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| <b>Project Title</b>           | Updating <i>Bremia</i> resistance information for UK lettuce growers |
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The results and conclusions in this report are based on a series of experiments conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

**AUTHENTICATION**

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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## **Grower Summary**

### **Headline**

- Significant levels of “field” or partial resistance to the BI 25 race of downy mildew have been identified in a wide range of lettuce varieties lacking complete resistance to the race
- When used in conjunction with fungicides, partial resistance provides an effective means of disease control for growers through the season
- Other varieties were highly susceptible to BI 25, and will require careful monitoring by growers and more intensive fungicide inputs
- Varieties with claimed resistance to BI 25 generally had low or no infection, though some appeared to show late season disease increase, and a small number of varieties with claimed resistance to BI 25 had significant disease earlier in the season

### **Background**

Major gene, complete resistance to downy mildew (*Bremia lactucae*) is frequently overcome by new variants of the fungus. The BI 25 pathotype was confirmed in 2004, and is established in the UK. However, as with the occurrence of other new pathotypes, some varieties have appeared less susceptible to the disease even though they lacked “major” gene resistance. Partial resistance, which is probably polygenic, can be a useful factor in disease control, since it can help to reduce the number of sprays applied while still achieving the desired quality. A significant level of partial resistance may also mean that the commercial life of a variety can be prolonged. It is equally important to identify varieties with little or no residual resistance so that growers can be aware of the higher risk posed by them.

### **Objectives and expected deliverables**

The objective of this work was to identify a range of varieties of interest with growers, and evaluate field resistance when inoculated with BI 25 over a growing season with and without a standard fungicide programme. Varieties with and without claimed BI 25 resistance were included.

The expected deliverable is to identify high and lower risk types for BI 25 susceptibility, and to identify those where partial resistance coupled with standard fungicide programmes is likely to provide effective disease control.

### **Summary of the project and main conclusions**

Inoculation with BI 25 on field grown plots was successful. A three spray fungicide programme applied to one half of the plots allowed a direct comparison between chemical and chemical + genotypic control of disease. Four groups of varieties were identified. Group A were highly susceptible to BI 25, and the three spray programme used was not effective in controlling disease. Group B were moderately susceptible, and the fungicide programme reduced disease to more acceptable levels, though in

commercial production a more intensive programme would still be needed. Group C were moderately resistant, and fungicides gave good disease control and generally high head quality and cleanliness at harvest. Group D were highly resistant, and most had claims for BI 25 resistance. However, even within this group some varieties had low levels of disease in untreated plots, but levels were insignificant or zero in treated plots. Groups are listed together with claimed BI resistances from seed company descriptions where available.

**Group A: Highly susceptible, careful monitoring and intensive spray programmes**

| Type       | Variety        | Claimed resistance (/ = no information) |
|------------|----------------|---|
| Little Gem | Little Gem     | BI 1,5,7,10                             |
| Little Gem | Lucena         | /                                       |
| Little Gem | SSC 1868       | BI 1-16, 19, 21, 23                     |
| Cos        | Chicago        | /                                       |
| Little Gem | ROM 7517       | BI 1-24                                 |
| Little Gem | Tamburo        | BI 1-16, 21,23                          |
| Little Gem | Kikos          | BI 1-16, 18-24                          |
| Iceberg    | Conquest       | /                                       |
| Cos        | Romany Let 066 | BI 1,5, 7                               |
| Cos        | Frisco         | /                                       |
| Iceberg    | Durango        | /                                       |
| Little Gem | Maribel        | BI 1-25                                 |
| Iceberg    | SSC 1626       | 1-16, 19, 21, 23                        |

**Group B: susceptible, likely to develop significant disease**

| Type          | Variety    | Claimed resistance (/ = no information) |
|---------------|------------|---|
| Iceberg       | Capriole   | /                                       |
| Iceberg       | Brenson    | /                                       |
| Iceberg       | Robinson   | /                                       |
| Batavia red   | Redfun     | BI 1-16, 18-24                          |
| Iceberg       | Challenge  | /                                       |
| Cos           | SSC 1837   | BI 1-16, 19, 23                         |
| Cos           | Daytona    | /                                       |
| Cos           | SSC 1839   | /                                       |
| Iceberg       | NIZ 44-107 | BI 1-16, 22, 23                         |
| Red Oak Leaf  | Vulcania   | BI 1-24                                 |
| Red Oak Leaf  | Vesuve     | BI 1-24                                 |
| Cos           | LS4851     | BI 1-26, 18-24                          |
| Batavia Green | Funtaste   | BI 1-16, 18-24                          |
| Iceberg       | Chirvel    | /                                       |
| Red Oak       | Galiano    | BI 1-16, 21, 23                         |

**Group C: Moderate resistance – some disease development, but good control when treated**

| <b>Type</b>     | <b>Variety</b> | <b>Claimed resistance (/= no information)</b> |
|-----------------|----------------|---|
| Cos             | Pinokkio       | BI 1-5, 7, 10, 11,17                          |
| Batavia         | Noisette       | BI 1-17, 21, 23                               |
| Little Gem      | Coventry       | BI 1-21, 23-25                                |
| Iceberg         | NIZ 44-501     | BI 1-23, 25                                   |
| Batavia         | Follomy        | BI 1-24                                       |
| Batavia         | Estony         | /   |
| Little Gem      | Maureen        | BI 1-21, 23-25                                |
| Red Oak         | SSC 1866       | BI 1-23, 25                                   |
| Cos             | LS4853         | BI 1-24                                       |
| Iceberg         | Stylist        | BI 1-25                                       |
| Oak Leaf red    | Gourmandine    | BI 1-25                                       |
| Iceberg         | NIZ 44-502     | BI 1-23, 25                                   |
| Leaf curly leaf | Cancan         | /   |
| Cos             | E16.3323       | /   |
| Iceberg         | E14.0246       | /   |
| Batavia Green   | Comice         | BI 1-25                                       |
| Little Gem      | Mickey         | BI 1-25                                       |

**Group D: Resistant varieties, unlikely to develop disease, reduced inputs possible**

| Type             | Variety       | Claimed resistance (/ = no information) |
|------------------|---------------|---|
| Iceberg          | Tiger         | BI 1-25                                 |
| Oak Leaf red     | Paradai       | BI 1-25                                 |
| Iceberg          | 45-25 RZ      | BI 1-25                                 |
| Cos              | E16.1919      | /                                       |
| Cos              | Jiminy        | /                                       |
| Iceberg          | Ensemble      | BI 1-25                                 |
| Iceberg          | Etude         | BI 1-25                                 |
| Iceberg          | Edition       | /                                       |
| Iceberg          | Design        | BI 1-25                                 |
| Iceberg          | E14.7382      | /                                       |
| Little Gem       | Miranda       | BI 1-25                                 |
| Oak Leaf Green   | Kireve        | BI 1-25                                 |
| Leaf Lollo verde | Livigna       | BI 1-25                                 |
| Batavia Green    | Exquise       | BI 1-25                                 |
| Lollo Rossa      | Fortress      | BI 1-25                                 |
| Lollo Rossa      | SSC 1624      | BI 1-25                                 |
| Iceberg          | Hattrick      | BI 1-25                                 |
| Iceberg          | Boomerang     | BI 1-25                                 |
| Iceberg          | Flight        | BI 1-25                                 |
| Lolla Rossa      | Xenon         | BI 1-20, 22, 24                         |
| Leaf Green       | Ashbrook 2551 | BI 1-13, 15, 17                         |
| Batavian red     | Rosemoor 2243 | BI 1-16, 19, 21, 23                     |
| Leaf red         | Foxley 2435   | BI 1-16, 19, 21, 23                     |
| Iceberg          | 45-72 RZ      | BI 1-25                                 |
| Little Gem       | Corberra      | /                                       |
| Red Batavia      | Bijou         | /                                       |
| Lollo Rossa      | Carmoli       | /                                       |
| Lollo Rossa      | Nation        | /                                       |
| Lollo Rossa      | Bastile       | /                                       |
| Iceberg          | Kuaia         | /                                       |

Many varieties without BI 25 resistance still showed significant levels of resistance when inoculated with the race. Coupled with fungicide applications, levels of resistance were high enough to give good quality heads with little disease. Absence of major gene resistance thus does not necessarily mean that a variety is unacceptably susceptible.

### Financial benefits

Number of sprays can be significantly reduced on varieties with BI 1-25 resistance. In addition, spray frequency could also be reduced on many varieties where there is no claim for BI 25 resistance.



### **Action points for growers**

- Monitor varieties in Group A carefully since downy mildew will develop quickly and there is little background resistance
- Group B varieties will also develop significant downy mildew when BL 25 predominates, but fewer sprays may be needed
- For those varieties in Group C, spray frequency may also be reduced, while for those in Group D, sprays may be unnecessary, especially when seasonal disease pressure is low.

## Science Section

### Introduction

Downy mildew of lettuce (*Bremia lactucae*) continues to cause considerable losses to UK growers. Fungicides are used to control the disease, but growers also exploit resistance to as part of integrated control programmes and the identification of high and low risk varieties. Disease resistance based on major gene (R genes) provides a high level of resistance, but is frequently unstable due to the evolution of new virulences in the pathogen which overcome R gene mediated resistance. Recently, a new race, BI:25, has been identified which overcomes a specific combination of resistances, including that from the variety Discovery, and this has led to the breakdown of resistance in many commercial varieties. BI:25 has been identified in several European countries, including the UK. Despite loss of major gene resistance, background “field resistance” may still be present, and at a sufficiently high level to be of practical use to growers. However, without a controlled field test, the value of such resistance remains unknown. Equally, if there is little or no field resistance remaining after R gene breakdown, a variety will be high risk and will require appropriate management.

This project will evaluate the field resistance of selected lettuce varieties against the BI:25 race in an inoculated test. Disease progress will be monitored through the season to normal harvest date for specific types and for a period after this, to ensure that the robustness of field resistance under high infection pressure is adequately described. The extent to which disease can be effectively managed on varieties with differing levels of resistance will be investigated by applying a standard downy mildew fungicide programme to one half of the plots.

### Materials and methods

Race BI 25 was obtained from Natkuinbouw, The Netherlands, and increased on the variety Little Gem by spraying spores onto block raised plants with 4-6 leaves in a growth room at 16-18°C, incubating at 100% RH for 48h, growing on for 7 days, and then inducing sporulation by increasing RH again to 100%. Spores were washed from infected leaves with water and used to inoculate field plots directly. Spore concentrations in the range of 1 to 5 x 10<sup>4</sup> spores/ml were applied on 10<sup>th</sup> August, 14<sup>th</sup> August, 17<sup>th</sup> August and 30<sup>th</sup> August, at a rate of 50 ml per plot.

Block raised lettuce plants were transplanted on 12<sup>th</sup> July. Plots were 2.25 m long with 4 rows each of 10 plants, and there were 3 replicates of each variety laid out in a randomised block design. A total of 75 varieties were planted. The variety list was agreed with the Grower Coordinator.

One half of each plot, approximately 1 m<sup>2</sup>, was sprayed with a standard fungicide programme applied with hand held equipment. The programme consisted of Aliette (at 30g per 100m<sup>2</sup>) on 21<sup>st</sup> August, Manzate WG + Amistar ( 1.7kg/ha and 1l/ha ) on 4<sup>th</sup> September, and Fubol Gold (1.9 kg/ha) on 12<sup>th</sup> September.

All plots were irrigated during the very dry conditions which were experienced after planting, and again during growth to encourage cycles of downy mildew infection and sporulation. Water was applied daily in three to five minute periods during late afternoon.

Each plot half (sprayed and non-sprayed) was assessed for % leaf area infected with downy mildew on 1<sup>st</sup> September, 9<sup>th</sup> September, and 15<sup>th</sup> September. Quality and disease assessments were carried out on plants cut from the sprayed half of the plots only on 19<sup>th</sup> September. Downy mildew severity on the head (0-5, where 5 is most severe), head quality (0-5, where 5 is best quality and 0= poor) and basal cleanliness (0-5, where 5 is poor) were evaluated. Basal cleanliness was the total effect of downy mildew, Botrytis, and senescence. A final assessment of % leaf area infected with downy mildew was made on unsprayed plants only on 29<sup>th</sup> September

## Results and Discussion

Downy mildew progressed rapidly after the initial score on September 1<sup>st</sup>. The fungicide programme gave good disease control, good head quality and high basal cleanliness on those varieties which had moderate to low downy mildew scores in the untreated half of the plots, but control was much less effective on the highly susceptible varieties. Varieties were separated into highly susceptible, moderately susceptible, moderately resistant and high resistant groups, based on the untreated plot scores on 15<sup>th</sup> September (Tables 1, 2, 3 and 4). Plot data are given in Appendix I

**Table 1: Downy mildew severity (% leaf area infected) on untreated and treated plots (very susceptible group)**

| Type       | Variety        | Untreated |       |       |       | Treated |       |       |
|------------|----------------|-----------|-------|-------|-------|---------|-------|-------|
|            |                | 01/09     | 08/09 | 15/09 | 29/09 | 01/09   | 08/09 | 15/09 |
| Little Gem | Little Gem     | 25.0      | 45.3  | 45.0  | 55.7  | 8.3     | 29.3  | 35.0  |
| Little Gem | Lucena         | 14.0      | 44.0  | 44.7  | 50.7  | 2.7     | 30.0  | 42.0  |
| Little Gem | SSC 1868       | 5.7       | 36.3  | 44.0  | 50.7  | 1.3     | 18.0  | 30.7  |
| Cos        | Chicago        | 26.7      | 37.7  | 41.0  | 42.3  | 7.3     | 23.3  | 32.0  |
| Little Gem | ROM 7517       | 13.3      | 35.3  | 38.0  | 34.0  | 1.7     | 20.0  | 28.0  |
| Little Gem | Tamburo        | 15.7      | 38.3  | 36.7  | 50.3  | 2.7     | 24.0  | 34.3  |
| Little Gem | Kikos          | 8.4       | 38.3  | 36.7  | 38.0  | 1.7     | 20.0  | 26.0  |
| Iceberg    | Conquest       | 21.7      | 22.7  | 35.7  | 43.3  | 5.3     | 8.0   | 22.0  |
| Cos        | Romany Let 066 | 9.0       | 25.0  | 34.0  | 37.7  | 1.3     | 12.0  | 25.0  |
| Cos        | Frisco         | 15.7      | 31.3  | 32.0  | 38.0  | 2.0     | 19.0  | 23.0  |
| Iceberg    | Durango        | 20.7      | 19.0  | 32.0  | 46.7  | 4.0     | 13.3  | 23.0  |
| Little Gem | Maribel        | 4.3       | 15.0  | 30.7  | 44.7  | 0.3     | 6.3   | 19.3  |
| Iceberg    | SSC 1626       | 11.7      | 20.0  | 30.3  | 46.7  | 2.4     | 7.3   | 16.0  |

**Table 1 (contd.) Harvest scores, very susceptible group, from fungicide treated area**

| Type       | Variety        | Downy mildew<br>0-5,<br>5= severe | Head quality<br>0-5,<br>5 = good | Basal cleanliness<br>0-5,<br>5 = poorest |
|------------|----------------|-----------------------------------|----------------------------------|--|
| Little Gem | Little Gem     | 4.3                               | 3.0                              | 3.7                                      |
| Little Gem | Lucena         | 4.3                               | 2.3                              | 3.7                                      |
| Little Gem | SSC 1868       | 4.3                               | 3.0                              | 2.7                                      |
| Cos        | Chicago        | 4.3                               | 3.7                              | 2.0                                      |
| Little Gem | ROM 7517       | 4.0                               | 3.0                              | 3.3                                      |
| Little Gem | Tamburo        | 3.7                               | 3.5                              | 3.0                                      |
| Little Gem | Kikos          | 3.0                               | 3.7                              | 2.3                                      |
| Iceberg    | Conquest       | 3.7                               | 2.7                              | 2.7                                      |
| Cos        | Romany Let 066 | 3.7                               | 3.7                              | 3.0                                      |
| Cos        | Frisco         | 4.0                               | 4.0                              | 1.7                                      |
| Iceberg    | Durango        | 4.0                               | 2.3                              | 2.3                                      |
| Little Gem | Maribel        | 3.0                               | 4.0                              | 2.7                                      |
| Iceberg    | SSC 1626       | 3.0                               | 3.3                              | 2.0                                      |

**Table 2: Downy mildew severity (% leaf area infected) on untreated and treated plots (susceptible group)**

| Type          | Variety    | Untreated |       |       |       | Treated |       |       |
|---------------|------------|-----------|-------|-------|-------|---------|-------|-------|
|               |            | 01/09     | 08/09 | 15/09 | 29/09 | 01/09   | 08/09 | 15/09 |
| Iceberg       | Capriole   | 5.7       | 10.3  | 27.3  | 46.3  | 0.1     | 1.0   | 16.3  |
| Iceberg       | Brenson    | 6.7       | 15.3  | 27.0  | 44.7  | 1.0     | 6.7   | 19.3  |
| Iceberg       | Robinson   | 10.7      | 19.0  | 26.7  | 34.0  | 3.3     | 9.7   | 18.0  |
| Batavia red   | Redfun     | 5.7       | 10.0  | 25.3  | 31.0  | 0.1     | 1.7   | 9.3   |
| Iceberg       | Challenge  | 2.7       | 12.7  | 24.7  | 41.7  | 0.0     | 0.7   | 14.0  |
| Cos           | SSC 1837   | 1.7       | 18.0  | 23.3  | 22.7  | 0.3     | 9.0   | 10.3  |
| Cos           | Daytona    | 10.0      | 15.7  | 20.7  | 26.3  | 1.0     | 6.0   | 11.7  |
| Cos           | SSC 1839   | 7.3       | 15.3  | 19.7  | 22.7  | 0.7     | 5.4   | 8.3   |
| Iceberg       | NIZ 44-107 | 1.0       | 6.0   | 19.0  | 41.0  | 0.0     | 0.7   | 11.7  |
| Red Oak Leaf  | Vulcania   | 5.0       | 2.3   | 19.0  | 22.3  | 0.0     | 0.3   | 6.0   |
| Red Oak Leaf  | Vesuve     | 10.0      | 11.7  | 18.7  | 35.0  | 0.4     | 0.0   | 8.0   |
| Cos           | LS4851     | 5.0       | 13.0  | 18.3  | 26.7  | 0.3     | 4.7   | 10.3  |
| Batavia Green | Funtaste   | 2.4       | 6.3   | 17.3  | 15.0  | 0.0     | 0.0   | 6.3   |
| Iceberg       | Chirvel    | 0.0       | 0.0   | 14.3  | 44.3  | 0.0     | 0.0   | 2.7   |
| Red Oak       | Galiano    | 6.3       | 10.7  | 13.7  | 24.7  | 0.5     | 1.7   | 4.7   |

**Table 2 (contd.) Harvest scores, susceptible group, from fungicide treated area**

| Type | Variety | Downy mildew<br>0-5, | Head quality<br>0-5, | Basal cleanliness<br>0-5, |
|------|---------|----------------------|----------------------|---------------------------|
|------|---------|----------------------|----------------------|---------------------------|

|               |            | 5= severe | 5 = good | 5 = poorest |
|---------------|------------|-----------|----------|-------------|
| Iceberg       | Capriole   | 3.7       | 2.3      | 2.0         |
| Iceberg       | Brenson    | 2.7       | 3.7      | 2.3         |
| Iceberg       | Robinson   | 4.0       | 3.3      | 3.0         |
| Batavia red   | Redfun     | 0.7       | 3.7      | 1.0         |
| Iceberg       | Challenge  | 2.7       | 2.7      | 1.7         |
| Cos           | SSC 1837   | 2.3       | 4.3      | 1.3         |
| Cos           | Daytona    | 3.3       | 4.7      | 2.0         |
| Cos           | SSC 1839   | 2.3       | 4.0      | 1.3         |
| Iceberg       | NIZ 44-107 | 1.7       | 3.7      | 1.3         |
| Red Oak Leaf  | Vulcania   | 0.0       | 3.7      | 1.7         |
| Red Oak Leaf  | Vesuve     | 0.7       | 4.0      | 1.3         |
| Cos           | LS4851     | 2.3       | 4.0      | 1.7         |
| Batavia Green | Funtaste   | 2.0       | 4.7      | 1.7         |
| Iceberg       | Chirvel    | 1.0       | 3.7      | 0.7         |
| Red Oak       | Galiano    | 1.0       | 3.0      | 1.0         |
| Iceberg       | Capriole   | 3.7       | 2.3      | 2.0         |

**Table 3: Downy mildew severity (% leaf area infected) on untreated and treated plots (moderate resistance group)**

| Type            | Variety     | Untreated |       |       |       | Treated |       |       |
|-----------------|-------------|-----------|-------|-------|-------|---------|-------|-------|
|                 |             | 01/09     | 08/09 | 15/09 | 29/09 | 01/09   | 08/09 | 15/09 |
| Cos             | Pinokkio    | 0.5       | 2.0   | 10.7  | 15.3  | 0.0     | 0.7   | 2.3   |
| Batavia         | Noisette    | 5.0       | 1.7   | 10.3  | 9.3   | 0.4     | 0.0   | 2.3   |
| Little Gem      | Coventry    | 1.7       | 3.0   | 8.3   | 19.3  | 0.3     | 1.7   | 1.7   |
| Iceberg         | NIZ 44-501  | 0.0       | 0.3   | 8.3   | 40.3  | 0.0     | 0.0   | 1.0   |
| Batavia         | Follomy     | 0.7       | 0.7   | 6.7   | 12.3  | 0.0     | 0.0   | 1.3   |
| Batavia         | Estony      | 0.7       | 0.0   | 6.3   | 7.3   | 0.0     | 0.0   | 0.7   |
| Little Gem      | Maureen     | 0.3       | 5.0   | 5.7   | 39.7  | 0.3     | 0.3   | 1.3   |
| Red Oak         | SSC 1866    | 1.3       | 0.0   | 4.7   | 10.0  | 0.0     | 0.0   | 1.3   |
| Cos             | LS4853      | 0.0       | 0.2   | 4.3   | 12.3  | 0.0     | 0.0   | 1.7   |
| Iceberg         | Stylist     | 1.3       | 0.7   | 4.0   | 6.7   | 0.0     | 0.0   | 0.7   |
| Oak Leaf red    | Gourmandine | 0.0       | 0.0   | 4.0   | 3.3   | 0.0     | 0.0   | 0.7   |
| Iceberg         | NIZ 44-502  | 0.4       | 0.3   | 3.7   | 27.0  | 0.0     | 0.0   | 1.0   |
| Leaf curly leaf | Cancan      | 0.0       | 0.0   | 2.7   | 9.0   | 0.0     | 0.0   | 0.0   |
| Cos             | E16.3323    | 1.0       | 0.0   | 1.7   | 0.0   | 0.0     | 0.0   | 0.0   |
| Iceberg         | E14.0246    | 0.0       | 0.0   | 1.7   | 0.7   | 0.0     | 0.0   | 0.0   |
| Batavia Green   | Comice      | 0.3       | 0.0   | 1.3   | 0.7   | 0.0     | 0.0   | 0.3   |
| Little Gem      | Mickey      | 0.0       | 0.0   | 1.0   | 0.0   | 0.0     | 0.0   | 0.0   |

**Table 3 (contd.) Harvest scores, moderate resistance group, from fungicide treated area**

| Type | Variety | Downy mildew<br>0-5, | Head quality<br>0-5, | Basal cleanliness<br>0-5, |
|------|---------|----------------------|----------------------|---------------------------|
|------|---------|----------------------|----------------------|---------------------------|

|                 |             | 5= severe | 5 = good | 5 = poorest |
|-----------------|-------------|-----------|----------|-------------|
| Cos             | Pinokkio    | 1.7       | 4.3      | 1.7         |
| Batavia         | Noisette    | 1.0       | 4.7      | 1.7         |
| Little Gem      | Coventry    | 1.3       | 3.5      | 1.7         |
| Iceberg         | NIZ 44-501  | 0.7       | 4.0      | 1.0         |
| Batavia         | Follomy     | 1.3       | 4.0      | 2.0         |
| Batavia         | Estony      | 1.0       | 3.7      | 2.3         |
| Little Gem      | Maureen     | 1.3       | 4.7      | 1.7         |
| Red Oak         | SSC 1866    | 0.0       | 4.7      | 0.3         |
| Cos             | LS4853      | 1.0       | 4.3      | 0.7         |
| Iceberg         | Stylist     | 1.3       | 3.0      | 1.0         |
| Oak Leaf red    | Gourmandine | 0.3       | 4.3      | 2.7         |
| Iceberg         | NIZ 44-502  | 1.0       | 4.0      | 1.3         |
| Leaf curly leaf | Cancan      | 0.0       | 4.7      | 2.0         |
| Cos             | E16.3323    | 0.0       | 4.0      | 1.0         |
| Iceberg         | E14.0246    | 0.3       | 4.0      | 1.0         |
| Batavia Green   | Comice      | 0.3       | 4.0      | 2.3         |
| Little Gem      | Mickey      | 1.0       | 4.0      | 0.7         |

**Table 4: Downy mildew severity (% leaf area infected) on untreated and treated plots (resistant group)**

| Type    | Variety | Untreated |       |       |       | Treated |       |       |
|---------|---------|-----------|-------|-------|-------|---------|-------|-------|
|         |         | 01/09     | 08/09 | 15/09 | 29/09 | 01/09   | 08/09 | 15/09 |
| Iceberg | Tiger   | 0.4       | 0.0   | 0.7   | 0.0   | 0.0     | 0.0   | 0.3   |

|                  |               |     |     |     |      |     |     |     |
|------------------|---------------|-----|-----|-----|------|-----|-----|-----|
| Oak Leaf red     | Paradai       | 0.0 | 0.0 | 0.7 | 0.0  | 0.0 | 0.0 | 0.0 |
| Iceberg          | 45-25 RZ      | 0.3 | 0.0 | 0.7 | 0.0  | 0.0 | 0.0 | 0.0 |
| Cos              | E16.1919      | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Cos              | Jiminy        | 0.2 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Iceberg          | Ensemble      | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Iceberg          | Etude         | 0.0 | 0.0 | 0.0 | 0.7  | 0.0 | 0.0 | 0.0 |
| Iceberg          | Edition       | 0.3 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Iceberg          | Design        | 0.2 | 0.7 | 0.0 | 2.0  | 0.0 | 0.0 | 0.0 |
| Iceberg          | E14.7382      | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Little Gem       | Miranda       | 0.0 | 2.0 | 0.0 | 0.0  | 0.0 | 0.3 | 0.0 |
| Oak Leaf Green   | Kireve        | 0.1 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Leaf Lollo verde | Livigna       | 0.7 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Batavia Green    | Exquise       | 0.7 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Lollo Rossa      | Fortress      | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Lollo Rossa      | SSC 1624      | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Iceberg          | Hattrick      | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Iceberg          | Boomerang     | 0.3 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Iceberg          | Flight        | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Lolla Rossa      | Xenon         | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Leaf Green       | Ashbrook 2551 | 1.2 | 0.0 | 0.0 | 6.0  | 0.0 | 0.0 | 0.0 |
| Batavian red     | Rosemoor 2243 | 0.0 | 0.0 | 0.0 | 18.3 | 0.0 | 0.0 | 0.0 |
| Leaf red         | Foxley 2435   | 0.0 | 0.0 | 0.0 | 5.3  | 0.0 | 0.0 | 0.0 |
| Iceberg          | 45-72 RZ      | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Little Gem       | Corberra      | 0.7 | 0.1 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Red Batavia      | Bijou         | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Lollo Rossa      | Carmoli       | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Lollo Rossa      | Nation        | 0.0 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0 | 0.0 |
| Lollo Rossa      | Bastile       | 0.0 | 7.0 | 0.0 | 0.0  | 0.0 | 5.0 | 0.0 |
| Iceberg          | Kuaia         | 2.7 | 1.0 | 0.0 | 1.3  | 0.3 | 0.0 | 0.0 |

**Table 4 (contd.) Harvest scores, resistant group, from fungicide treated area**

| Type | Variety | Downy mildew<br>0-5,<br>5= severe | Head quality<br>0-5,<br>5 = good | Basal cleanliness<br>0-5,<br>5 = poorest |
|------|---------|-----------------------------------|----------------------------------|--|
|------|---------|-----------------------------------|----------------------------------|--|

|                  |               |     |     |     |
|------------------|---------------|-----|-----|-----|
| Iceberg          | Tiger         | 1.3 | 3.7 | 0.7 |
| Oak Leaf red     | Paradai       | 0.3 | 3.7 | 2.7 |
| Iceberg          | 45-25 RZ      | 0.0 | 4.3 | 1.0 |
| Cos              | E16.1919      | 0.3 | 4.3 | 0.7 |
| Cos              | Jiminy        | 0.3 | 4.3 | 2.0 |
| Iceberg          | Ensemble      | 0.5 | 3.5 | 0.5 |
| Iceberg          | Etude         | 0.7 | 3.7 | 1.0 |
| Iceberg          | Edition       | 0.7 | 4.3 | 1.0 |
| Iceberg          | Design        | 0.3 | 4.7 | 1.0 |
| Iceberg          | E14.7382      | 0.0 | 3.7 | 1.0 |
| Little Gem       | Miranda       | 1.0 | 4.0 | 1.0 |
| Oak Leaf Green   | Kireve        | 0.0 | 5.0 | 2.3 |
| Leaf Lollo verde | Livigna       | 0.0 | 5.0 | 1.7 |
| Batavia Green    | Exquise       | 0.0 | 4.3 | 2.3 |
| Lollo Rossa      | Fortress      | 0.0 | 4.0 | 1.0 |
| Lollo Rossa      | SSC 1624      | 0.0 | 4.0 | 0.3 |
| Iceberg          | Hatrick       | 0.7 | 4.3 | 0.0 |
| Iceberg          | Boomerang     | 0.3 | 4.0 | 1.3 |
| Iceberg          | Flight        | 0.3 | 3.3 | 0.7 |
| Lolla Rossa      | Xenon         | 0.0 | 4.0 | 1.3 |
| Leaf Green       | Ashbrook 2551 | 0.3 | 5.0 | 1.3 |
| Batavian red     | Rosemoor 2243 | 0.0 | 4.3 | 0.7 |
| Leaf red         | Foxley 2435   | 0.0 | 4.7 | 0.3 |
| Iceberg          | 45-72 RZ      | 0.3 | 4.7 | 0.7 |
| Little Gem       | Corberra      | 0.3 | 3.5 | 1.0 |
| Red Batavia      | Bijou         | 0.0 | 3.7 | 0.3 |
| Lollo Rossa      | Carmoli       | 0.0 | 3.5 | 1.0 |
| Lollo Rossa      | Nation        | 0.0 | 4.7 | 1.3 |
| Lollo Rossa      | Bastile       | 0.0 | 4.3 | 1.0 |
| Iceberg          | Kuaia         | 0.7 | 3.7 | 0.7 |

There was considerable variation in the severity of downy mildew developing on varieties without any claimed resistance to BI 25. For instance, Follomy and Noisette were classified as moderately resistant, and in treated plots, disease levels were very low. Follomy has claimed resistance to BI 1-24, and Noisette has resistance to BI 1-17, 21 and 23. The severity of disease on these, and some other varieties without BI 25 resistance was as low as that observed on some material which had claimed resistance to the race. Of those with claimed resistance to BI 25, few developed a high level of disease, though low levels were observed on several e.g. Gourmandine and Maureen. The latter variety developed significant levels in the final score. It is not known whether this represents the local and naturally occurring presence of a BI 25 breaking race, or whether there may have been an unusual effect of late season conditions which caused the material to break down. Nevertheless, in the treated part of the plots, levels remained very low, and head quality was high. Unusually, a few varieties with BI 1-25 resistance claims were very susceptible, e.g. Maribel.

## Conclusions

This work has demonstrated that significant levels of partial resistance are present in varieties without major genes for resistance to BI 25. When used with a fungicide programme, plants show very little disease development and retain good quality at



harvest. Identification and use of partial resistance in disease management can extend the life of varieties even when major resistances are not effective. Under low disease pressure, fungicide inputs might also be reduced. However, other varieties without BI 25 resistance were very susceptible to the race breaking that resistance, and the fungicide programme used here failed to control disease adequately. Such varieties are at high risk of downy mildew infection, and would require careful monitoring and intensive spray programmes.

### Technology transfer

The principles and outcomes of this project were outlined in the proceedings of the British Leafy Salads Association Conference, November 2006, and an HDC News Article, May 2007. A Fact Sheet to cover varieties of major interest is proposed.

## APPENDIX I

### Plot data, disease severity scores

| Score date | UT<br>01-<br>Sep | T<br>01-<br>Sep | UT<br>08-<br>Sep | T<br>08-<br>Sep | UT<br>15-<br>Sep | T<br>15-<br>Sep | UT<br>29-<br>Sep |
|------------|------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| 1 Follomy  | 0.1              | 0               | 1                | 0               | 0                | 0               | 12               |
|            | 0                | 0               | 1                | 0               | 7                | 2               | 5                |
|            | 2                | 0               | 0                | 0               | 13               | 2               | 20               |

|        |                   |      |      |      |      |       |      |       |
|--------|-------------------|------|------|------|------|-------|------|-------|
| Mean = |                   | 0.7  | 0    | 0.67 | 0    | 6.67  | 1.33 | 12.33 |
| 2      | Estony            | 0.1  | 0    | 0    | 0    | 11    | 2    | 10    |
|        |                   | 2    | 0    | 0    | 0    | 5     | 0    | 2     |
|        |                   | 0    | 0    | 0    | 0    | 3     | 0    | 10    |
| Mean = |                   | 0.7  | 0    | 0    | 0    | 6.33  | 0.67 | 7.33  |
| 3      | Noisette          | 5    | 0.1  | 5    | 0.1  | 8     | 3    | 6     |
|        |                   | 7    | 1    | 0    | 0    | 15    | 2    | 12    |
|        |                   | 3    | 0    | 0    | 0    | 8     | 2    | 10    |
| Mean = |                   | 5    | 0.37 | 1.67 | 0.03 | 10.33 | 2.33 | 9.33  |
| 4      | E16.8179 (Mickey) | 0    | 0    | 0    | 0    | 3     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
| Mean = |                   | 0    | 0    | 0    | 0    | 1     | 0    | 0     |
| 5      | E16.3323          | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 3    | 0    | 0    | 0    | 5     | 0    | 0     |
| Mean = |                   | 1    | 0    | 0    | 0    | 1.67  | 0    | 0     |
| 6      | E16.1919          | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
| Mean = |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
| 7      | Maureen           | 0    | 1    | 3    | 0    | 0     | 0    | 45    |
|        |                   | 0    | 0    | 0    | 0    | 4     | 1    | 32    |
|        |                   | 1    | 0    | 12   | 1    | 13    | 3    | 42    |
| Mean = |                   | 0.33 | 0.33 | 5    | 0.33 | 5.67  | 1.33 | 39.67 |
| 8      | Pinokkio          | 1    | 0    | 5    | 2    | 8     | 2    | 20    |
|        |                   | 0.5  | 0    | 1    | 0    | 16    | 2    | 20    |
|        |                   | 0    | 0    | 0    | 0    | 8     | 3    | 6     |
| Mean = |                   | 0.5  | 0    | 2    | 0.67 | 10.67 | 2.33 | 15.33 |
| 9      | Coventry          | 5    | 1    | 1    | 0.1  | 5     | 2    | 20    |
|        |                   | 0.1  | 0    | 8    | 5    | 10    | 3    | 16    |
|        |                   | 0    | 0    | 0    | 0    | 10    | 0    | 22    |
| Mean = |                   | 1.7  | 0.33 | 3    | 1.7  | 8.33  | 1.67 | 19.33 |
| 10     | Jiminy            | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0.5  | 0    | 0    | 0    | 0     | 0    | 0     |
| Mean = |                   | 0.17 | 0    | 0    | 0    | 0     | 0    | 0     |
| 17     | Ensemble          | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
| Mean = |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
| 18     | Etude             | 0    | 0    | 0    | 0    | 0     | 0    | 2     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
| Mean = |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0.67  |
| 19     | Stylist           | 3    | 0.1  | 2    | 0.1  | 4     | 1    | 12    |
|        |                   | 1    | 0    | 0    | 0    | 8     | 1    | 8     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
| Mean = |                   | 1.33 | 0.03 | 0.67 | 0.03 | 4     | 0.67 | 6.67  |
| 20     | Tiger             | 1    | 0    | 0.1  | 0    | 0     | 0    | 0     |
|        |                   | 0.1  | 0    | 0    | 0    | 2     | 1    | 0     |
|        |                   | 0    | 0    | 0    | 0    | 0     | 0    | 0     |
| Mean = |                   | 0.37 | 0    | 0.03 | 0    | 0.67  | 0.33 | 0     |
| 21     | Edition           | 0    | 0    | 0    | 0    | 0     | 0    | 0     |

|        |                           |       |      |       |      |       |       |       |
|--------|---------------------------|-------|------|-------|------|-------|-------|-------|
|        |                           | 1     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0.33  | 0    | 0     | 0    | 0     | 0     | 0     |
|        | 22 Design                 | 0.5   | 0    | 2     | 0.1  | 0     | 0     | 6     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0.17  | 0    | 0.67  | 0.03 | 0     | 0     | 2     |
|        | 23 E14.7382               | 0.1   | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0.03  | 0    | 0     | 0    | 0     | 0     | 0     |
|        | 24 E14.0246               | 0     | 0    | 0     | 0    | 3     | 0     | 2     |
|        |                           | 0     | 0    | 0     | 0    | 2     | 0     | 0     |
|        |                           | 0     | 0    | 0.1   | 0    | 0     | 0     | 0     |
| Mean = |                           | 0     | 0    | 0.03  | 0    | 1.67  | 0     | 0.67  |
|        | 25 41-19 RZ (Miranda)     | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 6     | 1    | 0     | 0     | 0     |
|        |                           | 0.1   | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0.03  | 0    | 2     | 0.33 | 0     | 0     | 0     |
|        | 26 83-86 RZ (Kireve)      | 0.1   | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0.1   | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0.07  | 0    | 0     | 0    | 0     | 0     | 0     |
|        | 27 83-43 RZ (Paradai)     | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 2     | 0     | 0     |
| Mean = |                           | 0     | 0    | 0     | 0    | 0.67  | 0     | 0     |
|        | 28 85-00 RZ (Livigna)     | 2     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0.67  | 0    | 0     | 0    | 0     | 0     | 0     |
|        | 30 BVP.4883 (Comice)      | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 4     | 1     | 2     |
|        |                           | 1     | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0.33  | 0    | 0     | 0    | 1.33  | 0.33  | 0.67  |
|        | 31 Exquise                | 1     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 1     | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0.67  | 0    | 0     | 0    | 0     | 0     | 0     |
|        | 33 DIP.5490 (Gourmandine) | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                           | 0     | 0    | 0     | 0    | 12    | 2     | 10    |
|        |                           | 0     | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                           | 0     | 0    | 0     | 0    | 4     | 0.67  | 3.33  |
|        | 35 Brenson                | 5     | 1    | 15    | 7    | 18    | 12    | 40    |
|        |                           | 0     | 0    | 5     | 0    | 16    | 6     | 42    |
|        |                           | 15    | 2    | 26    | 13   | 47    | 40    | 52    |
| Mean = |                           | 6.67  | 1    | 15.33 | 6.67 | 27    | 19.33 | 44.67 |
|        | 37 Tamburo                | 7     | 1    | 30    | 15   | 15    | 28    | 50    |
|        |                           | 20    | 2    | 38    | 22   | 48    | 34    | 54    |
|        |                           | 20    | 5    | 47    | 35   | 47    | 41    | 47    |
| Mean = |                           | 15.67 | 2.67 | 38.33 | 24   | 36.67 | 34.33 | 50.33 |
|        | 38 Robinson               | 2     | 5    | 17    | 7    | 27    | 18    | 34    |

|        |               |       |      |       |      |       |       |       |
|--------|---------------|-------|------|-------|------|-------|-------|-------|
|        |               | 5     | 0    | 10    | 0    | 16    | 4     | 18    |
|        |               | 25    | 5    | 30    | 22   | 37    | 32    | 50    |
| Mean = |               | 10.67 | 3.33 | 19    | 9.67 | 26.67 | 18    | 34    |
|        | 39 Cancan     | 0     | 0    | 0     | 0    | 0     | 0     | 2     |
|        |               | 0     | 0    | 0     | 0    | 0     | 0     | 10    |
|        |               | 0     | 0    | 0     | 0    | 8     | 0     | 15    |
| Mean = |               | 0     | 0    | 0     | 0    | 2.67  | 0     | 9     |
|        | 40 NIZ 44-501 | 0.1   | 0    | 1     | 0    | 0     | 0     | 44    |
|        |               | 0     | 0    | 0     | 0    | 22    | 2     | 50    |
|        |               | 0     | 0    | 0     | 0    | 3     | 1     | 27    |
| Mean = |               | 0.03  | 0    | 0.33  | 0    | 8.33  | 1     | 40.33 |
|        | 43 ROM 7517   | 15    | 1    | 32    | 12   | 28    | 18    | 15    |
|        |               | 10    | 1    | 38    | 18   | 33    | 18    | 27    |
|        |               | 15    | 3    | 36    | 30   | 53    | 48    | 60    |
| Mean = |               | 13.33 | 1.67 | 35.33 | 20   | 38    | 28    | 34    |
|        | 44 NIZ 44-502 | 0.1   | 0    | 1     | 0    | 8     | 2     | 33    |
|        |               | 1     | 0    | 0     | 0    | 0     | 0     | 18    |
|        |               | 0     | 0    | 0     | 0    | 3     | 1     | 30    |
| Mean = |               | 0.37  | 0    | 0.33  | 0    | 3.67  | 1     | 27    |
|        | 45 NIZ 44-107 | 0     | 0    | 8     | 1    | 14    | 8     | 48    |
|        |               | 0     | 0    | 10    | 1    | 26    | 12    | 48    |
|        |               | 3     | 0    | 0     | 0    | 17    | 15    | 27    |
| Mean = |               | 1     | 0    | 6     | 0.67 | 19    | 11.67 | 41    |
|        | 61 Galiano    | 7     | 1    | 15    | 5    | 12    | 4     | 32    |
|        |               | 5     | 0    | 7     | 0    | 8     | 2     | 12    |
|        |               | 7     | 0.5  | 10    | 0    | 21    | 8     | 30    |
| Mean = |               | 6.33  | 0.5  | 10.67 | 1.67 | 13.67 | 4.67  | 24.67 |
|        | 67 Redfun     | 5     | 0.1  | 10    | 5    | 18    | 8     | 27    |
|        |               | 5     | 0.1  | 10    | 0    | 26    | 2     | 33    |
|        |               | 7     | 0    | 10    | 0    | 32    | 18    | 33    |
| Mean = |               | 5.67  | 0.07 | 10    | 1.67 | 25.33 | 9.33  | 31    |
|        | 68 Kikos      | 10    | 2    | 45    | 15   | 38    | 26    | 47    |
|        |               | 0.1   | 0    | 27    | 12   | 32    | 20    | 20    |
|        |               | 15    | 3    | 43    | 33   | 40    | 32    | 47    |
| Mean = |               | 8.37  | 1.67 | 38.33 | 20   | 36.67 | 26    | 38    |
|        | 70 LS4853     | 0     | 0    | 0.5   | 0    | 8     | 2     | 12    |
|        |               | 0     | 0    | 0     | 0    | 2     | 2     | 13    |
|        |               | 0     | 0    | 0     | 0    | 3     | 1     | 12    |
| Mean = |               | 0     | 0    | 0.17  | 0    | 4.33  | 1.67  | 12.33 |
|        | 71 Funtaste   | 0.1   | 0    | 7     | 0    | 22    | 5     | 17    |
|        |               | 2     | 0    | 7     | 0    | 16    | 6     | 18    |
|        |               | 5     | 0    | 5     | 0    | 14    | 8     | 10    |
| Mean = |               | 2.37  | 0    | 6.33  | 0    | 17.33 | 6.33  | 15    |
|        | 72 LS4851     | 10    | 1    | 17    | 8    | 24    | 16    | 42    |
|        |               | 0     | 0    | 0     | 0    | 5     | 2     | 14    |
|        |               | 5     | 0    | 22    | 6    | 26    | 13    | 24    |
| Mean = |               | 5     | 0.33 | 13    | 4.67 | 18.33 | 10.33 | 26.67 |
|        | 73 Conquest   | 20    | 7    | 27    | 5    | 32    | 12    | 50    |
|        |               | 10    | 2    | 17    | 9    | 37    | 32    | 50    |
|        |               | 35    | 7    | 24    | 10   | 38    | 22    | 30    |
| Mean = |               | 21.67 | 5.33 | 22.67 | 8    | 35.67 | 22    | 43.33 |
|        | 74 SSC 1626   | 15    | 2    | 20    | 9    | 22    | 14    | 50    |

|        |               |       |      |       |       |       |       |       |
|--------|---------------|-------|------|-------|-------|-------|-------|-------|
|        |               | 5     | 0.1  | 12    | 1     | 23    | 15    | 40    |
|        |               | 15    | 5    | 28    | 12    | 46    | 19    | 50    |
| Mean = |               | 11.67 | 2.37 | 20    | 7.33  | 30.33 | 16    | 46.67 |
|        | 76 Frisco     | 25    | 3    | 40    | 20    | 34    | 22    | 36    |
|        |               | 10    | 2    | 22    | 16    | 30    | 22    | 38    |
|        |               | 12    | 1    | 32    | 21    | 32    | 25    | 40    |
| Mean = |               | 15.67 | 2    | 31.33 | 19    | 32    | 23    | 38    |
|        | 77 Daytona    | 20    | 2    | 30    | 12    | 22    | 10    | 28    |
|        |               | 5     | 0    | 0     | 0     | 14    | 6     | 24    |
|        |               | 5     | 1    | 17    | 6     | 26    | 19    | 27    |
| Mean = |               | 10    | 1    | 15.67 | 6     | 20.67 | 11.67 | 26.33 |
|        | 78 SSC 1837   | 0     | 0    | 14    | 7     | 14    | 7     | 22    |
|        |               | 5     | 1    | 14    | 2     | 28    | 6     | 18    |
|        |               | 0     | 0    | 26    | 18    | 28    | 18    | 28    |
| Mean = |               | 1.67  | 0.33 | 18    | 9     | 23.33 | 10.33 | 22.67 |
|        | 79 SSC 1839   | 10    | 1    | 7     | 0.1   | 16    | 6     | 25    |
|        |               | 7     | 1    | 16    | 4     | 17    | 7     | 18    |
|        |               | 5     | 0    | 23    | 12    | 26    | 12    | 25    |
| Mean = |               | 7.33  | 0.67 | 15.33 | 5.37  | 19.67 | 8.33  | 22.67 |
|        | 80 Chicago    | 30    | 10   | 38    | 20    | 38    | 26    | 36    |
|        |               | 15    | 5    | 28    | 18    | 37    | 32    | 44    |
|        |               | 35    | 7    | 47    | 32    | 48    | 38    | 47    |
| Mean = |               | 26.67 | 7.33 | 37.67 | 23.33 | 41    | 32    | 42.33 |
|        | 81 Fortress   | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
| Mean = |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        | 82 SSC 1624   | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
| Mean = |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        | 83 Maribel    | 3     | 0    | 18    | 5     | 27    | 5     | 47    |
|        |               | 7     | 1    | 27    | 14    | 38    | 32    | 45    |
|        |               | 3     | 0    | 0     | 0     | 27    | 21    | 42    |
| Mean = |               | 4.33  | 0.33 | 15    | 6.33  | 30.67 | 19.33 | 44.67 |
|        | 84 Little Gem | 25    | 10   | 45    | 18    | 38    | 30    | 50    |
|        |               | 25    | 5    | 44    | 28    | 47    | 33    | 52    |
|        |               | 25    | 10   | 47    | 42    | 50    | 42    | 65    |
| Mean = |               | 25    | 8.33 | 45.33 | 29.33 | 45    | 35    | 55.67 |
|        | 85 SSC 1866   | 2     | 0    | 0.1   | 0     | 0     | 0     | 0     |
|        |               | 0     | 0    | 0     | 0     | 0     | 0     | 12    |
|        |               | 2     | 0    | 0     | 0     | 14    | 4     | 18    |
| Mean = |               | 1.33  | 0    | 0.03  | 0     | 4.67  | 1.33  | 10    |
|        | 86 SSC 1868   | 10    | 2    | 40    | 20    | 50    | 42    | 57    |
|        |               | 0     | 0    | 27    | 14    | 38    | 20    | 50    |
|        |               | 7     | 2    | 42    | 20    | 44    | 30    | 45    |
| Mean = |               | 5.67  | 1.33 | 36.33 | 18    | 44    | 30.67 | 50.67 |
|        | 88 Hatrick    | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
| Mean = |               | 0     | 0    | 0     | 0     | 0     | 0     | 0     |
|        | 89 Boomerang  | 1     | 0    | 0     | 0     | 0     | 0     | 0     |

|        |                    |      |      |       |      |       |       |       |
|--------|--------------------|------|------|-------|------|-------|-------|-------|
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                    | 0.33 | 0    | 0     | 0    | 0     | 0     | 0     |
|        | 90 Flight          | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        | 91 Xenon           | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        | 92 Vesuve          | 15   | 0.1  | 15    | 0    | 12    | 6     | 28    |
|        |                    | 5    | 0.1  | 10    | 0    | 22    | 10    | 47    |
|        |                    | 10   | 1    | 10    | 0    | 22    | 8     | 30    |
| Mean = |                    | 10   | 0.4  | 11.67 | 0    | 18.67 | 8     | 35    |
|        | 93 Vulcania        | 0    | 0    | 7     | 1    | 14    | 6     | 17    |
|        |                    | 5    | 0    | 0     | 0    | 28    | 12    | 24    |
|        |                    | 10   | 0    | 0     | 0    | 15    | 0     | 26    |
| Mean = |                    | 5    | 0    | 2.33  | 0.33 | 19    | 6     | 22.33 |
|        | 102 Ashbrook 2551  | 0.5  | 0    | 0     | 0    | 0     | 0     | 5     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 5     |
|        |                    | 3    | 0    | 0     | 0    | 0     | 0     | 8     |
| Mean = |                    | 1.17 | 0    | 0     | 0    | 0     | 0     | 6     |
|        | 104 Rosemoor 2243  | 0    | 0    | 0     | 0    | 0     | 0     | 8     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 15    |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 32    |
| Mean = |                    | 0    | 0    | 0     | 0    | 0     | 0     | 18.33 |
|        | 105 Foxley 2435    | 0    | 0    | 0     | 0    | 0     | 0     | 8     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 8     |
| Mean = |                    | 0    | 0    | 0     | 0    | 0     | 0     | 5.33  |
|        | 109 Romany Let 066 | 12   | 3    | 35    | 20   | 38    | 33    | 38    |
|        |                    | 5    | 0    | 30    | 16   | 34    | 20    | 35    |
|        |                    | 10   | 1    | 10    | 0    | 30    | 22    | 40    |
| Mean = |                    | 9    | 1.33 | 25    | 12   | 34    | 25    | 37.67 |
|        | 112 45-25 RZ       | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 2     | 0     | 0     |
|        |                    | 1    | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                    | 0.33 | 0    | 0     | 0    | 0.67  | 0     | 0     |
|        | 113 45-72 RZ       | 0.1  | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    | 0    | 0    | 0     | 0    | 0     | 0     | 0     |
| Mean = |                    | 0.03 | 0    | 0     | 0    | 0     | 0     | 0     |
|        |                    |      |      |       |      |       |       |       |
|        | 114 Challenge      | 3    | 0.1  | 10    | 0.1  | 22    | 8     | 40    |
|        |                    | 2    | 0    | 10    | 0    | 22    | 18    | 37    |
|        |                    | 3    | 0    | 18    | 2    | 30    | 16    | 48    |
| Mean = |                    | 2.67 | 0.03 | 12.67 | 0.7  | 24.67 | 14    | 41.67 |
|        | 115 Capriole       | 5    | 0.1  | 8     | 1    | 12    | 3     | 45    |
|        |                    | 5    | 0.1  | 15    | 1    | 30    | 14    | 48    |
|        |                    | 7    | 0    | 8     | 1    | 40    | 32    | 46    |
| Mean = |                    | 5.67 | 0.07 | 10.33 | 1    | 27.33 | 16.33 | 46.33 |
|        | 116 Durango        | 12   | 5    | 15    | 7    | 28    | 22    | 50    |

|        |     |          |       |      |      |       |       |      |       |
|--------|-----|----------|-------|------|------|-------|-------|------|-------|
|        |     |          | 20    | 2    | 18   | 15    | 23    | 14   | 40    |
|        |     |          | 30    | 5    | 24   | 18    | 45    | 33   | 50    |
| Mean = |     |          | 20.67 | 4    | 19   | 13.33 | 32    | 23   | 46.67 |
|        | 117 | Lucena   | 15    | 2    | 40   | 20    | 28    | 45   | 55    |
|        |     |          | 7     | 1    | 45   | 38    | 52    | 43   | 50    |
| Mean = |     |          | 20    | 5    | 47   | 32    | 54    | 38   | 47    |
|        | 118 | Corberra | 14    | 2.67 | 44   | 30    | 44.67 | 42   | 50.67 |
|        |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
|        |     |          | 1     | 0    | 0.1  | 0     | 0     | 0    | 0     |
| Mean = |     |          | 0.67  | 0    | 0.07 | 0     | 0     | 0    | 0     |
|        | 119 | Bijou    | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
|        |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
| Mean = |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
|        | 120 | Carmoli  | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
|        |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
| Mean = |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
|        | 121 | Nation   | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
|        |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
| Mean = |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
|        | 122 | Bastile  | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
|        |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 0     |
| Mean = |     |          | 0     | 0    | 21   | 15    | 0     | 0    | 0     |
|        | 123 | Chirvel  | 0     | 0    | 7    | 5     | 0     | 0    | 0     |
|        |     |          | 0     | 0    | 0.1  | 0     | 26    | 5    | 44    |
|        |     |          | 0     | 0    | 0    | 0     | 15    | 2    | 47    |
| Mean = |     |          | 0     | 0    | 0    | 0     | 2     | 1    | 42    |
|        | 124 | Kuaia    | 0     | 0    | 0.03 | 0     | 14.33 | 2.67 | 44.33 |
|        |     |          | 5     | 1    | 3    | 0.1   | 0     | 0    | 0     |
|        |     |          | 3     | 0    | 0    | 0     | 0     | 0    | 0     |
| Mean = |     |          | 0     | 0    | 0    | 0     | 0     | 0    | 4     |
|        |     |          | 2.67  | 0.33 | 1    | 0.03  | 0     | 0    | 1.33  |

### Harvest quality scores

| Plot | code | Variety | Type    | Harvest quality scores    |                                 |                                       |
|------|------|---------|---------|---------------------------|---------------------------------|---------------------------------------|
|      |      |         |         | D Mildew 0-5<br>5= severe | Head quality<br>0-5<br>5 = good | Basal<br>cleanliness 0-5<br>5 = worst |
| 43   | 1    | Follomy | Batavia | 1.0                       | 4.0                             | 1.0                                   |
| 108  | 1    | Follomy | Batavia | 1.0                       | 4.0                             | 2.0                                   |
| 187  | 1    | Follomy | Batavia | 2.0                       | 4.0                             | 3.0                                   |
|      |      |         |         | 1.3                       | 4.0                             | 2.0                                   |

|     |    |                   |            |     |     |     |
|-----|----|-------------------|------------|-----|-----|-----|
| 69  | 2  | Estony            | Batavia    | 0.0 | 4.0 | 2.0 |
| 107 | 2  | Estony            | Batavia    | 1.0 | 4.0 | 2.0 |
| 181 | 2  | Estony            | Batavia    | 2.0 | 3.0 | 3.0 |
|     |    |                   |            | 1.0 | 3.7 | 2.3 |
| 57  | 3  | Noisette          | Batavia    | 1.0 | 5.0 | 2.0 |
| 129 | 3  | Noisette          | Batavia    | 1.0 | 4.0 | 1.0 |
| 173 | 3  | Noisette          | Batavia    | 1.0 | 5.0 | 2.0 |
|     |    |                   |            | 1.0 | 4.7 | 1.7 |
| 2   | 4  | E16.8179 (Mickey) | Little Gem | 1.0 | 4.0 | 0.0 |
| 134 | 4  | E16.8179 (Mickey) | Little Gem | 1.0 | 4.0 | 1.0 |
| 164 | 4  | E16.8179 (Mickey) | Little Gem | 1.0 | 4.0 | 1.0 |
|     |    |                   |            | 1.0 | 4.0 | 0.7 |
| 66  | 5  | E16.3323          | Cos        | 0.0 | 4.0 | 1.0 |
| 124 | 5  | E16.3323          | Cos        | 0.0 | 3.0 | 0.0 |
| 189 | 5  | E16.3323          | Cos        | 0.0 | 5.0 | 2.0 |
|     |    |                   |            | 0.0 | 4.0 | 1.0 |
| 24  | 6  | E16.1919          | Cos        | 0.0 | 5.0 | 0.0 |
| 149 | 6  | E16.1919          | Cos        | 1.0 | 4.0 | 1.0 |
| 186 | 6  | E16.1919          | Cos        | 0.0 | 4.0 | 1.0 |
|     |    |                   |            | 0.3 | 4.3 | 0.7 |
| 23  | 7  | Maureen           | Little Gem | 1.0 | 5.0 | 1.0 |
| 118 | 7  | Maureen           | Little Gem | 1.0 | 4.0 | 2.0 |
| 214 | 7  | Maureen           | Little Gem | 2.0 | 5.0 | 2.0 |
|     |    |                   |            | 1.3 | 4.7 | 1.7 |
| 5   | 8  | Pinokkio          | Cos        | 1.0 | 4.0 | 2.0 |
| 132 | 8  | Pinokkio          | Cos        | 2.0 | 4.0 | 1.0 |
| 182 | 8  | Pinokkio          | Cos        | 2.0 | 5.0 | 2.0 |
|     |    |                   |            | 1.7 | 4.3 | 1.7 |
| 44  | 9  | Coventry          | Little Gem | 2.0 | 5.0 | 2.0 |
| 97  | 9  | Coventry          | Little Gem | 1.0 | 3.0 | 2.0 |
| 176 | 9  | Coventry          | Little Gem | 1.0 | 4.0 | 1.0 |
|     |    |                   |            | 1.3 | 4.0 | 1.7 |
| 68  | 10 | Jiminy            | Cos        | 1.0 | 4.0 | 3.0 |
| 121 | 10 | Jiminy            | Cos        | 0.0 | 4.0 | 1.0 |
| 195 | 10 | Jiminy            | Cos        | 0.0 | 5.0 | 2.0 |
|     |    |                   |            | 0.3 | 4.3 | 2.0 |
| 60  | 17 | Ensemble          | Iceberg    | 0.0 | 4.0 | 0.0 |
| 103 | 17 | Ensemble          | Iceberg    | 1.0 | 3.0 | 1.0 |
| 223 | 17 | Ensemble          | Iceberg    | MP  |     |     |
|     |    |                   |            | 0.5 | 3.5 | 0.5 |
| 12  | 18 | Etude             | Iceberg    | 1.0 | 4.0 | 1.0 |
| 81  | 18 | Etude             | Iceberg    | 1.0 | 3.0 | 1.0 |
| 222 | 18 | Etude             | Iceberg    | 0.0 | 4.0 | 1.0 |
|     |    |                   |            | 0.7 | 3.7 | 1.0 |
| 9   | 19 | Stylist           | Iceberg    | 2.0 | 3.0 | 1.0 |
| 85  | 19 | Stylist           | Iceberg    | 1.0 | 3.0 | 1.0 |
| 179 | 19 | Stylist           | Iceberg    | 1.0 | 3.0 | 1.0 |
|     |    |                   |            | 1.3 | 3.0 | 1.0 |
| 40  | 20 | Tiger             | Iceberg    | 1.0 | 3.0 | 0.0 |
| 102 | 20 | Tiger             | Iceberg    | 2.0 | 4.0 | 1.0 |
| 215 | 20 | Tiger             | Iceberg    | 1.0 | 4.0 | 1.0 |
|     |    |                   |            | 1.3 | 3.7 | 0.7 |
| 62  | 21 | Edition           | Iceberg    | 1.0 | 5.0 | 1.0 |



|     |    |                           |                     |     |     |     |
|-----|----|---------------------------|---------------------|-----|-----|-----|
| 92  | 21 | Edition                   | Iceberg             | 1.0 | 4.0 | 1.0 |
| 178 | 21 | Edition                   | Iceberg             | 0.0 | 4.0 | 1.0 |
|     |    |                           |                     | 0.7 | 4.3 | 1.0 |
| 33  | 22 | Design                    | Iceberg             | 1.0 | 5.0 | 1.0 |
| 150 | 22 | Design                    | Iceberg             | 0.0 | 4.0 | 1.0 |
| 174 | 22 | Design                    | Iceberg             | 0.0 | 5.0 | 1.0 |
|     |    |                           |                     | 0.3 | 4.7 | 1.0 |
| 61  | 23 | E14.7382                  | Iceberg             | 0.0 | 4.0 | 0.0 |
| 128 | 23 | E14.7382                  | Iceberg             | 0.0 | 3.0 | 1.0 |
| 185 | 23 | E14.7382                  | Iceberg             | 0.0 | 4.0 | 2.0 |
|     |    |                           |                     | 0.0 | 3.7 | 1.0 |
| 55  | 24 | E14.0246                  | Iceberg             | 0.0 | 4.0 | 1.0 |
| 146 | 24 | E14.0246                  | Iceberg             | 0.0 | 4.0 | 1.0 |
| 191 | 24 | E14.0246                  | Iceberg             | 1.0 | 4.0 | 1.0 |
|     |    |                           |                     | 0.3 | 4.0 | 1.0 |
| 21  | 25 | 41-19 RZ (Miranda)        | Little Gem          | 0.0 | 4.0 | 0.0 |
| 136 | 25 | 41-19 RZ (Miranda)        | Little Gem          | 1.0 | 4.0 | 2.0 |
| 160 | 25 | 41-19 RZ (Miranda)        | Little Gem          | 2.0 | 4.0 | 1.0 |
|     |    |                           |                     | 1.0 | 4.0 | 1.0 |
| 48  | 26 | 83-86 RZ (Kireve)         | Oak Leaf<br>green   | 0.0 | 5.0 | 3.0 |
| 105 | 26 | 83-86 RZ (Kireve)         | Oak Leaf<br>green   | 0.0 | 5.0 | 2.0 |
| 197 | 26 | 83-86 RZ (Kireve)         | Oak Leaf<br>green   | 0.0 | 5.0 | 2.0 |
|     |    |                           |                     | 0.0 | 5.0 | 2.3 |
| 31  | 27 | 83-43 RZ (Paradai)        | Oak Leaf red        | 1.0 | 3.0 | 3.0 |
| 98  | 27 | 83-43 RZ (Paradai)        | Oak Leaf red        | 0.0 | 4.0 | 3.0 |
| 175 | 27 | 83-43 RZ (Paradai)        | Oak Leaf red        | 0.0 | 4.0 | 2.0 |
|     |    |                           |                     | 0.3 | 3.7 | 2.7 |
| 51  | 28 | 85-00 RZ (Livigna)        | Leaf Lollo<br>verde | 0.0 | 5.0 | 2.0 |
| 109 | 28 | 85-00 RZ (Livigna)        | Leaf Lollo<br>verde | 0.0 | 5.0 | 1.0 |
| 211 | 28 | 85-00 RZ (Livigna)        | Leaf Lollo<br>verde | 0.0 | 5.0 | 2.0 |
|     |    |                           |                     | 0.0 | 5.0 | 1.7 |
| 47  | 30 | BVP.4883 (Comice)         | Batavia<br>Green    | 0.0 | 4.0 | 3.0 |
| 106 | 30 | BVP.4883 (Comice)         | Batavia<br>Green    | 0.0 | 4.0 | 2.0 |
| 151 | 30 | BVP.4883 (Comice)         | Batavia<br>Green    | 1.0 | 4.0 | 2.0 |
|     |    |                           |                     | 0.3 | 4.0 | 2.3 |
| 41  | 31 | Exquise                   | Batavia<br>Green    | 0.0 | 4.0 | 1.0 |
| 93  | 31 | Exquise                   | Batavia<br>Green    | 0.0 | 4.0 | 3.0 |
| 168 | 31 | Exquise                   | Batavia<br>Green    | 0.0 | 5.0 | 3.0 |
|     |    |                           |                     | 0.0 | 4.3 | 2.3 |
| 7   | 33 | DIP.5490<br>(Gourmandine) | Oak Leaf red        | 0.0 | 4.0 | 3.0 |
| 119 | 33 | DIP.5490                  | Oak Leaf red        | 1.0 | 5.0 | 3.0 |

|     |    |               |              |     |     |     |
|-----|----|---------------|--------------|-----|-----|-----|
|     |    | (Gourmandine) |              |     |     |     |
|     |    | DIP.5490      |              |     |     |     |
| 225 | 33 | (Gourmandine) | Oak Leaf red | 0.0 | 4.0 | 2.0 |
|     |    |               |              | 0.3 | 4.3 | 2.7 |
| 16  | 35 | Brenson       | Iceberg      | 2.0 | 4.0 | 2.0 |
| 87  | 35 | Brenson       | Iceberg      | 2.0 | 4.0 | 2.0 |
| 184 | 35 | Brenson       | Iceberg      | 4.0 | 3.0 | 3.0 |
|     |    |               |              | 2.7 | 3.7 | 2.3 |
| 15  | 37 | Tamburo       | Little Gem   | 3.0 | 3.0 | 3.0 |
| 142 | 37 | Tamburo       | Little Gem   | 4.0 | 4.0 | 3.0 |
| 205 | 37 | Tamburo       | Little Gem   | 4.0 | 5*  | 3.0 |
|     |    |               |              | 3.7 | 3.5 | 3.0 |
| 67  | 38 | Robinson      | Iceberg      | 4.0 | 3.0 | 3.0 |
| 131 | 38 | Robinson      | Iceberg      | 3.0 | 4.0 | 2.0 |
| 165 | 38 | Robinson      | Iceberg      | 5.0 | 3.0 | 4.0 |
|     |    |               |              | 4.0 | 3.3 | 3.0 |
|     |    |               | Leaf curly   |     |     |     |
| 26  | 39 | Cancan        | leaf         | 0.0 | 4.0 | 2.0 |
|     |    |               | Leaf curly   |     |     |     |
| 94  | 39 | Cancan        | leaf         | 0.0 | 5.0 | 2.0 |
|     |    |               | Leaf curly   |     |     |     |
| 200 | 39 | Cancan        | leaf         | 0.0 | 5.0 | 2.0 |
|     |    |               |              | 0.0 | 4.7 | 2.0 |
| 34  | 40 | NIZ 44-501    | Iceberg      | 0.0 | 4.0 | 1.0 |
| 138 | 40 | NIZ 44-501    | Iceberg      | 1.0 | 4.0 | 1.0 |
| 172 | 40 | NIZ 44-501    | Iceberg      | 1.0 | 4.0 | 1.0 |
|     |    |               |              | 0.7 | 4.0 | 1.0 |
| 65  | 43 | ROM 7517      | Little Gem   | 4.0 | 3.0 | 3.0 |
| 88  | 43 | ROM 7517      | Little Gem   | 3.0 | 3.0 | 3.0 |
| 161 | 43 | ROM 7517      | Little Gem   | 5.0 | 5.0 | 4.0 |
|     |    |               |              | 4.0 | 3.7 | 3.3 |
| 70  | 44 | NIZ 44-502    | Iceberg      | 1.0 | 4.0 | 2.0 |
| 101 | 44 | NIZ 44-502    | Iceberg      | 1.0 | 4.0 | 1.0 |
| 212 | 44 | NIZ 44-502    | Iceberg      | 1.0 | 4.0 | 1.0 |
|     |    |               |              | 1.0 | 4.0 | 1.3 |
| 35  | 45 | NIZ 44-107    | Iceberg      | 1.0 | 4.0 | 1.0 |
| 133 | 45 | NIZ 44-107    | Iceberg      | 3.0 | 3.0 | 1.0 |
| 221 | 45 | NIZ 44-107    | Iceberg      | 1.0 | 4.0 | 2.0 |
|     |    |               |              | 1.7 | 3.7 | 1.3 |
| 28  | 61 | Galiano       | Red Oak      | 1.0 | 2.0 | 1.0 |
| 96  | 61 | Galiano       | Red Oak      | 1.0 | 3.0 | 1.0 |
| 207 | 61 | Galiano       | Red Oak      | 1.0 | 4.0 | 1.0 |
|     |    |               |              | 1.0 | 3.0 | 1.0 |
| 3   | 67 | Redfun        | Batavia red  | 0.0 | 4.0 | 1.0 |
| 130 | 67 | Redfun        | Batavia red  | 1.0 | 3.0 | 1.0 |
| 190 | 67 | Redfun        | Batavia red  | 1.0 | 4.0 | 1.0 |
|     |    |               |              | 0.7 | 3.7 | 1.0 |
|     |    |               |              |     |     |     |
| 32  | 68 | Kikos         | Little Gem   | 3.0 | 4.0 | 1.0 |
| 114 | 68 | Kikos         | Little Gem   | 3.0 | 3.0 | 3.0 |
| 198 | 68 | Kikos         | Little Gem   | 3.0 | 4.0 | 3.0 |
|     |    |               |              | 3.0 | 3.7 | 2.3 |
| 30  | 70 | LS4853        | Cos          | 1.0 | 3.0 | 0.0 |
| 115 | 70 | LS4853        | Cos          | 1.0 | 5.0 | 1.0 |
| 177 | 70 | LS4853        | Cos          | 1.0 | 5.0 | 1.0 |
|     |    |               |              | 1.0 | 4.3 | 0.7 |

|     |    |            |               |     |     |     |
|-----|----|------------|---------------|-----|-----|-----|
| 37  | 71 | Funtaste   | Batavia Green | 1.0 | 5.0 | 1.0 |
| 122 | 71 | Funtaste   | Batavia Green | 2.0 | 5.0 | 2.0 |
| 206 | 71 | Funtaste   | Batavia Green | 3.0 | 4.0 | 2.0 |
|     |    |            |               | 2.0 | 4.7 | 1.7 |
| 4   | 72 | LS4851     | Cos           | 3.0 | 4.0 | 2.0 |
| 86  | 72 | LS4851     | Cos           | 1.0 | 4.0 | 0.0 |
| 213 | 72 | LS4851     | Cos           | 3.0 | 4.0 | 3.0 |
|     |    |            |               | 2.3 | 4.0 | 1.7 |
| 73  | 73 | Conquest   | Iceberg       | 3.0 | 3.0 | 3.0 |
| 140 | 73 | Conquest   | Iceberg       | 4.0 | 3.0 | 2.0 |
| 209 | 73 | Conquest   | Iceberg       | 4.0 | 2.0 | 3.0 |
|     |    |            |               | 3.7 | 2.7 | 2.7 |
| 49  | 74 | SSC 1626   | Iceberg       | 4.0 | 3.0 | 2.0 |
| 123 | 74 | SSC 1626   | Iceberg       | 2.0 | 4.0 | 1.0 |
| 201 | 74 | SSC 1626   | Iceberg       | 3.0 | 3.0 | 3.0 |
|     |    |            |               | 3.0 | 3.3 | 2.0 |
| 54  | 76 | Frisco     | Cos           | 4.0 | 4.0 | 2.0 |
| 112 | 76 | Frisco     | Cos           | 4.0 | 4.0 | 2.0 |
| 193 | 76 | Frisco     | Cos           | 4.0 | 4.0 | 1.0 |
|     |    |            |               | 4.0 | 4.0 | 1.7 |
| 8   | 77 | Daytona    | Cos           | 4.0 | 4.0 | 3.0 |
| 120 | 77 | Daytona    | Cos           | 2.0 | 5.0 | 1.0 |
| 153 | 77 | Daytona    | Cos           | 4.0 | 5.0 | 2.0 |
|     |    |            |               | 3.3 | 4.7 | 2.0 |
| 20  | 78 | SSC 1837   | Cos           | 1.0 | 4.0 | 1.0 |
| 148 | 78 | SSC 1837   | Cos           | 2.0 | 4.0 | 1.0 |
| 166 | 78 | SSC 1837   | Cos           | 4.0 | 5.0 | 2.0 |
|     |    |            |               | 2.3 | 4.3 | 1.3 |
| 45  | 79 | SSC 1839   | Cos           | 3.0 | 4.0 | 1.0 |
| 117 | 79 | SSC 1839   | Cos           | 1.0 | 4.0 | 1.0 |
| 152 | 79 | SSC 1839   | Cos           | 3.0 | 5.0 | 2.0 |
|     |    |            |               | 2.3 | 4.3 | 1.3 |
| 53  | 80 | Chicago    | Cos           | 4.0 | 3.0 | 2.0 |
| 77  | 80 | Chicago    | Cos           | 4.0 | 4.0 | 1.0 |
| 183 | 80 | Chicago    | Cos           | 5.0 | 4.0 | 3.0 |
|     |    |            |               | 4.3 | 3.7 | 2.0 |
| 64  | 81 | Fortress   | Lollo Rossa   | 0.0 | 4.0 | 1.0 |
| 127 | 81 | Fortress   | Lollo Rossa   | 0.0 | 3.0 | 1.0 |
| 210 | 81 | Fortress   | Lollo Rossa   | 0.0 | 5.0 | 1.0 |
|     |    |            |               | 0.0 | 4.0 | 1.0 |
| 27  | 82 | SSC 1624   | Lollo Rossa   | 0.0 | 4.0 | 0.0 |
| 147 | 82 | SSC 1624   | Lollo Rossa   | 0.0 | 4.0 | 1.0 |
| 219 | 82 | SSC 1624   | Lollo Rossa   | 0.0 | 4.0 | 0.0 |
|     |    |            |               | 0.0 | 4.0 | 0.3 |
| 74  | 83 | Maribel    | Little Gem    | 2.0 | 3.0 | 1.0 |
| 135 | 83 | Maribel    | Little Gem    | 4.0 | 4.0 | 3.0 |
| 180 | 83 | Maribel    | Little Gem    | 3.0 | 5.0 | 4.0 |
|     |    |            |               | 3.0 | 4.0 | 2.7 |
| 6   | 84 | Little Gem | Little Gem    | 4.0 | 2.0 | 4.0 |
| 99  | 84 | Little Gem | Little Gem    | 4.0 | 3.0 | 3.0 |
| 194 | 84 | Little Gem | Little Gem    | 5.0 | 4.0 | 4.0 |

|     |     |                |              |     |     |     |
|-----|-----|----------------|--------------|-----|-----|-----|
|     |     |                |              | 4.3 | 3.0 | 3.7 |
| 42  | 85  | SSC 1866       | Red Oak      | 0.0 | 4.0 | 0.0 |
| 82  | 85  | SSC 1866       | Red Oak      | 0.0 | 5.0 | 0.0 |
| 156 | 85  | SSC 1866       | Red Oak      | 0.0 | 5.0 | 1.0 |
|     |     |                |              | 0.0 | 4.7 | 0.3 |
| 50  | 86  | SSC 1868       | Little Gem** | 5.0 | 3.0 | 3.0 |
| 113 | 86  | SSC 1868       | Little Gem** | 5.0 | 5.0 | 3.0 |
| 218 | 86  | SSC 1868       | Little Gem** | 3.0 | 3.0 | 2.0 |
|     |     |                |              | 4.3 | 3.7 | 2.7 |
| 46  | 88  | Hattrick       | Iceberg      | 1.0 | 4.0 | 0.0 |
| 80  | 88  | Hattrick       | Iceberg      | 0.0 | 4.0 | 0.0 |
| 216 | 88  | Hattrick       | Iceberg      | 1.0 | 5.0 | 0.0 |
|     |     |                |              | 0.7 | 4.3 | 0.0 |
| 38  | 89  | Boomerang      | Iceberg      | 0.0 | 4.0 | 1.0 |
| 144 | 89  | Boomerang      | Iceberg      | 1.0 | 4.0 | 1.0 |
| 202 | 89  | Boomerang      | Iceberg      | 0.0 | 4.0 | 2.0 |
|     |     |                |              | 0.3 | 4.0 | 1.3 |
| 14  | 90  | Flight         | Iceberg      | 0.0 | 3.0 | 0.0 |
| 84  | 90  | Flight         | Iceberg      | 0.0 | 3.0 | 1.0 |
| 220 | 90  | Flight         | Iceberg      | 1.0 | 4.0 | 1.0 |
|     |     |                |              | 0.3 | 3.3 | 0.7 |
| 63  | 91  | Xenon          | Lolla Rossa  | 0.0 | 4.0 | 2.0 |
| 111 | 91  | Xenon          | Lolla Rossa  | 0.0 | 4.0 | 1.0 |
| 217 | 91  | Xenon          | Lolla Rossa  | 0.0 | 4.0 | 1.0 |
|     |     |                |              | 0.0 | 4.0 | 1.3 |
|     |     |                | Red Oak      |     |     |     |
| 1   | 92  | Vesuve         | Leaf         | 0.0 | 5.0 | 1.0 |
|     |     |                | Red Oak      |     |     |     |
| 125 | 92  | Vesuve         | Leaf         | 1.0 | 4.0 | 1.0 |
|     |     |                | Red Oak      |     |     |     |
| 163 | 92  | Vesuve         | Leaf         | 1.0 | 4.0 | 2.0 |
|     |     |                |              | 0.7 | 4.3 | 1.3 |
|     |     |                | Red Oak      |     |     |     |
| 56  | 93  | Vulcania       | Leaf         | 0.0 | 3.0 | 1.0 |
|     |     |                | Red Oak      |     |     |     |
| 143 | 93  | Vulcania       | Leaf         | 0.0 | 4.0 | 2.0 |
|     |     |                | Red Oak      |     |     |     |
| 188 | 93  | Vulcania       | Leaf         | 0.0 | 4.0 | 2.0 |
|     |     |                |              | 0.0 | 3.7 | 1.7 |
| 25  | 102 | Ashbrook 2551  | Leaf Green   | 0.0 | 5.0 | 1.0 |
| 79  | 102 | Ashbrook 2551  | Leaf Green   | 0.0 | 5.0 | 1.0 |
| 169 | 102 | Ashbrook 2551  | Leaf Green   | 1.0 | 5.0 | 2.0 |
|     |     |                |              | 0.3 | 5.0 | 1.3 |
| 58  | 104 | Rosemoor 2243  | Batavian red | 0.0 | 5.0 | 1.0 |
| 104 | 104 | Rosemoor 2243  | Batavian red | 0.0 | 4.0 | 1.0 |
| 158 | 104 | Rosemoor 2243  | Batavian red | 0.0 | 4.0 | 0.0 |
|     |     |                |              | 0.0 | 4.3 | 0.7 |
|     |     |                |              |     |     |     |
| 18  | 105 | Foxley 2435    | Leaf red     | 0.0 | 4.0 | 0.0 |
| 145 | 105 | Foxley 2435    | Leaf red     | 0.0 | 5.0 | 0.0 |
| 162 | 105 | Foxley 2435    | Leaf red     | 0.0 | 5.0 | 1.0 |
|     |     |                |              | 0.0 | 4.7 | 0.3 |
| 71  | 109 | Romany Let 066 | Cos          | 4.0 | 3.0 | 4.0 |
| 90  | 109 | Romany Let 066 | Cos          | 3.0 | 4.0 | 2.0 |

|     |     |                |             |     |     |     |
|-----|-----|----------------|-------------|-----|-----|-----|
| 157 | 109 | Romany Let 066 | Cos         | 4.0 | 4.0 | 3.0 |
|     |     |                |             | 3.7 | 3.7 | 3.0 |
| 75  | 112 | 45-25 RZ       | Iceberg     | 0.0 | 5.0 | 2.0 |
| 89  | 112 | 45-25 RZ       | Iceberg     | 0.0 | 4.0 | 0.0 |
| 203 | 112 | 45-25 RZ       | Iceberg     | 0.0 | 4.0 | 1.0 |
|     |     |                |             | 0.0 | 4.3 | 1.0 |
| 13  | 113 | 45-72 RZ       | Iceberg     | 0.0 | 4.0 | 1.0 |
| 116 | 113 | 45-72 RZ       | Iceberg     | 0.0 | 5.0 | 1.0 |
| 154 | 113 | 45-72 RZ       | Iceberg     | 1.0 | 5.0 | 0.0 |
|     |     |                |             | 0.3 | 4.7 | 0.7 |
| 10  | 114 | Challenge      | Iceberg     | 2.0 | 3.0 | 1.0 |
| 78  | 114 | Challenge      | Iceberg     | 2.0 | 3.0 | 2.0 |
| 159 | 114 | Challenge      | Iceberg     | 4.0 | 2.0 | 2.0 |
|     |     |                |             | 2.7 | 2.7 | 1.7 |
| 11  | 115 | Capriole       | Iceberg     | 3.0 | 2.0 | 0.0 |
| 141 | 115 | Capriole       | Iceberg     | 4.0 | 3.0 | 3.0 |
| 204 | 115 | Capriole       | Iceberg     | 4.0 | 2.0 | 3.0 |
|     |     |                |             | 3.7 | 2.3 | 2.0 |
| 52  | 116 | Durango        | Iceberg     | 4.0 | 3.0 | 3.0 |
| 76  | 116 | Durango        | Iceberg     | 4.0 | 2.0 | 2.0 |
| 208 | 116 | Durango        | Iceberg     | 4.0 | 2.0 | 2.0 |
|     |     |                |             | 4.0 | 2.3 | 2.3 |
| 17  | 117 | Lucena         | Little Gem  | 4.0 | 2.0 | 4.0 |
| 95  | 117 | Lucena         | Little Gem  | 4.0 | 2.0 | 4.0 |
| 224 | 117 | Lucena         | Little Gem  | 5.0 | 3.0 | 3.0 |
|     |     |                |             | 4.3 | 2.3 | 3.7 |
| 22  | 118 | Corberra       | Little Gem  | 0.0 | 3.0 | 1.0 |
| 83  | 118 | Corberra       | Little Gem  | 0.0 | 4.0 | 1.0 |
| 199 | 118 | Corberra       | Little Gem  | 1.0 | 4.0 | 1.0 |
|     |     |                |             | 0.3 | 3.7 | 1.0 |
| 36  | 119 | Bijou          | Red Batavia | 0.0 | 4.0 | 0.0 |
| 126 | 119 | Bijou          | Red Batavia | 0.0 | 3.0 | 0.0 |
| 192 | 119 | Bijou          | Red Batavia | 0.0 | 4.0 | 1.0 |
|     |     |                |             | 0.0 | 3.7 | 0.3 |
| 59  | 120 | Carmoli        | Lollo Rossa | 0.0 | 4.0 | 1.0 |
| 137 | 120 | Carmoli        | Lollo Rossa | 0.0 | 3.0 | 1.0 |
| 196 | 120 | Carmoli        | Lollo Rossa | 0.0 | 5.0 | 1.0 |
|     |     |                |             | 0.0 | 4.0 | 1.0 |
| 72  | 121 | Nation         | Lollo Rossa | 0.0 | 5.0 | 1.0 |
| 91  | 121 | Nation         | Lollo Rossa | 0.0 | 4.0 | 1.0 |
| 155 | 121 | Nation         | Lollo Rossa | 0.0 | 5.0 | 2.0 |
|     |     |                |             | 0.0 | 4.7 | 1.3 |
| 19  | 122 | Bastile        | Lollo Rossa | 0.0 | 5.0 | 1.0 |
| 110 | 122 | Bastile        | Lollo Rossa | 0.0 | 4.0 | 1.0 |
| 171 | 122 | Bastile        | Lollo Rossa | 0.0 | 4.0 | 1.0 |
|     |     |                |             | 0.0 | 4.3 | 1.0 |
| 29  | 123 | Chirvel        | Iceberg     | 1.0 | 2.0 | 0.0 |
| 100 | 123 | Chirvel        | Iceberg     | 1.0 | 4.0 | 1.0 |
| 170 | 123 | Chirvel        | Iceberg     | 1.0 | 5.0 | 1.0 |
|     |     |                |             | 1.0 | 3.7 | 0.7 |
| 39  | 124 | Kuaia          | Iceberg     | 0.0 | 3.0 | 0.0 |
| 139 | 124 | Kuaia          | Iceberg     | 1.0 | 4.0 | 1.0 |

|     |     |       |         |     |     |     |
|-----|-----|-------|---------|-----|-----|-----|
| 167 | 124 | Kuaia | Iceberg | 1.0 | 4.0 | 1.0 |
|     |     |       |         | 0.7 | 3.7 | 0.7 |