         | 2          |
|            | Venezia        | Europlant/Karmack/<br>Greenvale | 2E              | 2         | 2          |

## **IVT Test Methods**

The test methods used were those agreed and set out in the standard protocols prepared for the 2014 programme. Details of this year's tests are provided below:

### **Foliage late blight in the field, 2014**

The test tubers were planted in plots of 2 tubers at Dalrymple, by Ayr on 12 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 5 August. On 13, 18, 21, 25, 28 August and 1 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, 2014**

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 14 April. 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 25 August 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, 2014**

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 and placed in a polytunnel on 17 April 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 16 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, 2014**

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 7 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 15 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.

#### **Rhizoctonia stem canker, 2014**

Three isolates of *Rhizoctonia solani* AG-3 pathogenic to potatoes 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 containing the contaminated compost and was placed in an individual watering saucer. Six replicate pots of each of 36 varieties were laid out in a shade house (polytunnel with mesh sides) as a randomised block experiment. Plants were grown and maintained as described for black dot above.

All replicates were assessed four weeks post-emergence (1 July). Thus assessment date was confounded with spatial location in all cases. The numbers of stolons and pruned (i.e. infected) stolons in each pot were recorded in all cases. Additionally, stolon and stem canker severity on a 0-4 scale was recorded. The corresponding range of severity percentages for each category of the scoring scale is shown in the table below.

Scoring scale for stem and stolon canker severity -

| Score | % severity | Mid-point |
|-------|------------|-----------|
| 0     | 0          | 0         |
| 1     | 1 – 10     | 5         |
| 2     | 10 – 25    | 17.5      |
| 3     | 26 – 50    | 37.5      |
| 4     | > 50       | 75        |

#### **Potato mop top virus (spraing), 2014**

A plot in the Woodlands field at SAC Aberdeen previously contaminated with powdery scab / PMTV in 2009 was planted on the 27 May with varieties grown in single tuber randomised blocks with 6 replicates. The plots were irrigated during the season.

After harvest on the 7 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 2014”. 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 ten 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 Table 1. 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.

### ***Rhizoctonia* stem canker**

A development trial was conducted for *Rhizoctonia* stem canker in 2014. A report on the statistical analysis of the data for the test is included in the appendix of this document.

## 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 completing two years of trials. The summary provides an overview of the two years of the test and highlights the performance of particular varieties. The 1-9 ratings listed for the varieties in the relevant test table are presented in bold and are the final scores for the varieties after completing the two years of trials.

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

Due to wet weather the trial was not planted until 12<sup>th</sup> June. The first assessment was conducted on 13<sup>th</sup> August where some late blight was recorded for some plants. Five further assessments were conducted at 3 or 4 day intervals and late blight developed well in the trial.

Overall there was more blight observed in 2014 than 2013. Reference variety Cara and candidates Pizazz and Ellie had slightly less blight recorded in 2014. No candidate demonstrated good resistance to late blight scoring between 3.8 (Venezia) and 5.5 (Churchill). The resistant reference variety Sarpo Mira performed similarly in both years and was the most resistant in trial scoring 8.0.

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

| Variety               | Test Year |      | 1-9 rating |
|-----------------------|-----------|------|------------|
|                       | 2013      | 2014 |            |
| <b>BINTJE</b>         | 47.5      | 60.7 | <b>3.0</b> |
| <b>CARA</b>           | 32.8      | 31.8 | <b>6.1</b> |
| <b>RUSSET BURBANK</b> | 41.4      | 64.5 | <b>3.2</b> |
| <b>SARPO MIRA</b>     | 18.0      | 19.3 | <b>8.0</b> |
| <b>VALOR</b>          | 27.6      | 34.9 | <b>6.2</b> |
| PIZAZZ                | 49.0      | 46.1 | <b>3.9</b> |
| ELLIE                 | 43.6      | 40.7 | <b>4.7</b> |
| 02M012-001            | 39.5      | 41.6 | <b>4.9</b> |
| VIZELLE               | 42.8      | 50.4 | <b>4.1</b> |
| REVIE                 | 32.3      | 45.4 | <b>5.1</b> |
| STRACHAN              | 38.9      | 52.6 | <b>4.2</b> |
| LORIMER               | 39.1      | 46.8 | <b>4.6</b> |
| CHURCHILL             | 32.4      | 40.5 | <b>5.5</b> |
| ARSENAL               | 38.0      | 48.7 | <b>4.5</b> |
| DOLLY                 | 42.8      | 50.6 | <b>4.0</b> |
| EDONY                 | 37.2      | 42.2 | <b>5.0</b> |
| GWENNE                | 42.4      | 43.3 | <b>4.6</b> |
| IVORY RUSSET          | 35.2      | 40.6 | <b>5.3</b> |
| VENEZIA               | 47.9      | 48.8 | <b>3.8</b> |
| LSD (P0.05)           | 6.3       | 7.5  | <b>1.3</b> |

### **Rhizoctonia stem canker**

2012 saw the first year of this test as a possible replacement for the black scurf test, the test was conducted again in 2013 and 2014. A report produced by BioSS regarding the statistical analysis of the data is included in the appendix of this document.

### **Black dot (Table 4)**

The incidence of black dot was variable between the two years with some varieties having large differences (e.g. Pizazz, Ellie). Ivory Russet performed similarly over the two years and was the most resistant in the trial scoring 7.8 which was better than the resistant reference variety Saxon (6.0). Ellie, Gwenne and Arsenal were the most susceptible varieties scoring 2.4, 2.3 and 2.2, respectively.

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

| <b>Variety</b>      | <b>Test Year</b> |             | <b>1-9 rating</b> |
|---------------------|------------------|-------------|-------------------|
|                     | <b>2013</b>      | <b>2014</b> |                   |
| <b>CARA</b>         | 52.2             | 54.0        | <b>3.4</b>        |
| <b>FIANNA</b>       | 69.0             | 50.2        | <b>2.8</b>        |
| <b>LADY CHRISTL</b> | 30.4             | 52.5        | <b>4.5</b>        |
| <b>P SQUIRE</b>     | 43.2             | 71.6        | <b>3.0</b>        |
| <b>SAXON</b>        | 18.9             | 30.6        | <b>6.0</b>        |
| PIAZZ               | 22.3             | 47.5        | <b>5.1</b>        |
| ELLIE               | 54.9             | 71.9        | <b>2.4</b>        |
| 02M012-001          | 43.1             | 48.4        | <b>4.1</b>        |
| VIZELLE             | 48.1             | 33.4        | <b>4.5</b>        |
| REVIE               | 46.9             | 51.9        | <b>3.7</b>        |
| STRACHAN            | 29.8             | 23.0        | <b>5.8</b>        |
| LORIMER             | 47.9             | 52.9        | <b>3.6</b>        |
| CHURCHILL           | 32.5             | 38.2        | <b>5.0</b>        |
| ARSENAL             | 73.4             | 58.7        | <b>2.2</b>        |
| DOLLY               | 28.9             | 14.2        | <b>6.3</b>        |
| EDONY               | 64.7             | 52.7        | <b>2.9</b>        |
| GWENNE              | 65.8             | 64.7        | <b>2.3</b>        |
| IVORY RUSSET        | 5.5              | 5.9         | <b>7.8</b>        |
| VENEZIA             | 29.2             | 45.5        | <b>4.8</b>        |
| LSD (P0.05)         | 22.2             | 23.0        | <b>2.0</b>        |



**Silver scurf** (Table 5)

There was a greater incidence of silver scurf in 2014 compared to the 2013 trial. In both years the susceptible reference variety Lady Christl had the most silver scurf recorded of all varieties in the test. Ivory Russet, Churchill, Dolly, Gwenne, Edony and Vizelle all demonstrated some resistance to silver scurf scoring between 7.4 and 6.7. Strachan was the most susceptible variety scoring 3.3.

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

| <b>Variety</b>         | <b>Test Year</b> |             | <b>1-9 rating</b> |
|------------------------|------------------|-------------|-------------------|
|                        | <b>2013</b>      | <b>2014</b> |                   |
| <b>CARA</b>            | 7.8              | 19.9        | <b>7.0</b>        |
| <b>FIANNA</b>          | 12.7             | 34.6        | <b>5.7</b>        |
| <b>LADY CHRISTL</b>    | 36.9             | 67.9        | <b>2.0</b>        |
| <b>PENTLAND SQUIRE</b> | 34.0             | 40.4        | <b>4.0</b>        |
| <b>ROMANO</b>          | 16.3             | 29.2        | <b>5.8</b>        |
| <b>SAXON</b>           | 21.8             | 46.1        | <b>4.4</b>        |
| PIZAZZ                 | 16.2             | 35.5        | <b>5.4</b>        |
| ELLIE                  | 7.7              | 37.9        | <b>5.8</b>        |
| 02M012-001             | 25.8             | 49.9        | <b>3.9</b>        |
| VIZELLE                | 5.8              | 26.1        | <b>6.7</b>        |
| REVIE                  | 9.9              | 26.4        | <b>6.4</b>        |
| STRACHAN               | 35.6             | 49.6        | <b>3.3</b>        |
| LORIMER                | 24.2             | 44.5        | <b>4.3</b>        |
| CHURCHILL              | 7.1              | 19.3        | <b>7.1</b>        |
| ARSENAL                | 17.8             | 20.1        | <b>6.3</b>        |
| DOLLY                  | 10.7             | 15.3        | <b>7.1</b>        |
| EDONY                  | 9.0              | 21.5        | <b>6.8</b>        |
| GWENNE                 | 8.9              | 17.3        | <b>7.1</b>        |
| IVORY RUSSET           | 9.9              | 11.5        | <b>7.4</b>        |
| VENEZIA                | 27.0             | 41.7        | <b>4.3</b>        |
| LSD (P0.05)            | 6.8              | 5.7         | <b>1.6</b>        |

**Skin spot** (Table 6)

Overall there was more skin spot recorded in 2014 than 2013, however the reference varieties Fianna, King Edward and Pentland Squire as well as candidates Pizazz and Dolly had slightly less skin spot recorded in the 2014 trial.

Three varieties (Ellie, Vizelle and Venezia) were very resistant scoring 9.0. Churchill, Strachan, Gwenne, 02M012-001, Ivory Russet and Lorimer also demonstrated resistance scoring between 8.3 and 6.6. Arsenal was the most susceptible candidate scoring 2.1; Edony was also susceptible scoring 2.6.

**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 |      | 1-9 rating |
|-----------------|-----------|------|------------|
|                 | 2013      | 2014 |            |
| FIANNA          | -0.4      | -0.5 | 8.1        |
| KING EDWARD     | 0.9       | 0.7  | 1.8        |
| PENTLAND SQUIRE | 0.8       | 0.6  | 2.0        |
| ROMANO          | -0.6      | 0.1  | 7.0        |
| SANTE           | 0.8       | 0.8  | 1.5        |
| SAXON           | 0.0       | 0.4  | 4.6        |
| PIZAZZ          | 0.1       | -0.1 | 6.0        |
| ELLIE           | -1.0      | -0.8 | 9.0        |
| 02M012-001      | -0.4      | -0.0 | 6.8        |
| VIZELLE         | -0.9      | -0.3 | 9.0        |
| REVIE           | -0.3      | 0.4  | 5.6        |
| STRACHAN        | -0.9      | 0.2  | 7.6        |
| LORIMER         | -0.3      | 0.0  | 6.6        |
| CHURCHILL       | -0.7      | -0.3 | 8.3        |
| ARSENAL         | 0.4       | 1.1  | 2.1        |
| DOLLY           | 0.5       | 0.4  | 3.5        |
| EDONY           | 0.6       | 0.7  | 2.6        |
| GWENNE          | -0.4      | -0.3 | 7.6        |
| IVORY RUSSET    | -0.4      | 0.1  | 6.7        |
| VENEZIA         | -0.9      | -0.4 | 9.0        |
| LSD (P0.05)     | 0.4       | 0.4  | 2.7        |

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

Overall there were more mop top (spraing) symptoms recorded in 2014 for the candidate varieties. 12 of the 14 candidates were very resistant scoring 9.0, the other two candidates Pizazz and Dolly still demonstrated some resistance scoring 8.4 and 7.0 respectively.

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

| Variety      | Test Year |      | 1-9 rating |
|--------------|-----------|------|------------|
|              | 2013      | 2014 |            |
| CARA         | 33.5      | 22.1 | 7.0        |
| NICOLA       | 13.8      | 22.0 | 9.0        |
| VALOR        | 37.4      | 23.0 | 6.3        |
| SATURNA      | 46.0      | 31.1 | 4.0        |
| MARIS PIPER  | 4.8       | 7.2  | 9.0        |
| PIAZZ        | 33.4      | 12.1 | 8.4        |
| ELLIE        | 9.1       | 8.2  | 9.0        |
| 02M012-001   | 5.5       | 21.9 | 9.0        |
| VIZELLE      | 5.6       | 10.5 | 9.0        |
| REVIE        | 0.0       | 7.5  | 9.0        |
| STRACHAN     | 16.3      | 9.8  | 9.0        |
| LORIMER      | 2.9       | 2.7  | 9.0        |
| CHURCHILL    | 2.5       | 14.5 | 9.0        |
| ARSENAL      | 0.0       | 3.7  | 9.0        |
| DOLLY        | 22.3      | 33.3 | 7.0        |
| EDONY        | 1.8       | 6.4  | 9.0        |
| GWENNE       | 10.4      | 15.5 | 9.0        |
| IVORY RUSSET | 0.0       | 5.0  | 9.0        |
| VENEZIA      | 0.0       | 6.9  | 9.0        |
| LSD (P0.05)  | 10.8      | 16.2 | 4.2        |

## **NL Tests**

For each NL test there is a summary of common catalogue varieties completing two years of trials (2013 and 2014). The summary provides an overview of the two years of the test and highlights the performance of particular varieties. The 1-9 ratings listed for the varieties in the relevant test table are presented in bold and are the final scores for the varieties after completing the two years of trials.

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

The reference variety Bintje and candidate varieties Arsenal, Ivory Russet and Venezia performed the same in both years. For all other varieties there was slightly less blight recorded in 2014. The exception was reference variety Cara where there was a larger decrease in symptoms in 2014 compared to 2013. All candidates were susceptible to tuber late blight scoring between 3.3 and 2.0.

**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>1-9 rating</b> |
|-------------------|------------------|-------------|-------------------|
|                   | <b>2013</b>      | <b>2014</b> |                   |
| <b>BINTJE</b>     | 90.0             | 90.0        | <b>2.0</b>        |
| <b>CARA</b>       | 67.6             | 36.5        | <b>6.0</b>        |
| <b>SARPO MIRA</b> | 78.1             | 71.6        | <b>3.6</b>        |
| <b>VALOR</b>      | 43.3             | 38.0        | <b>7.2</b>        |
| ARSENAL           | 90.0             | 90.0        | <b>2.0</b>        |
| DOLLY             | 79.2             | 75.8        | <b>3.3</b>        |
| EDONY             | 90.0             | 77.2        | <b>2.7</b>        |
| GWENNE            | 90.0             | 83.8        | <b>2.3</b>        |
| IVORY RUSSET      | 80.4             | 80.4        | <b>3.0</b>        |
| VENEZIA           | 90.0             | 90.0        | <b>2.0</b>        |
| LSD (P0.05)       | 10.4             | 12.2        | <b>1.4</b>        |

**Blackleg** (Table 9)

Very low levels of blackleg were recorded in the 2014 trial and for this reason the data has not been published. 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 2013 (SASA and NIAB) and 2014 (NIAB only). The 1-9 score for the candidate varieties are based on the 2013 SASA trial.

Edony (8.1) and Gwenne (7.4) were the most resistant candidates. Venezia and Ivory Russet were the most susceptible scoring 2.0 and 2.6 respectively.

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

| Variety           | Test Year      |                | 2014*<br>(SASA) | 2014<br>(NIAB) | 1-9 rating <sup>^</sup> |
|-------------------|----------------|----------------|-----------------|----------------|-------------------------|
|                   | 2013<br>(SASA) | 2013<br>(NIAB) |                 |                |                         |
| <b>AILSA</b>      | 20.2           | 3.1            |                 | 20.5           | 8.0                     |
| <b>CONCURRENT</b> | 42.1           | 41.9           |                 | 54.1           | 3.0                     |
| <b>CULTRA</b>     | 21.6           | 15.0           |                 | 33.4           | 6.6                     |
| <b>ESTIMA</b>     | 47.9           | 45.0           |                 | 75.0           | 1.4                     |
| <b>MORENE</b>     | 50.0           | 55.2           |                 | 38.9           | 2.7                     |
| ARSENAL           | 41.9           |                |                 |                | 3.8                     |
| DOLLY             | 25.7           |                |                 |                | 6.4                     |
| EDONY             | 14.8           |                |                 |                | 8.1                     |
| GWENNE            | 19.4           |                |                 |                | 7.4                     |
| IVORY RUSSET      | 49.1           |                |                 |                | 2.6                     |
| VENEZIA           | 53.3           |                |                 |                | 2.0                     |
| LSD (P0.05)       | 14.5           | 11.6           |                 | 14.2           | <b>5.0</b>              |

2014 data from SASA not published due to very low levels of blackleg in the trial.

<sup>^</sup>NL trial is conducted at 2 sites (SASA and NIAB); 1-9 rating for reference varieties uses data from 2 sites in 2013 and 1 site in 2014, 1-9 rating for candidate varieties uses data from SASA in 2013 only.

**Common scab** (Table 10)

There was a lack of discrimination between varieties in the 2013 test and therefore the data has not been published. 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 2013 (NIAB only) and 2014 (SASA and NIAB). The 1-9 score for the candidate varieties are based on the 2014 SASA trial.

Ivory Russet demonstrated some resistance scoring 6.1. The other candidates performed similarly scoring between 3.5 and 4.1.

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

| Variety        | Test Year       |                | 2014<br>(SASA) | 2014<br>(NIAB) | 1-9 rating ^ |
|----------------|-----------------|----------------|----------------|----------------|--------------|
|                | 2013*<br>(SASA) | 2013<br>(NIAB) |                |                |              |
| DESIREE        |                 | 20.4           | 57.3           | 28.8           | 5.0          |
| ESTIMA         |                 | 24.3           | 50.4           | 32.5           | 5.0          |
| HOME GUARD     |                 | 24.0           | 59.5           | 32.5           | 4.4          |
| MARIS BARD     |                 | 21.8           | 60.9           | 37.6           | 4.2          |
| MARIS PEER     |                 | 24.2           | 59.0           | 31.2           | 4.5          |
| MARIS PIPER    |                 | 44.9           | 62.3           | 48.4           | 2.0          |
| PENTLAND CROWN |                 | 16.6           | 30.7           | 27.2           | 7.0          |
| ARSENAL        |                 |                | 57.9           |                | 4.1          |
| DOLLY          |                 |                | 58.0           |                | 4.1          |
| EDONY          |                 |                | 57.1           |                | 4.3          |
| GWENNE         |                 |                | 61.3           |                | 3.5          |
| IVORY RUSSET   |                 |                | 47.3           |                | 6.1          |
| VENEZIA        |                 |                | 59.4           |                | 3.8          |
| LSD (P0.05)    |                 | 12.1           | 7.0            | 8.5            | 3.4          |

\*2013 data from SASA not published due to lack of discrimination between varieties.

^NL trial is conducted at 2 sites (SASA and NIAB); 1-9 rating for reference varieties uses data from 1 site in 2013 and 2 sites in 2014, 1-9 rating for candidate varieties uses data from SASA in 2014 only.

**Powdery scab** (Table 11)

The incidence of powdery scab was variable for some varieties between the two years of testing. For example, Arsenal and Venezia had less powdery scab recorded in 2014 than in 2013, whereas Dolly, Edony and Gwenne had slightly less in 2013. Ivory Russet performed similarly in both years. The reference variety Estima had less powdery scab in 2014 but was still the most susceptible of the reference varieties.

Ivory Russet was the most resistant candidate scoring 8.0, while Gwenne was the most susceptible scoring 3.3.

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

| Variety               | Test Year |      | 1-9 rating |
|-----------------------|-----------|------|------------|
|                       | 2013      | 2014 |            |
| <b>ACCENT</b>         | 22.6      | 15.4 | <b>6.2</b> |
| <b>CARA</b>           | 12.7      | 14.1 | <b>7.2</b> |
| <b>ESTIMA</b>         | 46.9      | 29.3 | <b>3.0</b> |
| <b>PENTLAND CROWN</b> | 10.4      | 10.5 | <b>7.6</b> |
| <b>SANTE</b>          | 7.9       | 8.8  | <b>8.0</b> |
| ARSENAL               | 27.6      | 13.2 | <b>6.0</b> |
| DOLLY                 | 31.4      | 35.9 | <b>3.8</b> |
| EDONY                 | 15.3      | 22.9 | <b>6.2</b> |
| GWENNE                | 33.0      | 39.2 | <b>3.3</b> |
| IVORY RUSSET          | 8.4       | 7.9  | <b>8.0</b> |
| VENEZIA               | 32.0      | 19.8 | <b>5.1</b> |
| LSD (P0.05)           | 7.3       | 5.6  | <b>1.8</b> |

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

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

Generally there was less disease recorded in 2014 than 2013. The susceptible reference variety Catriona had the same amount of disease in both years. The reference variety Sante and candidates Arsenal and Ivory Russet performed similarly in both years.

Most varieties demonstrated resistance scoring between 8.3 (Ivory Russet) and 7.1 (Venezia). The least resistant variety was Dolly scoring 6.0.

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

| Variety                | Test Year |      | 1-9 rating |
|------------------------|-----------|------|------------|
|                        | 2013      | 2014 |            |
| <b>NADINE</b>          | 36.4      | 20.0 | <b>6.1</b> |
| <b>CATRIONA</b>        | 66.0      | 66.0 | <b>2.3</b> |
| <b>ESTIMA</b>          | 46.6      | 25.1 | <b>5.3</b> |
| <b>PENTLAND SQUIRE</b> | 55.1      | 49.7 | <b>3.7</b> |
| <b>SANTE</b>           | 8.3       | 9.8  | <b>8.0</b> |
| ARSENAL                | 8.7       | 9.4  | <b>8.0</b> |
| DOLLY                  | 35.7      | 22.8 | <b>6.0</b> |
| EDONY                  | 17.8      | 12.9 | <b>7.4</b> |
| GWENNE                 | 17.1      | 8.5  | <b>7.6</b> |
| IVORY RUSSET           | 5.5       | 6.7  | <b>8.3</b> |
| VENEZIA                | 24.9      | 11.3 | <b>7.1</b> |
| LSD (P0.05)            | 10.8      | 7.9  | <b>1.3</b> |



*F. sulphureum* (Table 13)

Overall, there was less disease recorded in 2014, although reference variety Maris Piper and candidates Arsenal and Edony performed similarly in both years.

Edony and Gwenne were the most resistant candidates in trial scoring 7.3 and 7.0 respectively. Arsenal and Venezia were both very susceptible scoring 1.0.

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

| Variety            | Test Year |      | 1-9 rating |
|--------------------|-----------|------|------------|
|                    | 2013      | 2014 |            |
| <b>SANTE</b>       | 6.0       | 10.6 | <b>8.0</b> |
| <b>ATLANTIC</b>    | 34.9      | 30.1 | <b>3.8</b> |
| <b>MARIS PIPER</b> | 37.3      | 37.1 | <b>3.0</b> |
| <b>NADINE</b>      | 42.9      | 24.2 | <b>3.6</b> |
| <b>SAXON</b>       | 32.2      | 10.0 | <b>5.8</b> |
| ARSENAL            | 64.2      | 66.9 | <b>1.0</b> |
| DOLLY              | 20.0      | 14.8 | <b>6.4</b> |
| EDONY              | 12.4      | 12.8 | <b>7.3</b> |
| GWENNE             | 12.4      | 16.0 | <b>7.0</b> |
| IVORY RUSSET       | 41.7      | 34.6 | <b>2.8</b> |
| VENEZIA            | 61.2      | 57.2 | <b>1.0</b> |
| LSD (P0.05)        | 8.6       | 7.6  | <b>2.4</b> |

**External damage (splitting)** (Table 14)

Overall there was less splitting recorded in 2014 than 2013 with the exception of the reference varieties Maris Peer and Russet Burbank where there was a slight increase in 2014. The largest difference between years was for the candidate variety Arsenal. The candidate Edony had no splitting recorded in the 2 years of trials.

Edony and Venezia were the most resistant varieties in trial scoring 6.9 and 6.7, respectively. Ivory Russet was susceptible and scored 1.2.

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

| Variety               | Test Year |      | 1-9 rating |
|-----------------------|-----------|------|------------|
|                       | 2013      | 2014 |            |
| <b>MARIS PEER</b>     | 28.0      | 32.1 | <b>4.7</b> |
| <b>MARIS PIPER</b>    | 10.0      | 2.0  | <b>6.4</b> |
| <b>RECORD</b>         | 20.0      | 4.0  | <b>6.0</b> |
| <b>RED CRAIGS</b>     | 56.0      | 24.0 | <b>3.9</b> |
| <b>ROYAL</b>          |           |      |            |
| <b>RUSSET BURBANK</b> | 64.0      | 66.0 | <b>2.1</b> |
| ARSENAL               | 41.2      | 6.0  | <b>5.1</b> |
| DOLLY                 | 28.0      | 0.0  | <b>5.9</b> |
| EDONY                 | 0.0       | 0.0  | <b>6.9</b> |
| GWENNE                | 22.0      | 5.7  | <b>5.9</b> |
| IVORY RUSSET          | 86.0      | 68.0 | <b>1.2</b> |
| VENEZIA               | 6.0       | 0.0  | <b>6.7</b> |

LSD (P0.05)

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

Bruising was similar in the two years of trials for the majority of varieties. The candidate Arsenal recorded the same level of bruising in both years of the trial.

Arsenal and Venezia were the most resistant varieties in trial both scoring 6.0. Ivory Russet and Dolly were the least resistant scoring 4.0 and 4.3 respectively.

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

| Variety        | Test Year |      | 1-9 rating |
|----------------|-----------|------|------------|
|                | 2013      | 2014 |            |
| MARIS PEER     | 4.3       | 3.1  | 5.4        |
| MARIS PIPER    | 2.9       | 2.3  | 6.0        |
| RECORD         | 3.1       | 5.0  | 5.2        |
| RED CRAIGS     | 5.1       | 5.2  | 4.6        |
| ROYAL          |           |      |            |
| RUSSET BURBANK | 5.2       | 7.3  | 4.0        |
| ARSENAL        | 2.6       | 2.6  | 6.0        |
| DOLLY          | 5.1       | 6.2  | 4.3        |
| EDONY          | 5.0       | 4.3  | 4.9        |
| GWENNE         | 3.9       | 4.7  | 5.1        |
| IVORY RUSSET   | 6.8       | 5.7  | 4.0        |
| VENEZIA        | 1.8       | 3.4  | 6.0        |
| LSD (P0.05)    |           |      | 0.9        |

### 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 were Dolly, Edony, Gwenne and Venezia.

The candidate Arsenal showed high resistance to *G. pallida*. Ivory Russet had a score of 4 and this still provides a valuable level of resistance to *G. pallida*. This is not based on major gene resistance similar to the H1 gene for *G. rostochiensis* Ro1 but can limit cyst multiplication in a comparable way.

**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   |
| ESTIMA       | 2 (S)   | *              | *   |
| MARIS PIPER  | 8       | 2 (S)          | 2   |
| 12380        | 9       | 6              | 7   |
| VANTAGE      | 5       | 5              | 6   |
| MORAG        | 4       | 3              | 3   |
| VALES        |         |                |     |
| EVEREST      | *       | 5              | 8   |
| INNOVATOR    | *       | 9              | 9   |
| ARSENAL      | 6       | 9              | 9   |
| DOLLY        | 7       | 2              | *   |
| EDONY        | 8       | 3              | 4   |
| GWENNE       | 9       | 2              | *   |
| IVORY RUSSET | 6       | 4              | 4   |
| VENEZIA      | 9       | 2 <sup>#</sup> | *   |

† S denotes fully susceptible reference cultivars

\* not tested

# Testing for Pa2/3 is conducted for a second year if a score of 3 or more is obtained in the first year. Venezia was not tested in year 2 for Pa 2/3 as it obtained a score less than 3 in year 1 (2013). When reviewing data in early 2015, SASA nematologists recommended that testing of Venezia for a second year should have been conducted as the reference variety Morag (which usually has a score of at least 3) also scored less than 3 in 2013. SASA nematologists have included Venezia in the 2015 trial to establish if the variety score should change from the current rating of 2.

## 5. DISCUSSION

The full range of disease tests was completed on time with reasonable disease development in most tests. After discussion between BioSS and SASA it was decided to exclude the 2013 common scab and 2014 blackleg data from the SASA trial. This resulted in the common catalogue varieties completing tests (Arsenal, Dolly, Edony, Gwenne, Ivory Russet and Venezia) having only 1 year of data. In some tests e.g. silver scurf, skin spot and mop top (spraing) disease severity was greater in 2014 than in 2013, whereas the incidence of dry rots and external damage (splitting) was generally less in 2014 than 2013. As in previous years, some differences in the relative reactions of varieties were found between test years. For example, Pizazz and Ellie were more susceptible to black dot in 2014 than 2013; and Pizazz and Strachan were more susceptible to mop top (spraing) in 2013 than 2014. 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.

At the start of 2012 it was decided to discontinue the *Rhizoctonia* black scurf test as the results were inconsistent from year to year. It was agreed that an assay to assess possible resistance/ tolerance for stem canker and related symptoms i.e. pruned stolons as caused by *R. solani* would be investigated. In 2012, the investigation consisted of a screen of all 36 varieties and a test with a known susceptible variety (Harmony) to determine the ideal time point expressed as weeks after planting for assessment of stem canker. From this work, assessment at 4 weeks after emergence gave the best discrimination. In the 2013 trial, 36 varieties were screened and assessments were conducted 4 weeks after emergence. There was strong statistical evidence in 2013 of differences in stem canker severity between varieties and some statistical evidence for differences in stolon canker severity between varieties. There was limited statistical evidence of a difference in the proportions of pruned stolons between varieties. A third year of testing was conducted in 2014 using the same method as 2013. In the 2014 trial there was no statistical evidence in stem canker severity or stolon canker severity, and some statistical evidence of differences in stolon canker incidence between varieties. From the over-years analysis of the 2013 and 2014 data there was some statistical evidence of differences in stem canker severity between varieties and no statistical differences in stolon canker severity or stolon canker incidence between varieties. From the trials it is clear that repeatability over-years is an issue given the poor association between variety means in 2013 and 2014.

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 4 years of testing the majority of varieties have demonstrated resistance. 12 of the 14 candidates completing trials in 2014 were highly resistant with a score of 9; the other two candidates also demonstrated some resistance.

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, 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 ten 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 and formally presented to industry at the Potatoes in Practice event in August, 2007. This is now the mechanism for publication of both NL and IVT data and brings this data together with breeder's information formerly presented in publications such as "Scotland - The Natural Home of Potatoes". This database allows SASA to publish 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.

<http://potatoes.ahdb.org.uk/seed-exports/varieties>

The site has additional features, such as 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 now be downloaded into Excel and the site is mobile device-compatible. Since 2007 when the database was launched, over 150 countries have used the site with the most frequent visitors from GB.

The 14 varieties which completed IVT in 2014 were Pizazz, Ellie, 02M012-001, Vizelle, Revie, Strachan, Lorimer, Churchill, Arsenal, Dolly, Edony, Gwenne, Ivory Russet and Venezia. In summary, the key findings for these varieties are as follows:

### **Pizazz**

Resistant to: **black dot, mop top (spraing), common scab, and internal damage**  
Susceptible to: **tuber late blight, PCN Ro1 and PCN Pa 2/3 and 1**

### **Ellie**

Resistant to: **silver scurf, skin spot, mop top (spraing), common scab, PCN Ro1 and external damage**  
Susceptible to: **black dot, tuber late blight, dry rot – *F. coeruleum* and *F. sulphureum* and PCN Pa 2/3 and 1**

### **02M012-001**

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

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

### **Vizelle (04C055-004)**

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

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

### **Revie (HG 99-97 1)**

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

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

### **Strachan (HG 05-3 A9)**

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

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

### **Lorimer (HG 05-3 A17)**

Resistant to: **skin spot, mop top (spraing), PCN Ro1 and external damage**

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

### **Churchill (01Z51 A 54)**

Resistant to: **black dot, silver scurf, skin spot, mop top (spraing), tuber late blight, and blackleg**

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

### **Arsenal**

Resistant to: **silver scurf, mop top (spraing), dry rot – *F. coeruleum*, PCN Pa 2/3 and 1 and internal damage**

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

### **Dolly**

Resistant to: **black dot, silver scurf, dry rot – *F. sulphureum* and PCN Ro1**

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

### **Edony**

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

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

### **Gwenne**

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

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

### **Ivory Russet**

Resistant to: **black dot, silver scurf, skin spot, mop top (spraing), powdery scab and dry rot – *F. coeruleum* scab and PCN Pa 2/3 and 1**

Susceptible to: **tuber late blight, blackleg, dry rot – *F. sulphureum***, and **external and internal damage**

### **Venezia**

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

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

## **6. REFERENCES**

Boyd AEW (1957) Field experiments on potato skin spot disease caused by *Oospora pustulans*. *Annals of Applied Biology* **45**, 284-292.

Carnegie SF, Cameron AM (1983) Testing potato cultivars for susceptibility to skin spot (*Polyscytalum pustulans*). *Potato Research* **26**, 69-72.

Cruickshank G, Stewart HE, Wastie RL (1982) An illustrated assessment key for foliage blight of potatoes. *Potato Research* **25**, 213-214.

Hilton AJ, Stewart HE, Linton SL, Nicolson MJ, Less AK (2000) Testing the resistance to silver scurf in commercial potato cultivars under controlled environmental conditions. *Potato Research* **43**, 263-272.

Fry WE. 1978. Quantification of general resistance of potato cultivars and fungicide effects for integrated control of potato late blight. *Phytopathology* **68**, 1650-1655.



## 7. APPENDIX

### 7.1 STATISTICAL ANALYSIS OF 2014 RHIZOCTONIA DATA AND COMBINED 2013/2014 DATA

#### Introduction

In 2012 a *Rhizoctonia solani* (black scurf) trial investigated which was the optimal assessment time after emergence for comparing varieties for susceptibility. As a consequence of the results in 2012, assessments in the subsequent 2013 and 2014 trials were made at only four weeks post emergence. This report presents the results from the 2014 trial along with an over-years' comparison of varieties based on the combined dataset from assessments at four weeks post-emergence over the last two years in which there were six replicate pots per variety tested in each year.

#### Data collected in 2014

Six replicate pots of each of 21 varieties were laid out as a randomised block experiment and assessed four weeks post-emergence. The numbers of stolons and the numbers of these in each pot that were pruned (i.e. infected) were recorded. Additionally, stolon and stem canker severity on a 0-4 scale was recorded. The corresponding range of severity percentages for each category of the scoring scale is shown in the table below.

Table 1: Scoring scale for stem and stolon canker severity

| Score | % severity | Mid-point |
|-------|------------|-----------|
| 0     | 0          | 0         |
| 1     | 1 – 10     | 5         |
| 2     | 10 – 25    | 17.5      |
| 3     | 26 – 50    | 37.5      |
| 4     | > 50       | 75        |

#### Varieties tested in years 2012, 2013 and 2014

Table 2 shows the varieties tested in each of the three years between 2012 and 2014. Only six varieties were tested in all three years. There were 21 varieties tested in both 2013 and 2014.

Table 2: Presence / absence of varieties on trial for rhizoctonia in 2012-2014

| Variety              | 2012 | 2013 | 2014 | No. of years on trial |
|----------------------|------|------|------|-----------------------|
| 00C133-020           | √    | √    |      | 2                     |
| 02.Z.216 A6          | √    | √    |      | 2                     |
| 02C053-016           | √    | √    |      | 2                     |
| 03.N.8A81            | √    |      |      | 1                     |
| 03.Z.6.A5            | √    | √    |      | 2                     |
| 03C114-006           | √    | √    |      | 2                     |
| 96HG773B1 (Bremner)  | √    |      |      | 1                     |
| Ambassador           | √    |      |      | 1                     |
| Arizona              | √    | √    |      | 2                     |
| BEE 96 482 (Safiyah) | √    |      |      | 1                     |
| Bute (166HVN05)      | √    | √    |      | 2                     |
| Cara                 | √    | √    | √    | 3                     |
| Compass              | √    | √    |      | 2                     |
| Duke of York         | √    | √    | √    | 3                     |
| Electra              | √    |      |      | 1                     |

|                    |    |    |    |   |
|--------------------|----|----|----|---|
| Emma               | √  |    |    | 1 |
| G03TT007006        | √  | √  |    | 2 |
| Harmony            | √  | √  | √  | 3 |
| Infinity           | √  | √  |    | 2 |
| Jelly              | √  | √  |    | 2 |
| King Edward        | √  | √  | √  | 3 |
| Lady Christl       | √  | √  | √  | 3 |
| Nitza              | √  |    |    | 1 |
| Panther            | √  | √  |    | 2 |
| Red Emmalie        | √  |    |    | 1 |
| Royal              | √  | √  |    | 2 |
| Sante              | √  | √  | √  | 3 |
| Saxon              | √  | √  | √  | 3 |
| Setanta            | √  | √  |    | 2 |
| Shelford           | √  |    |    | 1 |
| Taurus             | √  |    |    | 1 |
| Violetta           | √  |    |    | 1 |
| VR808              | √  |    |    | 1 |
| Zahov              | √  |    |    | 1 |
| Zohar              | √  |    |    | 1 |
| 01Z51 A 54         |    | √  | √  | 2 |
| 02M012-001         |    | √  | √  | 2 |
| 04C055-004         |    | √  | √  | 2 |
| 97Z55 B 10         |    | √  |    | 1 |
| Arsenal            |    | √  | √  | 2 |
| Dolly              |    | √  | √  | 2 |
| Edony              |    | √  | √  | 2 |
| G04TT107001        |    | √  | √  | 2 |
| Gwenne             |    | √  | √  | 2 |
| HG 05-3 A17        |    | √  | √  | 2 |
| HG 05-3 A9         |    | √  | √  | 2 |
| HG 99-97 1         |    | √  | √  | 2 |
| Ivory Russet       |    | √  | √  | 2 |
| Pizazz             |    | √  | √  | 2 |
| Venezia            |    | √  | √  | 2 |
| Varieties on trial | 35 | 36 | 21 |   |

### Statistical methods

Stem and stolon canker severity were recorded on an ordinal scale. Single unit increments in the scoring scale do not correspond to equal increments in increasing severity. In other words, an increase in the score from 1 to 2 does not correspond to the same increase in severity as an increase in the score from 2 to 3. Consequently, it would be inappropriate to analyse the scores per se by parametric analysis of variance. Instead, scores have been converted to percentage severity by assigning to the pot the mid-point value of the respective score. An angular transformation has then been applied to the pot percentages prior to statistical analysis to more closely satisfy the assumption of variance homogeneity. The 2014 trial was analysed as a randomized block design by analysis of variance. Formal comparisons should be made on the transformed scale and consequently SEDs, LSDs and P values have only been presented for the analysis of the transformed data. However, for reference only, means calculated on the original scale have also been presented.

Incidence data from 2014 represented by the number of pruned stolons out of the total number of stolons was analysed by fitting a generalized linear mixed model (GLMM) with a binomial error structure and the logit link function. This approach reflects the binomial nature of the response variable and also takes into account that there are more stolons in some pots than others, which impacts on precision.

Over-years analyses of the varieties X years means for stem canker severity and stolon canker severity on the angular transformed scale were carried out using only those varieties present in both 2013 and 2014. In the previous report (2013) over-years analyses of the combined 2012 and 2013 data were presented.

For the over-years analysis of the percentage of infected stolons, the percentages of infected stolons in each pot in each year were computed, angular transformed and then a varieties X years table of angular transformed percentages was derived by averaging over replicate pots. Thus each pot was given equal importance in the analysis irrespective of the total number of stolons in each pot. Only varieties trialled in both 2013 and 2014 were included in the analysis.

### Results

Stem and stolon canker percentage severity data from 2014 are shown in Table 3. There was no statistical evidence ( $P=0.582$ ) of differences in stem canker severity between varieties. This contrasts with the finding in the 2013 trial reported last year, in which there was very strong statistical evidence ( $P=0.002$ ) of differences in stem canker severity between the varieties tested in that year. The LSDs (5%) were almost identical in both years but the range in varietal means on the angular scale in 2013 (4.3 – 48.2) was wider than in 2014 (2.2 – 34.7).

Analysis of stolon canker severity data from 2014 identified that plot 63 (3<sup>rd</sup> replicate of Lady Christl) had a very high score in comparison to the other five replicates of it. In the third replicate it was scored as a “4” while the other five replicates scored twice as “0” and three times as “1”. This individual replicate of Lady Christl not only seriously alters its variety mean for percentage severity but also increases the SED and LSD slightly. The consequence is that when it is included there is no statistical evidence of a difference between varieties ( $P=0.216$ ). However, if this one plot is excluded then the mean for Lady Christl on the angular scale drops from 16.5 to 7.9, the LSD (5%) drops from 12.71 to 11.64 and there is some evidence of a difference between varieties ( $P=0.041$ ). This is due to Lady Christl then having the lowest susceptibility of all the varieties tested. There is no scientific reason to exclude this one replicate pot and so it should be retained in the statistical analysis but the sensitivity of the analysis to this one pot is worth noting. As reported last year, in 2013 there was fairly strong statistical evidence ( $P=0.017$ ) of differences in stolon canker severity between varieties. The LSDs (5%) were very similar in both years but the range in varietal means on the angular scale in 2013 (4.3 – 24.9) was slightly wider than in 2014 (8.4 – 26.9).

There was strong statistical evidence ( $P=0.012$ ) of a difference in the proportions of pruned stolons between varieties in 2014 (see Table 4). The range of standard errors of difference for comparisons between varieties on the logit transformed scale was (0.670 – 0.817). This corresponds to a range in LSD (5%) of (1.331 – 1.623). The LSD should be used simply as a yardstick as this LSD is not adjusted for multiple comparison testing.

Results from the over-years analysis of stem canker severity data for varieties tested in both 2013 and 2014 are shown in Table 5 and Figure 1. The rankings of the varieties in each of the years separately and also based on the average performance over the two years are also shown in the table. There was some statistical evidence ( $P=0.043$ ) of differences between varieties. However, it is clear from Figure 1 that the association between variety means in the two years was not good.

Results from the over-years analysis of stolon canker severity data for varieties tested in both 2013 and 2014 are shown in Table 6 and Figure 2. The rankings of the varieties in each of the years separately and also based on the average performance over the two years are also shown in the table. There was no statistical evidence ( $P=0.39$ ) of differences between varieties. The lack of association between variety means in the two years is clear from Figure 2.

Results from the over-years analysis of incidence of stolon canker for varieties tested in both 2013 and 2014 are shown in Table 7 and Figure 3. The rankings of the varieties in each of the years separately and also based on the average performance over the two years are also shown in the table. There was no statistical evidence ( $P=0.41$ ) of differences between varieties. The lack of association between variety means in the two years is clear from Figure 3.

Analysis of data from all varieties from all three years of trialling (results not presented) did identify statistically significant differences between varieties for stem canker severity ( $P=0.005$ ), weak evidence for such differences for stolon canker severity ( $P=0.068$ ) and a suggestion of differences for infected stolon incidence ( $P=0.098$ ). However the three-year analysis included some varieties not in the 2013-14 analysis and also the number of trials for individual varieties often differed between the two analyses. More importantly, it should be noted that even the presence of statistical evidence of differences between varieties does not necessarily imply the test is sensitive to differences between varieties in general. Even with large LSDs (reflecting substantial inconsistencies between years) a significant difference can be found in the over-years analysis if there are very large differences between a few of the varieties tested.

Table 3: Stem and stolon canker severity in 2014 on the original untransformed and angular transformed scales.

| Variety             | Stem severity % |            | Stolon severity % |            |
|---------------------|-----------------|------------|-------------------|------------|
|                     | Untransf        | Ang transf | Untransf          | Ang transf |
| 01Z51 A 54          | 16.2            | 18.9       | 8.3               | 14.7       |
| 02M012-001          | 14.2            | 14.3       | 4.6               | 8.4        |
| 04C055-004          | 11.7            | 16.9       | 6.3               | 12.7       |
| Arsenal             | 12.9            | 16.7       | 10.4              | 16.7       |
| Cara                | 14.2            | 14.3       | 6.3               | 12.7       |
| Dolly               | 0.8             | 2.2        | 4.2               | 10.8       |
| Duke of York        | 17.9            | 20.6       | 7.9               | 10.6       |
| Edony               | 25.4            | 26.7       | 15.8              | 20.8       |
| G04TT107001 (Ellie) | 32.5            | 32.6       | 16.7              | 23.0       |
| Gwenne              | 35.8            | 34.7       | 12.5              | 19.0       |
| Harmony             | 22.5            | 22.6       | 18.8              | 24.9       |
| HG 05-3 A17         | 7.5             | 12.6       | 4.2               | 10.8       |
| HG 05-3 A9          | 11.7            | 16.9       | 9.2               | 16.9       |
| HG 99-97 1          | 21.7            | 20.4       | 9.2               | 16.9       |
| Ivory Russet        | 19.2            | 20.4       | 24.2              | 26.9       |
| King Edward         | 19.2            | 20.4       | 8.3               | 14.7       |
| Lady Christl        | 17.1            | 18.4       | 15.0              | 16.5       |
| Pizazz              | 9.2             | 10.4       | 16.7              | 23.0       |
| Sante               | 15.4            | 14.1       | 8.8               | 12.8       |
| Saxon               | 21.7            | 20.4       | 11.7              | 16.9       |
| Venezia             | 32.5            | 32.6       | 14.6              | 21.0       |
| SED                 |                 | 11.40      |                   | 6.40       |
| LSD (5%)            |                 | 22.61      |                   | 12.71      |
| P value             |                 | 0.582      |                   | 0.216      |

Table 4: Proportions of pruned stolons in 2014 on the logit scale and back-transformed percentages

| Variety             | Transformed scale |       | Back-transformed percentage |
|---------------------|-------------------|-------|-----------------------------|
|                     | Prediction        | s.e.  | Prediction                  |
| 01Z51 A 54          | -0.41             | 0.509 | 39.95                       |
| 02M012-001          | -2.25             | 0.588 | 9.51                        |
| 04C055-004          | -1.18             | 0.520 | 23.56                       |
| Arsenal             | -1.42             | 0.523 | 19.52                       |
| Cara                | -1.19             | 0.521 | 23.37                       |
| Dolly               | -1.54             | 0.524 | 17.65                       |
| Duke of York        | -1.88             | 0.584 | 13.21                       |
| Edony               | -0.77             | 0.506 | 31.66                       |
| G04TT107001 (Ellie) | 0.30              | 0.484 | 57.49                       |
| Gwenne              | -0.21             | 0.485 | 44.75                       |
| Harmony             | -0.37             | 0.507 | 40.86                       |
| HG 05-3 A17         | -0.93             | 0.511 | 28.23                       |
| HG 05-3 A9          | 0.05              | 0.494 | 51.36                       |
| HG 99-97 1          | -1.23             | 0.504 | 22.59                       |
| Ivory Russet        | 0.05              | 0.494 | 51.15                       |
| King Edward         | -1.41             | 0.527 | 19.69                       |
| Lady Christl        | -1.86             | 0.578 | 13.42                       |
| Pizazz              | 0.00              | 0.484 | 50.08                       |
| Sante               | -1.84             | 0.555 | 13.71                       |
| Saxon               | -0.86             | 0.511 | 29.64                       |
| Venezia             | -0.87             | 0.494 | 29.53                       |

Table 5: Over years (2013-2014) angular transformed stem canker severity.

| Variety      | Mean<br>2013 | Mean<br>2014 | Mean<br>Average | Rank<br>2013 | Rank<br>2014 | Rank of<br>Average |
|--------------|--------------|--------------|-----------------|--------------|--------------|--------------------|
| Dolly        | 12.6         | 2.2          | 7.4             | 4            | 1            | 1                  |
| Pizazz       | 10.4         | 10.4         | 10.4            | 2            | 2            | 2                  |
| HG 05-3 A9   | 6.5          | 16.9         | 11.7            | 1            | 9            | 3                  |
| Ivory Russet | 10.6         | 20.4         | 15.5            | 3            | 12.5         | 4                  |
| HG 05-3 A17  | 20.6         | 12.6         | 16.6            | 6            | 3            | 5                  |
| Sante        | 20.4         | 14.1         | 17.3            | 5            | 4            | 6                  |
| 02M012-001   | 21.0         | 14.3         | 17.7            | 7            | 5.5          | 7                  |
| Cara         | 22.2         | 14.3         | 18.2            | 9.5          | 5.5          | 8                  |
| HG 99-97 1   | 22.6         | 20.4         | 21.5            | 12           | 14.5         | 9                  |
| Duke of York | 22.6         | 20.6         | 21.6            | 11           | 16           | 10                 |
| Harmony      | 22.2         | 22.6         | 22.4            | 9.5          | 17           | 11                 |
| Arsenal      | 28.4         | 16.7         | 22.6            | 14           | 7            | 12                 |
| Edony        | 21.0         | 26.7         | 23.9            | 8            | 18           | 13                 |
| 01Z51 A 54   | 32.6         | 18.9         | 25.7            | 15           | 11           | 14                 |
| King Edward  | 36.3         | 20.4         | 28.3            | 17           | 12.5         | 15                 |
| Lady Christl | 40.4         | 18.4         | 29.4            | 18           | 10           | 16                 |
| Gwenne       | 26.9         | 34.7         | 30.8            | 13           | 21           | 17                 |
| 04C055-004   | 48.2         | 16.9         | 32.6            | 21           | 8            | 18                 |
| Venezia      | 32.6         | 32.6         | 32.6            | 16           | 19.5         | 19                 |
| Saxon        | 46.3         | 20.4         | 33.3            | 20           | 14.5         | 20                 |
| G04TT107001  | 44.3         | 32.6         | 38.4            | 19           | 19.5         | 21                 |
| SED          |              |              | 7.94            |              |              |                    |
| LSD (5%)     |              |              | 16.57           |              |              |                    |
| P value      |              |              | P=0.043         |              |              |                    |

Table 6: Over years (2013-2014) angular transformed stolon canker severity.

| Variety      | Mean<br>2013 | Mean<br>2014 | Mean<br>Average | Rank<br>2013 | Rank<br>2014 | Rank of<br>Average |
|--------------|--------------|--------------|-----------------|--------------|--------------|--------------------|
| Dolly        | 6.5          | 10.8         | 8.6             | 1            | 3.5          | 1                  |
| HG 05-3 A17  | 10.8         | 10.8         | 10.8            | 4            | 3.5          | 2                  |
| Duke of York | 12.7         | 10.6         | 11.7            | 7            | 2            | 3                  |
| Sante        | 12.6         | 12.8         | 12.7            | 5            | 7            | 4                  |
| 02M012-001   | 18.8         | 8.4          | 13.6            | 13.5         | 1            | 5.5                |
| Arsenal      | 10.6         | 16.7         | 13.6            | 2.5          | 11.0         | 5.5                |
| HG 05-3 A9   | 10.6         | 16.9         | 13.7            | 2.5          | 12.5         | 7                  |
| Cara         | 18.8         | 12.7         | 15.8            | 13.5         | 5.5          | 8                  |
| 04C055-004   | 18.8         | 12.7         | 15.8            | 16           | 5.5          | 9                  |
| HG 99-97 1   | 14.7         | 16.9         | 15.8            | 10           | 12.5         | 10                 |
| King Edward  | 20.4         | 14.7         | 17.6            | 18           | 8.5          | 11                 |
| Lady Christl | 18.8         | 16.5         | 17.7            | 16           | 10           | 12                 |
| Edony        | 14.9         | 20.8         | 17.9            | 11           | 16           | 13                 |
| 01Z51 A 54   | 21.0         | 14.7         | 17.9            | 20           | 8.5          | 14.5               |
| Pizazz       | 12.8         | 23.0         | 17.9            | 8            | 18.5         | 14.5               |
| Gwenne       | 16.9         | 19.0         | 18.0            | 12           | 15           | 16                 |
| Ivory Russet | 12.6         | 26.9         | 19.7            | 6            | 21           | 17                 |
| Harmony      | 14.7         | 24.9         | 19.8            | 9            | 20           | 18                 |
| Venezia      | 18.8         | 21.0         | 19.9            | 16           | 17           | 19                 |
| Saxon        | 24.9         | 16.9         | 20.9            | 21           | 14           | 20                 |
| G04TT107001  | 20.8         | 23.0         | 21.9            | 19           | 18.5         | 21                 |
| SED          |              |              | 4.68            |              |              |                    |
| LSD (5%)     |              |              | 9.75            |              |              |                    |
| P value      |              |              | P=0.386         |              |              |                    |

Fig 1: Angular transformed Stem severity % 2013 v 2014

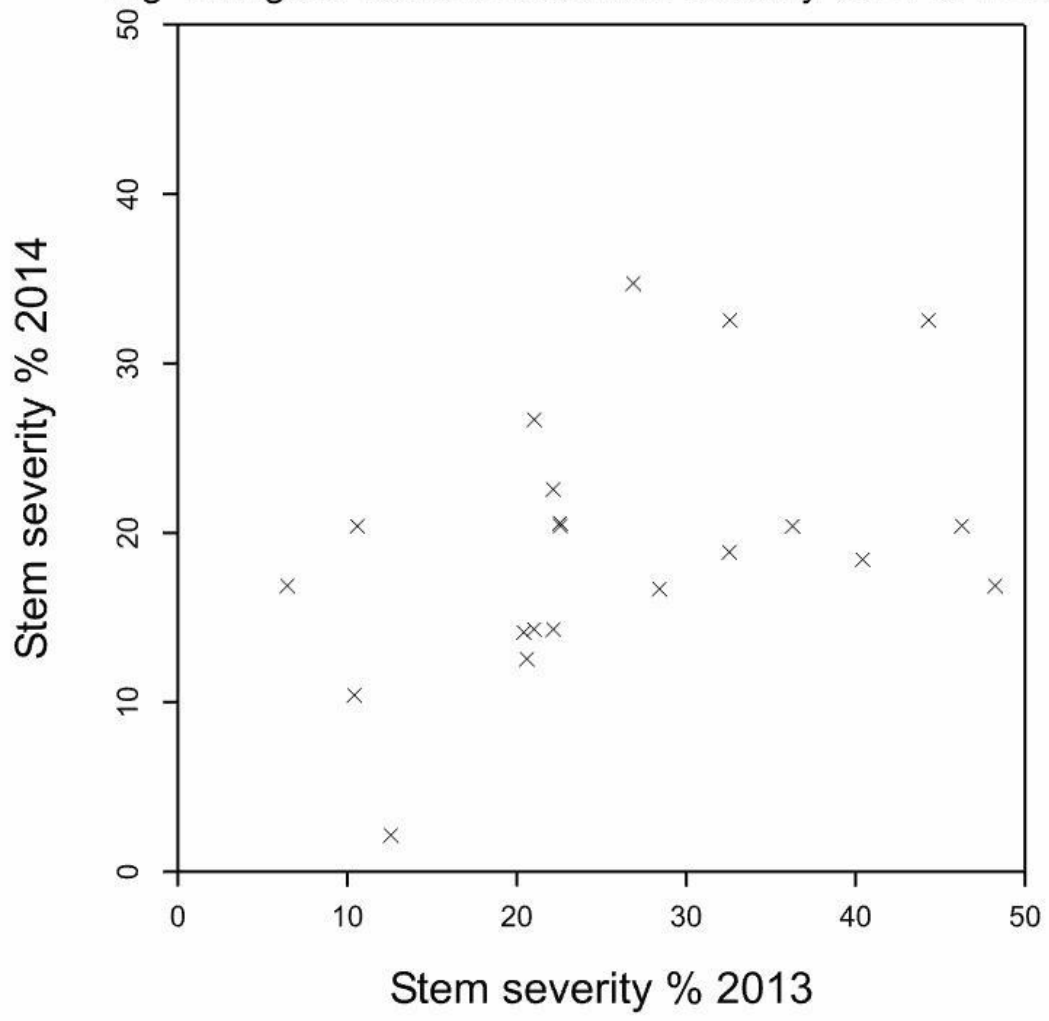


Fig 2: Angular transformed stolon severity % 2013 v 2014

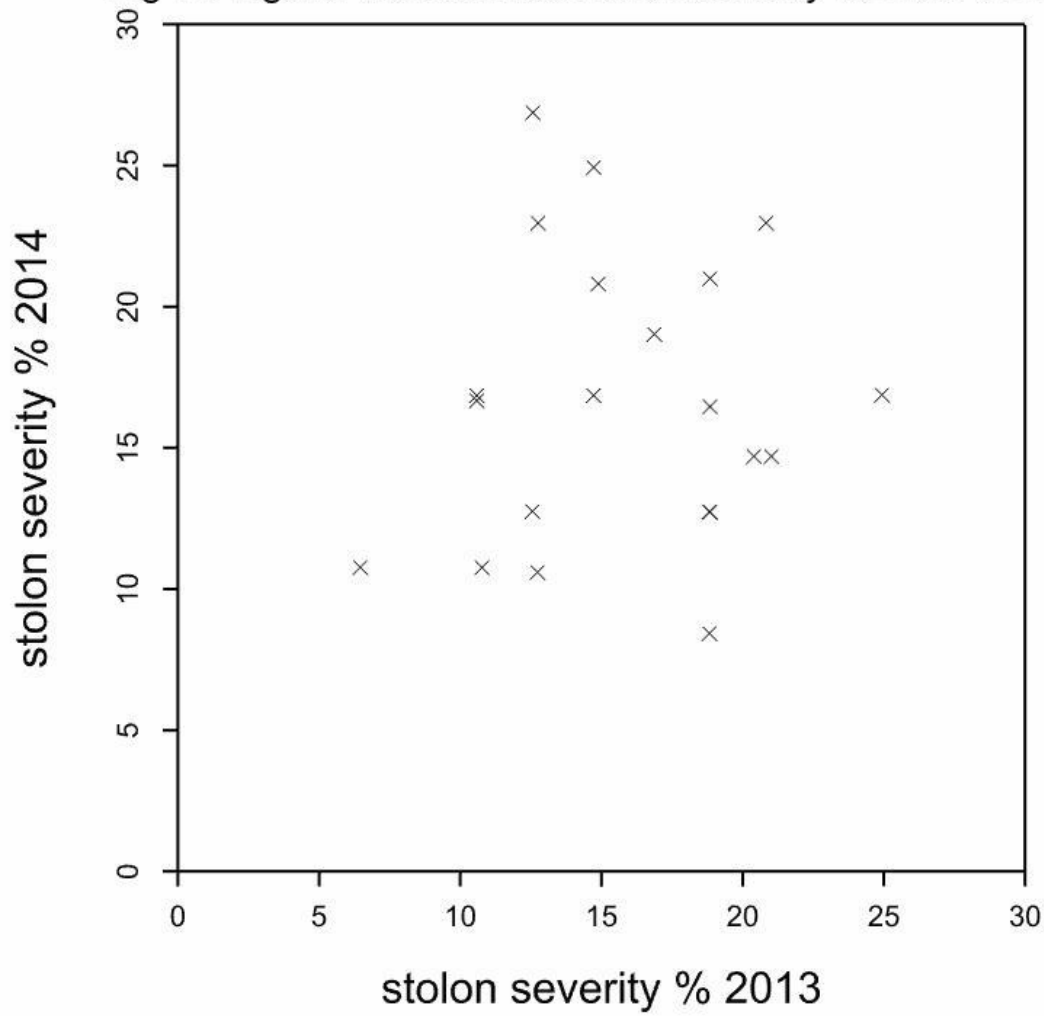
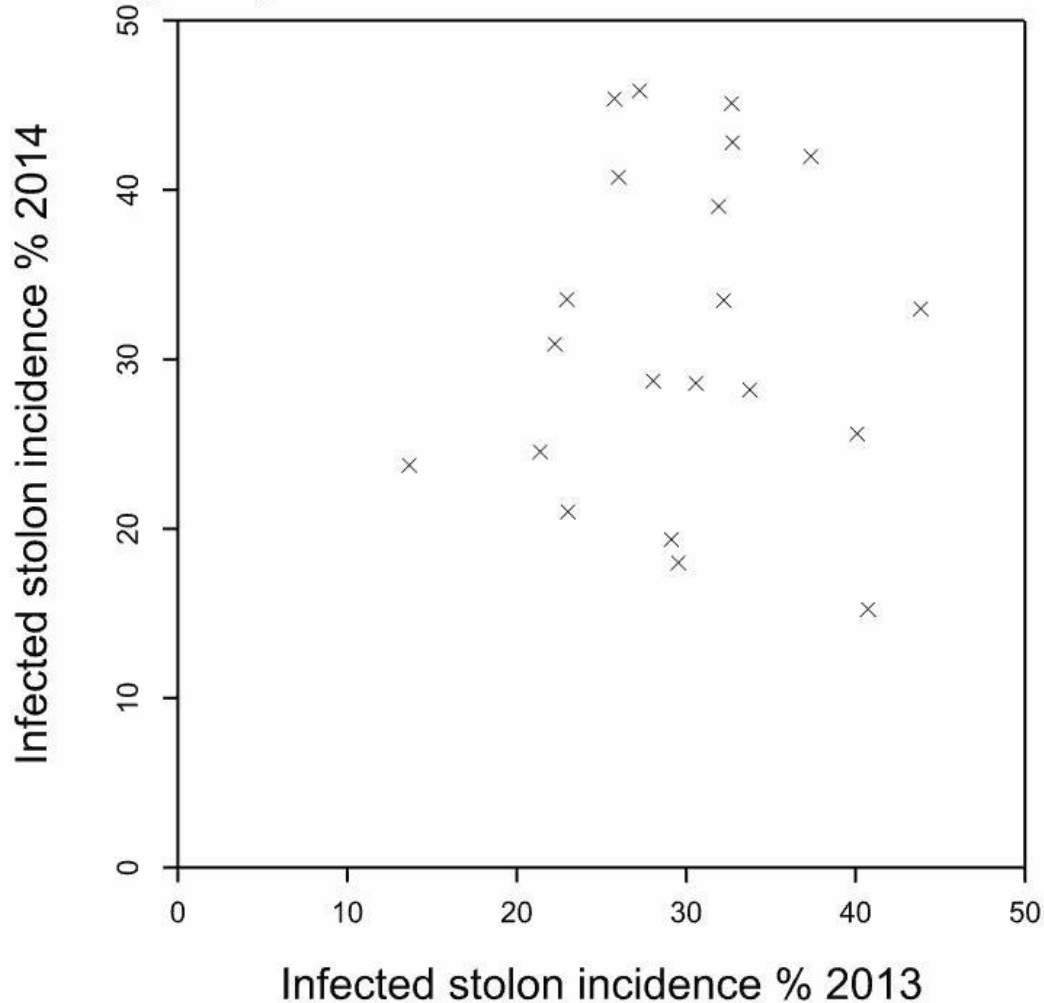




Table 7: Over years (2013-2014) angular transformed percentage of infected stolons.

| Variety      | Mean<br>2013 | Mean<br>2014 | Mean<br>Average | Rank<br>2013 | Rank<br>2014 | Rank of<br>Average |
|--------------|--------------|--------------|-----------------|--------------|--------------|--------------------|
| Dolly        | 13.7         | 23.7         | 18.7            | 1            | 5            | 1                  |
| Sante        | 23.0         | 21.0         | 22.0            | 5            | 4            | 2                  |
| Arsenal      | 21.4         | 24.6         | 23.0            | 2            | 6            | 3                  |
| Duke of York | 29.5         | 18.0         | 23.8            | 11           | 2            | 4                  |
| Lady Christl | 29.1         | 19.4         | 24.2            | 10           | 3            | 5                  |
| HG 05-3 A17  | 22.3         | 30.9         | 26.6            | 3            | 11           | 6                  |
| 02M012-001   | 40.7         | 15.3         | 28.0            | 20           | 1            | 7                  |
| Edony        | 23.0         | 33.5         | 28.3            | 4            | 14           | 8                  |
| Cara         | 28.0         | 28.7         | 28.4            | 9            | 10           | 9                  |
| HG 99-97 1   | 30.6         | 28.6         | 29.6            | 12           | 9            | 10                 |
| 04C055-004   | 33.8         | 28.2         | 31.0            | 17           | 8            | 11                 |
| Venezia      | 32.2         | 33.5         | 32.8            | 14           | 13           | 12                 |
| King Edward  | 40.1         | 25.6         | 32.9            | 19           | 7            | 13                 |
| Harmony      | 26.0         | 40.8         | 33.4            | 7            | 16           | 14                 |
| 01Z51 A 54   | 31.9         | 39.0         | 35.5            | 13           | 15           | 15                 |
| Ivory Russet | 25.8         | 45.4         | 35.6            | 6            | 20           | 16                 |
| HG 05-3 A9   | 27.3         | 45.9         | 36.6            | 8            | 21           | 17                 |
| G04TT107001  | 32.7         | 42.8         | 37.8            | 16           | 18           | 18                 |
| Saxon        | 43.8         | 33.0         | 38.4            | 21           | 12           | 19                 |
| Pizazz       | 32.7         | 45.1         | 38.9            | 15           | 19           | 20                 |
| Gwenne       | 37.4         | 42.0         | 39.7            | 18           | 17           | 21                 |
|              |              |              |                 |              |              |                    |
| SED          |              |              | 8.28            |              |              |                    |
| LSD (5%)     |              |              | 17.28           |              |              |                    |
| P value      |              |              | P=0.410         |              |              |                    |

Fig 3: Angular transf Infected stolon incidence % 2013 v 2014



### Conclusions

There was no statistical evidence ( $P=0.582$ ) of differences in stem canker severity between varieties in 2014.

There was some statistical evidence ( $P=0.043$ ) of differences in stem canker severity between varieties from the combined 2013 and 2014 data. However, it was clear that the association between variety means between the two years was very poor. As such, repeatability over years was an issue.

There was no statistical evidence ( $P=0.216$ ) of differences in stolon canker severity between varieties in 2014 though the conclusion is sensitive to one replicate pot of Lady Christl.

There was no statistical evidence ( $P=0.39$ ) of differences in stolon canker severity between varieties from the combined 2013 and 2014 data. It was clear that the association between variety means between the two years was very poor. As such, repeatability over years was an issue.

There was some statistical evidence ( $P=0.012$ ) of differences in stolon canker incidence between varieties in 2014.

There was no statistical evidence ( $P=0.41$ ) of differences in stolon canker incidence between varieties from the combined 2013 and 2014 data. It was clear that the association between variety means between the two years was very poor. As such, repeatability over years was an issue.

Overall, it has been agreed to discontinue work to develop a test for susceptibility to *R. solani* (stem canker or stolon canker) from 2015 onwards.