# SCEPTREPLUS

## Final Trial Report

| | |
|---|---|
| **Trial code:** | 2017 SP16 |
| **Title:** | Evaluation of biopesticides and conventional fungicides for control of Grey Mould (Botrytis cinerea) in stored Dutch White Cabbage |
| **Crop** | Dutch White Cabbage, Field Vegetables |
| **Target** | *Botrytis Cinerea* |
| **Lead researcher:** | Carl Sharp |
| **Organisation:** | Allium and Brassica Agronomy |
| **Period:** | April 2017 – June 2018 |
| **Report date:** | 18 Sep 2018 |
| **Report author:** | Carl Sharp |
| **ORETO Number:** (certificate should be attached) | 376 |

I the undersigned, hereby declare that the work was performed according to the procedures herein described and that this report is an accurate and faithful record of the results obtained

19/10/2018

……………………………
Date

………………………………
Authors signature

# Trial Summary

## Introduction

One replicated trial was conducted in Dutch White Cabbage to evaluate both conventional and bio-pesticides for the control of grey mould (*Botrytis cinerea*). The loss of Rovral WG (iprodione) in June 2018 left a gap in the ability to control diseases in stored cabbage. This trial was conducted to find new alternatives to Rovral WG.

## Methods

30 heads of cabbage were weighed, treated and placed into cold storage for 197 days. Upon removal from store on 12th June 2018 the crop was assessed visually for disease, then weighed (for de-hydration loss), trimmed and the marketable heads re-weighed (for trimming loss). Any heads not of marketable standard (due to severe *Phytopthora*, Canker or *Botrytis*) were also recorded and discarded.

## Results

The results obtained were compared with an untreated control, and the final results shown are the only results recorded.

| Assessment Type | Post trimming weight | Botrytis Score | Marketable heads | Heads discarded - Botrytis | Heads discarded - Phytophthora | Heads discarded - Canker |
|---|---|---|---|---|---|---|
| Assessment Unit | % of initial weight | 0-3 | % of 28 heads/plot | % | % | % |
| | | | | | | |
| Water | 48.99 | 2.483 | 58.40 | 29.78 | 7.965 | -0.230 |
| Rovral WG | 54.27 | **1.133** | 68.78 | 18.62 | 5.480 | 3.268 |
| AHDB9925 | **56.98** | **1.733** | **74.95** | **13.93** | 1.785 | 1.864 |
| AHDB9924 | 54.69 | **0.433** | 68.35 | 20.49 | 1.470 | 0.545 |
| AHDB9927 | 50.86 | **1.083** | 63.37 | 25.57 | 3.826 | 0.545 |
| AHDB9926 | **58.04** | **0.583** | **75.14** | **9.32** | 5.656 | 4.650 |
| AHDB9923 | **57.20** | **1.383** | **75.56** | **12.56** | 3.063 | 1.320 |
| Serenade | **56.57** | 2.383 | **75.34** | **11.64** | 4.965 | -0.230 |
| AHDB9937 | 50.43 | 2.083 | 63.26 | 19.50 | 11.828 | 1.089 |
| AHDB9956 | 49.70 | 2.033 | 63.51 | 21.81 | 6.381 | 5.824 |
| | | | | | | |
| l.s.d. P=0.5 | 6.599 | 0.5626 | 12.05 | 11.88 | 9.120 | 4.945 |
| s.e.d | 3.254 | 0.2774 | 5.94 | 5.86 | 4.497 | 2.438 |
| d.f | 36 | 36 | 36 | 36 | 36 | 36 |

Note: percentage values represent angular transformed data,
Figures highlighted/shaded were significantly different (at the 5% confidence level) to the water control

## Conclusions

There were positive efficacy effects for cabbage post trimming weight with the following products; AHDB9925, AHDB9926, AHDB9923 and Serenade all resulting in significantly increased yield compared with the water control.

When the number of marketable heads were assessed, the same 4 products; AHDB9925, AHDB9926, AHDB9923 and Serenade had significantly more marketable heads than the water control. However, none of these were significantly better than the current approved product Rovral WG.

Six products (including the formerly approved standard, Rovral WG) significantly reduced Botrytis; Rovral WG, AHDB9925, AHDB9924, AHDB9927, AHDB9926 and AHDB9923, and furthermore, AHDB9926, AHDB9923 and AHDB9927 were significantly better than the remaining test products.

Of the 3 biological products tested, only Serenade appeared to give any control.
The efficacy effects between Rovral WG and AHDB9924 are almost identical.

## Take home message:

The use of post-harvest treatments significantly reduces disease incidence and subsequent product wastage (either through trimming losses or the loss of entire heads).

Of those tested, 3 currently have approval on head cabbage, although in this study they have been applied outside the scope of approval.

AHDB9925 which was consistently among all the products providing positive efficacy effects, along with AHDB9924, which was providing efficacy comparable to that of Rovral WG (the outgoing standard) would be suitable candidates for EAMUs.

Either of these products would benefit the grower, providing similar or better control of Botrytis than what is now available, although care should be taken that any potential approval does not significantly adversely affect any current approvals on Cabbage that they currently have.

It should also be noted that Serenade ASO now has an EAMU (2825 of 2018, issued 11/10/2018) for post-harvest application, subject to strict environmental conditions.

## Objectives

To evaluate both conventional and bio-fungicides for the control of Grey Mould (Botrytis cinerea) in stored Dutch White Cabbage (DWC), against both plain water treatment and a standard fungicide control.

To monitor the treated crop for phytotoxic effects.

## Trial conduct

UK regulatory guidelines were followed but EPPO guidelines took precedence. The following EPPO guidelines were followed:

| Relevant EPPO guideline(s) | | Variation from EPPO |
|---|---|---|
| PP 1/152(3) | Design and analysis of efficacy evaluation trials | None |
| PP 1/135(3) | Phytotoxicity assessment | None |
| PP 1/181(3) | Conduct and reporting of efficacy evaluation trials including GEP | None |
| PP1/78(3) PP1/121(2) PP1/63(3) | Assessment of leaf and flowerhead brassica diseases | None |

There were no deviations from EPPO guidance:

Allium & Brassica Agronomy have been advised by CRD, that because all products were applied BEFORE storage, and that ALL treatments were in the same store and under the same storage conditions, this trial can claim GEP compliance

### Test site

| Item | Details |
|---|---|
| Location address | Boston, Lincolnshire, PE20 1QQ, UK |
| Crop | Dutch White Cabbage |
| Cultivar | Mucsuma |
| Soil or substrate type | N/A - Store |
| Agronomic practice | Planting Date – 12.04.2018 Density – 26,800 plants/ha |
| Prior history of site | Refrigerated cold stores – Cleaned during October prior to store loading. |

**Trial design**

The trial design was arranged as a balanced incomplete block design for 6 replicates of the 10 treatments, arranged in 15 blocks/blocks, each divided into 4 plots. The design has the properties that each pair of treatments occurs together in exactly two of the 15 blocks, with a standard analysis therefore being possible within the ANOVA framework. Blocks were arranged in 3 stacks, each of 5 boxes, with a requirement that each treatment occurred at least once in each of the 3 stacks.

The primary interest is the comparison between the treatments and the water control, and as such comparisons can be made using the present LSD for each assessment.

| Item | Details |
|---|---|
| Trial design: | Completely randomized |
| Number of replicates: | 6 |
| Row spacing: | N/A |
| Plot size: (w x l) | N/A |
| Plot size: (m²) | Partitioned box. 4 treatments/box. 15 boxes in total. Partition size 0.45m x 1.1m. |
| Number of plants per plot: | 30 heads (reducing to 28 after samples for residue testing) |

## Treatment details

| AHDB Code | Active substance | Product name/ manufacturers code | Formulation batch number | Content of active substance in product | Formulation type | Adjuvant |
|---|---|---|---|---|---|---|
| AHDB9937 | N/D | N/D | N/D | N/D | N/D | No |
| AHDB9936 | Bacillus Subtilis QST 713 | Serenade ASO | PCS 03847 EZU 1613005 | 1015.1 g/l | SC | No |
| AHDB9956 | N/D | N/D | N/D | N/D | N/D | No |
| AHDB9924 | N/D | N/D | N/D | N/D | N/D | No |
| AHDB9926 | N/D | N/D | N/D | N/D | N/D | No |
| AHDB9923 | N/D | N/D | N/D | N/D | N/D | No |
| AHDB9927 | N/D | N/D | N/D | N/D | N/D | No |
| AHDB9925 | N/D | N/D | N/D | N/D | N/D | No |
| N/A | Iprodione | Rovral WG | None | 750 g/Kg | WG | No |

## Application schedule

| Treatment number | Treatment: product name or AHDB code | Rate of active substance (ml or g a.s./ha) | Rate of product (l or kg/ha) | Water Volume |
|---|---|---|---|---|
| 1 | Untreated (Water control) | N/A | N/A | 1000 L |
| 2 | Rovral | 50.25 | 0.067 kg/ha | 1000 L |
| 3 | AHDB9925 | 267/67 | 1 kg/ha | 1000 L |
| 4 | AHDB9924 | 375/250 | 1 kg/ha | 1000 L |
| 5 | AHDB9927 | 600 | 1.2 kg/ha | 1000 L |
| 6 | AHDB9926 | 600 | 1.5 l/ha | 1000 L |
| 7 | AHDB9923 | 125 | 1 l/ha | 1000 L |
| 8 | Serenade | 30mls product/l spray solution | 3 % v/v | 1000 L |
| 9 | AHDB9937 | 20mls product/l spray solution | 2 % v/v | 1000 L |
| 10 | AHDB9956 | 470 | 0.5 kg/ha | 1000 L |

As any potential product(s) are likely to be tank mixed with SL 567A (metalaxyl-M) products were applied in water (dilution rate as above table) at the equivalent rate of 20L/tonne of cabbage EAMU (2117/06, expires 31/12/2020).

## Application details

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| | Application A |
|---|---|
| **Application date** | 27 Nov 2017 |
| **Time of day** | 12:00-15:00 |
| **Crop growth stage (Max, min average BBCH)** | 49 BBCH |
| **Crop height (cm)** | N/A |
| **Crop coverage (%)** | N/A |
| **Application Method** | Drench |
| **Application Placement** | Plot |
| **Application equipment** | Compressed air Sprayer |
| **Nozzle pressure** | 2bar |
| **Nozzle type** | Even spray |
| **Nozzle size** | E02 |
| **Application water volume** | 1000 l/ 50 tonnes |
| **Temperature of air - shade (°C)** | 5 |
| **Relative humidity (%)** | 78 |
| **Wind speed range (kph)** | 2 |
| **Dew presence (Y/N)** | N |
| **Temperature of soil - 2-5 cm (°C)** | N/A |
| **Wetness of soil - 2-5 cm** | N/A |
| **Cloud cover (%)** | 80 |

## Untreated levels of pests/pathogens at application and through the assessment period

| Common name | Scientific Name | EPPO Code | Infestation level pre-application | Infestation level at start of assessment period | Infestation level at end of assessment period |
|---|---|---|---|---|---|
| Grey Mould | Botrytis cinerea | BOTRSP | None | Moderate-High | Moderate-High |
| Phytophthora | Phytophthora sp. | PHYTBC | None | Low | Low |
| Canker | Phoma sp. | PHOMSP | None | Low | Low |

The trial was placed within a cold store so climatic conditions during the trial were stable, with stored conditions of 0-1°C and >90% humidity.

Species present in order of prevalence were Botrytis, Phytophthora, and Canker.

## Assessment details

Observations were made for application problems associated with product formulations and the evaluation types given below were followed. Additional details of methodology are included in the results section.

| Evaluation number | Evaluation description |
|---|---|
| 01 | Test product application |
| 02 | Initial weights of harvested Cabbage |
| 03 | Revised weights of cabbage after sample taken for potential MRL test |
| 04 | Visual disease score (Botrytis) |
| 05 | Weights post storage |
| 06 | Trimmed / marketable weight |
| 07 | Discarded heads – disease specific |

| Evaluation date | Crop Growth Stage (BBCH) | Evaluation type (efficacy, phytotox) | Assessment |
|---|---|---|---|
| 27/11/2017 | BBCH49 | 01, 02 | Post harvest |
| 20/02/2017 | BBCH49 | 03 | 84 DA |
| 12/06/2018 | BBCH49 | 04-07 | 197 DA |

\* DA – days after application

## Statistical analysis

Statistical analysis was performed by Andrew Mead (Rothamsted Research) using Genstat, the full Genstat report is included in the appendix.

# Results

## Formulations

Observations were made of ease of mixing of the formulations and for any conspicuous problems associated with nozzle blockages or uneven spray pattern during mixing and application.

The only product which caused problems with mixing and application at the given rates was Prestop, which caused filter blockages. Filters had to be removed in order to use this product in this trial.

## Phytotoxicity

No phytotoxic symptoms were observed or recorded.
There is no table to include as no data was analysed (all 0s).

**Efficacy**
No damage was observed other than the test organisms, where 6 products (including the current approved standard, Rovral WG) gave a clear visual and significant improvement on Botrytis; Rovral WG, AHDB9925, AHDB9924, AHDB9927, AHDB9926 and AHDB9923, and furthermore, AHDB9926, AHDB9923 and AHDB9927 were significantly better than the remaining test products in reducing damage through storage diseases.

There were differences in final marketable yield with 4 of the products giving increased marketable yield over the untreated water control. Those products being; AHDB9924, AHDB9926, AHDB9923 and Serenade.

| Assessment Type | Post trimming weight | Botrytis Score | Marketable heads | Heads discarded - Botrytis | Heads discarded - Phytophthora | Heads discarded - Canker |
|---|---|---|---|---|---|---|
| Assessment Unit | % of initial weight | 0-3 | % of 28 heads/plot | % | % | % |
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| Water | 48.99 | 2.483 | 58.40 | 29.78 | 7.965 | -0.230 |
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## Discussion

There were positive efficacy effects for cabbage post trimming weight with the following products; AHDB9925, AHDB9926, AHDB9923 and Serenade all resulting in significantly increased yield compared with the water control.

When the number of marketable heads were assessed, the same 4 products; AHDB9925, AHDB9926, AHDB9923 and Serenade had significantly more marketable heads than the water control. However, none of these were significantly better than the current approved product Rovral WG.

Six products (including the formerly approved standard, Rovral WG) significantly reduced Botrytis; Rovral WG, AHDB9925, AHDB9924, AHDB9927, AHDB9926 and AHDB9923, and furthermore, AHDB9926, AHDB9923 and AHDB9927 were significantly better than the remaining test products.

Of the 3 biological products tested, only Serenade appeared to give any control.
The efficacy effects between Rovral WG and AHDB9924 are almost identical.

## Conclusions

### Formulations
Filter and nozzle blockage problems were encountered during the application of AHDB9937, filters had to be removed.

### Crop safety
No phytotoxic effects were observed with any treatment.

### Crop Vigour
There were no effects on vigour as treatments were applied to a harvested crop.

### Control of target organism
The trial was placed within a cold store so climatic conditions during the trial were stable, with stored conditions of 0-1°C and >90% humidity.

Species present in order of prevalence were Botrytis, Phytophthora, and Canker.

### Vegetable damage
The only vegetable damage recorded was that caused by storage diseases.

### Crop yield
Yield was average for the season 2017 season.

## Acknowledgements

# Appendix

a. Crop diary – events related to growing crop

b. Trial diary

c. Photographs

d. Climatological data during study period

e. Raw data from assessments and GenStat output

f. Trial design

g. ORETO certificate should be pasted in at end.

## Appendix A– Crop Diary

The crop was harvested from a commercial field. The field used was the one currently being harvested at the time for cold storage.

All treatments (seed, fertiliser and pesticide) along with field mechanical operations were all undertaken to current best practice according to the GlobalGAP, assured produce scheme.

These standards would be similar for all growers producing Dutch White Cabbage for storage.
Climatic data for the grown crop is shown below.

| Location of the weather station | RAF Holbeach | | |
|---|---|---|---|
| Distance to the trial site | 10Km | | |
| Origin of the weather data | Met Office | | |
| **Long-term averages from 1981-2010** | | | |
| Month/period | Min temp (°C) | Max temp (°C) | Rainfall (mm) |
| April | 4.4 | 12.9 | 43.3 |
| May | 7.5 | 15.8 | 53.3 |
| June | 10.2 | 18.9 | 53.2 |
| July | 12.2 | 21.4 | 49.8 |
| August | 12.0 | 21.5 | 60.4 |
| September | 10.2 | 18.6 | 55.6 |
| October | 7.5 | 14.6 | 62.1 |
| November | 4.0 | 10.1 | 55.4 |

| **Average conditions during the trial** | | | | |
|---|---|---|---|---|
| Month/period | Av temp (°C) | Min temp (°C) | Max temp (°C) | Rainfall (mm) |
| April 2017 | 9 | 4 | 14 | 23 |
| May 2017 | 13 | 9 | 18 | 108 |
| June 2017 | 17 | 12 | 21 | 93 |
| July 2017 | 17 | 12 | 22 | 90 |
| August 2017 | 16 | 11 | 21 | 86 |
| September 2017 | 14 | 9 | 18 | 95 |
| October 2017 | 12 | 9 | 16 | 20 |
| November 2017 | 6 | 3 | 10 | 64 |

## Appendix B – Trial Diary

**Diary**

**26-11-2017**

Harvested cabbage from commercially grown field, and transported to ABC.

**27-11-2017**

Weighed 30 heads in to each bin section (3 x 10 cabbage)

Drenched each section with 2.356L spray solution using a compressed air plot sprayer. (single nozzle, even spray, 2bar, E02)

Cabbage placed into ambient store overnight.

**28-11-2017**

Cabbage placed into Cold store, as per treatment plan at the top.

Bins with plots1-4, 21-24 and 41-43 at the bottom of each stack.

Temperature monitoring probes placed in bin1 (plot1-4), bin 8 (plot29-32) and bin 15 (plot57-60).

**20-02-2018**

Samples taken for potential residue testing (samples back in cold store until delivery on 22-02-2018)

Samples to go to Eurofins –

Slade Lane, Wilson, Melbourne, Derby. DE73 8AG

Contact; Jason Adcock 07584 529019     JasonAdcock@eurofins.com

12 heads taken from each of the following treatments:

AHDB9925

AHDB9924

AHDB9927

AHDB9926

AHDB9923

Water

(2 bags of 6 heads/treatment)

**22-02-2018**

Pre-sampled cabbage removed from store (0830) and loaded into covered pickup truck and delivered to Eurofins by Carl Sharp, arrived at Eurofins 10:55.

**12-05-2018**

Commercial crop now all out of the store, only trial plots remain.

**12-06-2018**

Assessments start.

**Appendix C – Photographs**



Photo above shows the original 40 heads/bin. Heads are above the partitions and would result in run off in to adjacent treatments.



Photo above shows the original 40 heads/bin. Heads are above the partitions and would result in run off in to adjacent treatments.



Photo above shows the revised number of heads per treatment (30), and clearly shows that they all remain below the partition height, resulting in no treatment run off in adjacent plots.



Photo above illustrates how the trial was placed into store.

Example of Phytophthora



Example of Canker



Cabbage ex Store



Trimmed Cabbage

## Efficacy Photos

Note: Pictures have been collated in grids of 4 using a photo application. The pictures are not in plot order.

PLOT 30 Eff. score 1
PLOT 31 Eff. score 0
PLOT 23 Eff. score 3
PLOT 22 Eff. score 3
PLOT 21 Eff. score 1
PLOT 32 Eff. score 3
PLOT 21 Eff. score 1
PLOT 24 Eff. score 1
PLOT 55 Eff. score 3
PLOT 56 Eff. score 2
PLOT 60 Eff. score 1
PLOT 58 Eff. score 0
PLOT 54 Eff. score 0
PLOT 55 Eff. score 1
PLOT 57 Eff. score 1
PLOT 59 Eff. score 0

**Appendix D – Stored Temperature Data**

Comment: The trial was stored within a commercial stored crop of Dutch White Cabbage. A proportion of this commercial crop was removed from the store around 20th February 2018, at the same time samples were also removed for residue testing, which resulted in temperatures rising for a period of 4 days. Other than this anomaly storage temperatures were typically around 0.5-1°C.



Upper Probe Temperature and RH Records 27/11/17 to 12/6/18

**Middle Probe Temperature and RH  Records 27/11/17 to 12/6/18**



**Lower Probe Temperature Records 27/11/17 to 12/6/18**
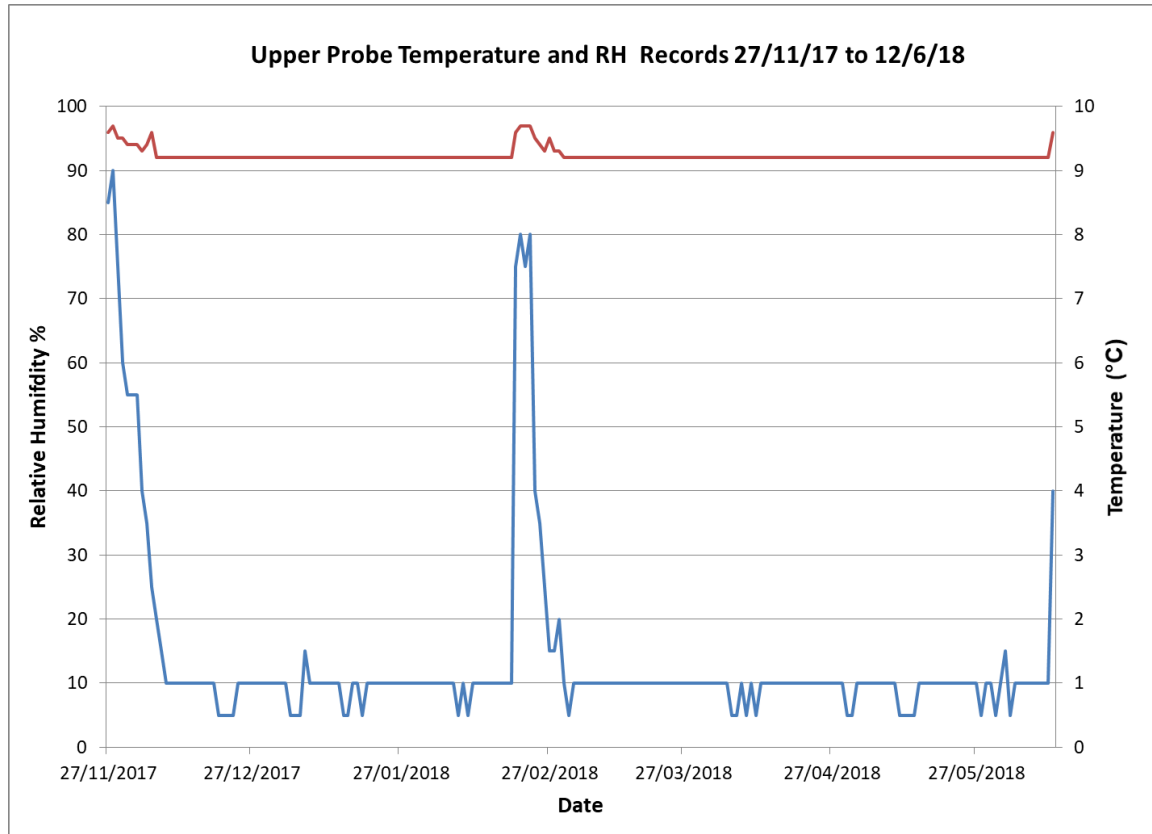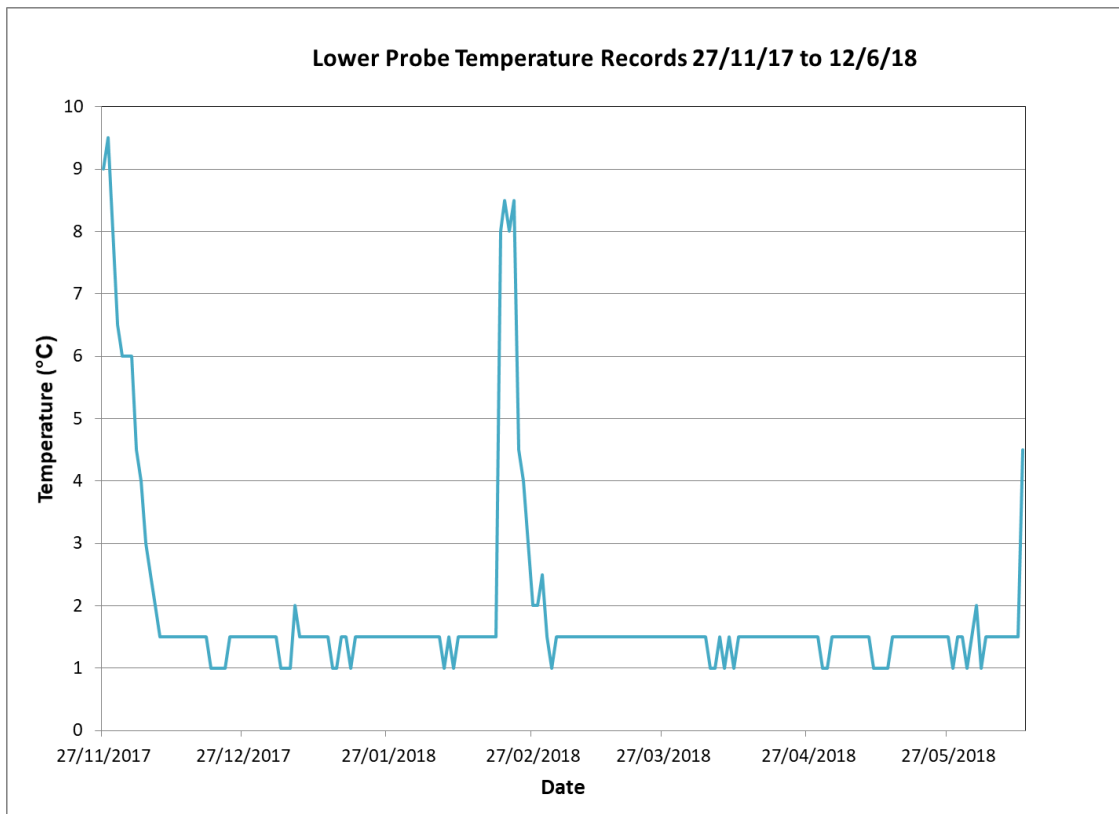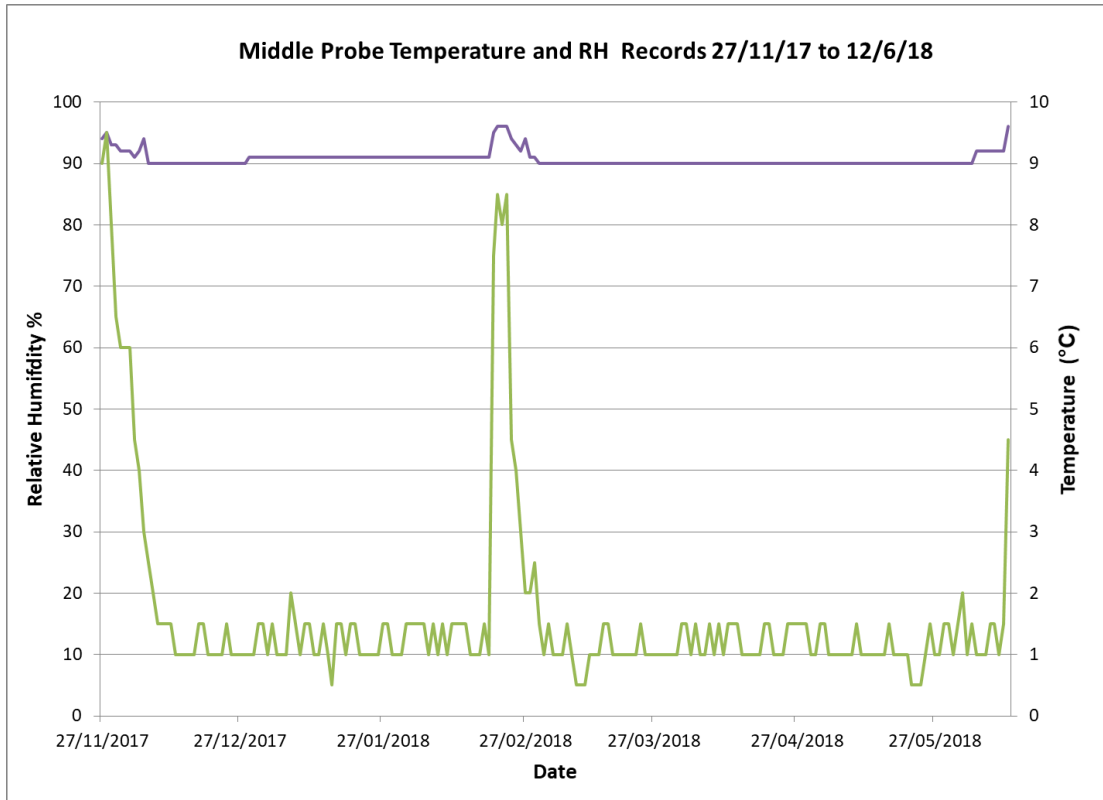
## Appendix E – Raw Data

| Plot No. | Calculated stored weight (kg) Post MRL samples | Post storage weight (kg) | | | | Post Trimming weight (kg) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Weight 1 | Weight 2 | Weight 3 | Total (KG) | Weight 1 | Weight 2 | Weight 3 | Total (KG) |
| 1 | 103.42 | 41.96 | 49.265 | 0 | 91.225 | 49.135 | 27.245 | 0 | 76.38 |
| 2 | 107.97 | 44.065 | 51.85 | | 95.915 | 47.61 | 35.92 | | 83.53 |
| 3 | 105.445 | 47.28 | 46.46 | | 93.74 | 51.01 | 30.39 | | 81.4 |
| 4 | 96.71 | 47.78 | 37.74 | | 85.52 | 45.41 | 26.5 | | 71.91 |
| 5 | 94.245 | 46.33 | 37.95 | | 84.28 | 47.85 | 26.61 | | 74.46 |
| 6 | 88.6 | 44.94 | 33.37 | | 78.31 | 54.545 | 2.32 | | 56.865 |
| 7 | 104.795 | 51.92 | 40.92 | | 92.84 | 49.75 | 23.82 | | 73.57 |
| 8 | 109.165 | 49.69 | 47.78 | | 97.47 | 52.08 | 28.12 | | 80.2 |
| 9 | 108.45 | 49.83 | 47.55 | | 97.38 | 46.06 | 22.13 | | 68.19 |
| 10 | 119.785 | 44.96 | 51.28 | 11.61 | 107.85 | 37.71 | 47.08 | | 84.79 |
| 11 | 110.865 | 47.8 | 51.51 | | 99.31 | 49.2 | 24.12 | | 73.32 |
| 12 | 113.855 | 50.71 | 50.31 | | 101.02 | 38.29 | 20.25 | | 58.54 |
| 13 | 105.255 | 51.5 | 43.79 | | 95.29 | 49.03 | 27.72 | | 76.75 |
| 14 | 107.04 | 47.52 | 49.36 | | 96.88 | 47.02 | 33.62 | | 80.64 |
| 15 | 101.565 | 49.84 | 41.95 | | 91.79 | 51.59 | 27.3 | | 78.89 |
| 16 | 117.585 | 49.86 | 54.29 | | 104.15 | 45.3 | 20.17 | | 65.47 |
| 17 | 114.255 | 51.26 | 50.63 | | 101.89 | 47.83 | 24.61 | | 72.44 |
| 18 | 118.44 | 50.16 | 54.4 | | 104.56 | 44.45 | 14.3 | | 58.75 |
| 19 | 110.225 | 50.05 | 46.17 | | 96.22 | 40.965 | | | 40.965 |
| 20 | 114.88 | 55.64 | 46.26 | | 101.9 | 52.36 | 3.75 | | 56.11 |
| 21 | 127.535 | 53.1 | 54.33 | 4.69 | 112.12 | 45.3 | | | 45.3 |
| 22 | 115.775 | 51.22 | 51.09 | | 102.31 | 50.44 | 32.68 | | 83.12 |
| 23 | 111.8 | 49.55 | 48.99 | | 98.54 | 44.2 | 16.37 | | 60.57 |
| 24 | 113.255 | 50.3 | 50.84 | | 101.14 | 51.93 | 8.985 | | 60.915 |
| 25 | 113.54 | 50.065 | 52.11 | | 102.175 | 52.45 | 23.785 | | 76.235 |
| 26 | 114.53 | 53.645 | 49.065 | | 102.71 | 53.055 | 27.715 | | 80.77 |
| 27 | 118.385 | 51.79 | 53.92 | | 105.71 | 52.895 | | | 52.895 |
| 28 | 123.375 | 52.06 | 54.115 | | 106.175 | 29.72 | | | 29.72 |
| 29 | 109.51 | 52.125 | 47.285 | | 99.41 | 49.395 | 28.645 | | 78.04 |
| 30 | 115.425 | 53.01 | 47.59 | | 100.6 | 55.26 | 28.53 | | 83.79 |
| 31 | 109.475 | 49.105 | 50.74 | | 99.845 | 42.955 | 38.345 | | 81.3 |
| 32 | 104.45 | 50.232 | 42.95 | | 93.182 | 53.39 | | | 53.39 |
| 33 | 111.005 | 51.435 | 49.465 | | 100.9 | 47.94 | 20.53 | | 68.47 |
| 34 | 114.475 | 51.605 | 50.64 | | 102.245 | 48.805 | 19.72 | | 68.525 |
| 35 | 113.84 | 54.245 | 48.53 | | 102.775 | 53.85 | 23.72 | | 77.57 |
| 36 | 113.69 | 50.205 | 52.09 | | 102.295 | 49.455 | 23.57 | | 73.025 |
| 37 | 114.3 | 48.24 | 55.025 | | 103.265 | 48.93 | 37.815 | | 86.745 |
| 38 | 113.915 | 52.88 | 49.025 | | 101.905 | 48.92 | 25.33 | | 74.25 |
| 39 | 104.28 | 52.415 | 41.365 | | 93.78 | 50.6 | 28.035 | | 78.635 |
| 40 | 105.61 | 53.255 | 39.9 | | 93.155 | 52.1 | 20.3 | | 72.4 |
| 41 | 113.47 | 54.815 | 45.9 | | 100.715 | 54.33 | 3.55 | | 57.88 |
| 42 | 106.515 | 53.64 | 40.953 | | 94.593 | 45.005 | 20.415 | | 65.42 |
| 43 | 108.845 | 52.34 | 45.215 | | 97.555 | 50.05 | 9.48 | | 59.53 |
| 44 | 109.14 | 50.095 | 46.95 | | 97.045 | 40.965 | 27.05 | | 68.015 |
| 45 | 110.325 | 53.88 | 44.705 | | 98.585 | 44.69 | 21.505 | | 66.195 |
| 46 | 106.625 | 51.53 | 43.825 | | 95.355 | 51.295 | 15.94 | | 67.235 |
| 47 | 116.04 | 50.5 | 55.13 | | 105.63 | 54.705 | 34.475 | | 89.18 |
| 48 | 118.775 | 47.645 | 55.26 | 3.31 | 106.215 | 50.71 | 12.99 | | 63.7 |
| 49 | 114.525 | 53.97 | 49.63 | | 103.6 | 54.06 | 21.73 | | 75.79 |
| 50 | 127.945 | 52.805 | 50.93 | 12.3 | 116.035 | 56.86 | 38.42 | | 95.28 |
| 51 | 115.002 | 49.265 | 55.01 | | 104.275 | 56.45 | 23.495 | | 79.945 |
| 52 | 111.77 | 56.805 | 44.185 | | 100.99 | 49.57 | 23.79 | | 73.36 |
| 53 | 115.16 | 55.2 | 51.725 | | 106.925 | 51.53 | 17.08 | | 68.61 |
| 54 | 106.15 | 53.07 | 43.84 | | 96.91 | 45.565 | 32.19 | | 77.755 |
| 55 | 103.515 | 51.94 | 41.12 | | 93.06 | 51.11 | 22.94 | | 74.05 |
| 56 | 110.43 | 51.157 | 48.02 | | 99.177 | 48.016 | 35.77 | | 83.786 |
| 57 | 105.92 | 55.26 | 40.525 | | 95.785 | 50.38 | 26 | | 76.38 |
| 58 | 103.83 | 49.12 | 44.28 | | 93.4 | 53.075 | 28.505 | | 81.58 |
| 59 | 110.265 | 49.995 | 50.035 | | 100.03 | 53.375 | 31.59 | | 84.965 |
| 60 | 105.39 | 53.08 | 40.705 | | 93.785 | 52.2 | 18.56 | | 70.76 |

| Plot No. | Losses recorded as % | | Botrytis visual scale | Number heads discarded | | |
|---|---|---|---|---|---|---|
| | Dehydration loss (%) | Trimming loss (ex-store) (%) | | Botrytis | Phytophora | Canker |
| 1 | 11.79 | 26.15 | 2 | 1 | 0 | 0 |
| 2 | 11.17 | 22.64 | 1 | 0 | 0 | 0 |
| 3 | 11.10 | 22.80 | 1 | 0 | 0 | 0 |
| 4 | 11.57 | 25.64 | 2 | 0 | 1 | 0 |
| 5 | 10.57 | 20.99 | 0 | 0 | 0 | 0 |
| 6 | 11.61 | 35.82 | 1 | 3 | 1 | 0 |
| 7 | 11.41 | 29.80 | 1 | 2 | 0 | 0 |
| 8 | 10.71 | 26.53 | 0 | 2 | 0 | 0 |
| 9 | 10.21 | 37.12 | 2 | 2 | 3 | 0 |
| 10 | 9.96 | 29.21 | 1 | 1 | 2 | 0 |
| 11 | 10.42 | 33.87 | 0 | 3 | 1 | 0 |
| 12 | 11.27 | 48.58 | 1 | 8 | 2 | 0 |
| 13 | 9.47 | 27.08 | 0 | 1 | 1 | 0 |
| 14 | 9.49 | 24.66 | 0 | 0 | 0 | 0 |
| 15 | 9.62 | 22.33 | 1 | 0 | 0 | 0 |
| 16 | 11.43 | 44.32 | 1 | 7 | 0 | 0 |
| 17 | 10.82 | 36.60 | 2 | 3 | 1 | 0 |
| 18 | 11.72 | 50.40 | 2 | 9 | 0 | 0 |
| 19 | 12.71 | 62.84 | 3 | 14 | 1 | 0 |
| 20 | 11.30 | 51.16 | 2 | 9 | 1 | 0 |
| 21 | 12.09 | 64.48 | 1 | 21 | 0 | 0 |
| 22 | 11.63 | 28.21 | 3 | 1 | 0 | 0 |
| 23 | 11.86 | 45.82 | 2 | 3 | 9 | 1 |
| 24 | 10.70 | 46.21 | 1 | 3 | 3 | 2 |
| 25 | 10.01 | 32.86 | 1 | 1 | 3 | 1 |
| 26 | 10.32 | 29.48 | 2 | 1 | 0 | 1 |
| 27 | 10.71 | 55.32 | 1 | 8 | 2 | 1 |
| 28 | 13.94 | 75.91 | 3 | 10 | 9 | 0 |
| 29 | 9.22 | 28.74 | 1 | 1 | 0 | 1 |
| 30 | 12.84 | 27.41 | 1 | 1 | 0 | 0 |
| 31 | 8.80 | 25.74 | 0 | 0 | 0 | 2 |
| 32 | 10.79 | 48.88 | 3 | 9 | 0 | 0 |
| 33 | 9.10 | 38.32 | 1 | 5 | 0 | 0 |
| 34 | 10.68 | 40.14 | 3 | 6 | 1 | 0 |
| 35 | 9.72 | 31.86 | 2 | 3 | 0 | 0 |
| 36 | 10.02 | 35.77 | 2 | 3 | 1 | 0 |
| 37 | 9.65 | 24.11 | 1 | 1 | 0 | 0 |
| 38 | 10.54 | 34.82 | 3 | 2 | 1 | 1 |
| 39 | 10.07 | 24.59 | 2 | 1 | 0 | 0 |
| 40 | 11.79 | 31.45 | 2 | 2 | 0 | 0 |
| 41 | 11.24 | 48.99 | 2 | 9 | 0 | 0 |
| 42 | 11.19 | 38.58 | 3 | 4 | 0 | 0 |
| 43 | 10.37 | 45.31 | 3 | 8 | 0 | 0 |
| 44 | 11.08 | 37.68 | 3 | 4 | 1 | 0 |
| 45 | 10.64 | 40.00 | 3 | 5 | 1 | 0 |
| 46 | 10.57 | 36.94 | 3 | 5 | 1 | 0 |
| 47 | 8.97 | 23.15 | 1 | 1 | 0 | 0 |
| 48 | 10.57 | 46.37 | 2 | 4 | 0 | 0 |
| 49 | 9.54 | 33.82 | 1 | 5 | 0 | 0 |
| 50 | 9.31 | 25.53 | 2 | 1 | 0 | 0 |
| 51 | 9.33 | 30.48 | 2 | 4 | 0 | 0 |
| 52 | 9.64 | 34.37 | 1 | 5 | 0 | 0 |
| 53 | 7.15 | 40.42 | 1 | 7 | 0 | 0 |
| 54 | 8.70 | 26.75 | 0 | 2 | 0 | 0 |
| 55 | 10.10 | 28.46 | 3 | 2 | 0 | 0 |
| 56 | 10.19 | 24.13 | 2 | 1 | 0 | 0 |
| 57 | 9.57 | 27.89 | 1 | 2 | 0 | 0 |
| 58 | 10.05 | 21.43 | 0 | 0 | 0 | 0 |
| 59 | 9.28 | 22.94 | 0 | 1 | 0 | 0 |
| 60 | 11.01 | 32.86 | 1 | 1 | 0 | 2 |

**Genstat output**

```
341  job 'analysis of SP16 - stored cabbage trial, SCEPTREPLUS, Carl
Sharp'
 342  "
-343  Simple analysis - BIBD, no spatial effects
-344  "
 345
 346  import 'AHDB SP16 RAW DATA.xlsx'; sheet='Data for analysis'
```

## Loading Spreadsheet File

Catalogue of file AHDB SP16 RAW DATA.xlsx

Sheet Title: Data for analysis
Description: Data read from AHDB SP16 RAW DATA.xlsx [Data for analysis]A2:U61
Sheet Type: vector

| Index | Type | Nval | Name |
|-------|------|------|------|
| 1 | factor | 60 | Stack |
| 2 | factor | 60 | Height |
| 3 | factor | 60 | Block |
| 4 | factor | 60 | Plot |
| 5 | factor | 60 | Treat |
| 6 | variate | 60 | Treat_no |
| 7 | variate | 60 | PlotNo |
| 8 | variate | 60 | Initial_weight |
| 9 | variate | 60 | Stored_wt |
| 10 | variate | 60 | Post_storage_wt |
| 11 | variate | 60 | Post_trimming_wt |
| 12 | variate | 60 | %Dehydration_loss |
| 13 | variate | 60 | %Trimming_loss |
| 14 | variate | 60 | Botrytis_score |
| 15 | variate | 60 | Botrytis_discard_no |
| 16 | variate | 60 | Phytophora_discard_no |
| 17 | variate | 60 | Canker_discard_no |

```
347
348  fact [lab=!t(Water,'Rovral WG',AHDB 9925,AHDB9924,AHDB
9927,AHDB9926,AHDB9923,AHDB9936,AHDB9937,\
349      AHDB9956); mod=y] Treatment; val=Treat_no
350
351  calc %Post_storage_wt = Post_storage_wt*100/Stored_wt
352  calc %Post_trimming_wt = Post_trimming_wt*100/Stored_wt
353
354  calc %Dehydration_loss = (Stored_wt -
Post_storage_wt)*100/Stored_wt
355  calc %Trimming_loss_ps = (Post_storage_wt -
Post_trimming_wt)*100/Post_storage_wt
356
357  calc
a%Post_storage_wt,a%Post_trimming_wt,a%Dehydration_loss,a%Trimming_lo
ss,a%Trimming_loss_ps =\
358
ang(%Post_storage_wt,%Post_trimming_wt,%Dehydration_loss,%Trimming_lo
ss,%Trimming_loss_ps)
359
360  calc All_discard_no = Botrytis_discard_no +
Phytophora_discard_no + Canker_discard_no
361  calc Marketable_no = 28 - All_discard_no
362
363  calc
%Marketable_no,%Botrytis_discard_no,%Phytophora_discard_no,%Canker_di
scard_no =\
364
Marketable_no,Botrytis_discard_no,Phytophora_discard_no,Canker_discar
d_no*100/28
365
366  calc
a%Marketable_no,a%Botrytis_discard_no,a%Phytophora_discard_no,a%Canke
r_discard_no =\
367
ang(%Marketable_no,%Botrytis_discard_no,%Phytophora_discard_no,%Canke
r_discard_no)
368
369  text h[1]; '  Total weight (30 heads) at storage'
370    & h[2]; '  Stored weight (28 heads (after sampling)'
371    & h[3]; '  Post-storage weight (28 heads)'
372    & h[4]; '  Post-trimming weight (28 heads)'
373    & h[5]; '  Post-storage weight (28 heads) as a percentage
of stored weight (angular transformation)'
374    & h[6]; '  Post-trimming weight (28 heads) as a percentage
of stored weight (angular transformation)'
375    & h[7]; '  Weight loss due to dehydration as a percentage
of stored weight (angular transformation)'
376    & h[8]; '  Weight loss due to trimming as a percentage of
stored weight (angular transformation)'
377    & h[9]; '  Weight loss due to trimming as a percentage of
post-storage weight (angular transformation)'
378    & h[10]; '  Botrytis score (per plot)'
379    & h[11]; '  Number of marketable heads (disease free) (out
of 28) (angular transformation)'
380    & h[12]; '  Number of Botrytis discard heads (out of 28)
(angular transformation)'
381    & h[13]; '  Number of Phytophora discard heads (out of 28)
(angular transformation)'
382    & h[14]; '  Number of Canker discard heads (out of 28)
(angular transformation)'
```

```
383
384  vari [mod=y]
Initial_weight,Stored_wt,Post_storage_wt,Post_trimming_wt,a%Post_stor
age_wt,\
385
a%Post_trimming_wt,a%Dehydration_loss,a%Trimming_loss,a%Trimming_loss
_ps,Botrytis_score,\
386
a%Marketable_no,a%Botrytis_discard_no,a%Phytophora_discard_no,a%Canke
r_discard_no;\
387       ext=h[1...14]
388
389  block Block
390  treat Treatment
391
392  for
dy=Initial_weight,Stored_wt,Post_storage_wt,Post_trimming_wt,Botrytis
_score
393
394  anov [pse=diff,lsd; fprob=y] dy
395  aplot
396
397  endfor
```

# Analysis of variance

Variate: Initial_weight Total weight (30 heads) at storage

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 1322.18 | 146.91 | 2.20 | 0.199 |
| Residual | 5 | 333.61 | 66.72 | 2.32 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 473.90 | 52.66 | 1.83 | 0.096 |
| Residual | 36 | 1034.34 | 28.73 | | |
| | | | | | |
| Total | 59 | 3164.02 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
| Treatment | 0.167 | |
| Block.*Units* stratum | | |
| Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | |
|---|---|---|
| Block 6 *units* 1 | 10.95 approx. s.e. | 4.15 |
| Block 13 *units* 4 | -9.18 approx. s.e. | 4.15 |

# Tables of means

Variate: Initial_weight Total weight (30 heads) at storage

Grand mean  117.81

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 112.70 | 120.44 | 118.57 | 118.27 | 122.83 | 117.18 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 115.49 | 113.09 | 119.68 | 119.84 |

## Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 3.390 |

## Least significant differences of means (5% level)

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 6.875 |

# Analysis of variance

Variate: Stored_wt Stored weight (28 heads (after sampling)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 1280.91 | 142.32 | 2.87 | 0.129 |
| Residual | 5 | 248.25 | 49.65 | 2.08 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 466.12 | 51.79 | 2.17 | 0.048 |
| Residual | 36 | 857.73 | 23.83 | | |
| | | | | | |
| Total | 59 | 2853.02 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
| Treatment | 0.167 | |
| Block.*Units* stratum | | |
| Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | |
|---|---|---|
| Block 6 *units* 1 | 9.73 approx. s.e. | 3.78 |
| Block 13 *units* 4 | -8.50 approx. s.e. | 3.78 |

# Tables of means

Variate: Stored_wt Stored weight (28 heads (after sampling)

Grand mean  110.67

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 105.31 | 113.10 | 111.59 | 110.89 | 115.44 | 110.65 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 108.30 | 106.09 | 113.07 | 112.30 |

## Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 3.087 |

## Least significant differences of means (5% level)

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 6.261 |

# Analysis of variance

Variate: Post_storage_wt Post-storage weight (28 heads)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 1024.86 | 113.87 | 2.45 | 0.169 |
| Residual | 5 | 232.72 | 46.54 | 2.44 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 382.75 | 42.53 | 2.23 | 0.043 |
| Residual | 36 | 687.45 | 19.10 | | |
| | | | | | |
| Total | 59 | 2327.78 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
| Treatment | 0.167 | |
| Block.*Units* stratum | | |
| Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | |
|---|---|---|
| Block 6 *units* 1 | 7.64 | approx. s.e. 3.38 |
| Block 13 *units* 2 | 7.86 | approx. s.e. 3.38 |
| Block 13 *units* 4 | -8.37 | approx. s.e. 3.38 |

# Tables of means

Variate: Post_storage_wt Post-storage weight (28 heads)

Grand mean 99.02

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 93.75 | 101.70 | 99.48 | 99.79 | 102.88 | 100.33 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 97.32 | 94.71 | 100.51 | 99.75 |

## Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 2.764 |

## Least significant differences of means (5% level)

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 5.605 |

# Analysis of variance

Variate: Post_trimming_wt Post-trimming weight (28 heads)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 1850.5 | 205.6 | 0.83 | 0.621 |
| Residual | 5 | 1241.1 | 248.2 | 2.41 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 1853.0 | 205.9 | 2.00 | 0.068 |
| Residual | 36 | 3704.6 | 102.9 | | |
| | | | | | |
| Total | 59 | 8649.2 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
|   Treatment | 0.167 | |
| Block.*Units* stratum | | |
|   Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | |
|---|---|---|
| Block 13 | 9.2 approx. s.e. | 4.5 |
| | | |
| Block 6 *units* 2 | 20.0 approx. s.e. | 7.9 |
| Block 7 *units* 4 | -21.9 approx. s.e. | 7.9 |
| Block 13 *units* 2 | 20.3 approx. s.e. | 7.9 |

# Tables of means

Variate: Post_trimming_wt Post-trimming weight (28 heads)

Grand mean 71.3

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 59.4 | 73.9 | 78.5 | 71.9 | 69.0 | 79.8 |

| Treatment | AHDB9923 | Serenade | AHDB9936 | AHDB9956 |
|---|---|---|---|---|
| | 75.9 | 73.6 | 66.3 | 64.8 |

## Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 6.42 |

## Least significant differences of means (5% level)

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 13.01 |

# Analysis of variance

Variate: Botrytis_score Botrytis score (per plot)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 18.9750 | 2.1083 | 1.41 | 0.367 |
| Residual | 5 | 7.4583 | 1.4917 | 7.75 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 23.5750 | 2.6194 | 13.62 | <.001 |
| Residual | 36 | 6.9250 | 0.1924 | | |
| | | | | | |
| Total | 59 | 56.9333 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
| Treatment | 0.167 | |
| Block.*Units* stratum | | |
| Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| Block 15 *units* 2 | -1.013 approx. s.e. | 0.340 |
|---|---|---|
| Block 15 *units* 3 | 0.787 approx. s.e. | 0.340 |

# Tables of means

Variate: Botrytis_score Botrytis score (per plot)

Grand mean  1.533

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 2.483 | 1.133 | 1.733 | 0.433 | 1.083 | 0.583 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 1.383 | 2.383 | 2.083 | 2.033 |

## Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 0.2774 |

## Least significant differences of means (5% level)

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 0.5626 |

```
 398
 399  for
dy=a%Post_storage_wt,a%Post_trimming_wt,a%Dehydration_loss,a%Trimming
_loss,a%Trimming_loss_ps,\
 400
a%Marketable_no,a%Botrytis_discard_no,a%Phytophora_discard_no,a%Canke
r_discard_no
 401
 402  anov [pse=diff,lsd; fprob=y] dy
 403  aplot
 404  akeep Treatment; means=mtab
 405  calc btmtab=iang(mtab)
 406  print mtab,btmtab
 407
 408  endfor
```

# Analysis of variance

Variate: a%Post_storage_wt Post-storage weight (28 heads) as a percentage of   stored weight (angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| **Block stratum** | | | | | |
| Treatment | 9 | 11.4711 | 1.2746 | 0.33 | 0.927 |
| Residual | 5 | 19.0911 | 3.8182 | 6.10 | |
| | | | | | |
| **Block.*Units* stratum** | | | | | |
| Treatment | 9 | 14.0643 | 1.5627 | 2.50 | 0.025 |
| Residual | 36 | 22.5220 | 0.6256 | | |
| | | | | | |
| Total | 59 | 67.1484 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
|   Treatment | 0.167 | |
| Block.*Units* stratum | | |
|   Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | | |
|---|---|---|---|
| Block 7 *units* 4 | -1.72 | approx. s.e. | 0.61 |
| Block 8 *units* 2 | -1.73 | approx. s.e. | 0.61 |
| Block 14 *units* 1 | 2.17 | approx. s.e. | 0.61 |

# Tables of means

Variate: a%Post_storage_wt Post-storage weight (28 heads) as a percentage of   stored weight (angular transformation)

Grand mean  71.10

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 70.66 | 71.50 | 70.75 | 71.64 | 70.79 | 72.17 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 71.46 | 70.90 | 70.61 | 70.48 |

# Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 0.500 |

# Least significant differences of means (5% level)

| Table | Treatment |
|-------|-----------|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 1.015 |

| Treatment | mtab | btmtab |
|-----------|-------|--------|
| Water | 70.66 | 89.04 |
| Rovral WG | 71.50 | 89.93 |
| AHDB9925 | 70.75 | 89.13 |
| AHDB9924 | 71.64 | 90.08 |
| AHDB9927 | 70.79 | 89.17 |
| AHDB9926 | 72.17 | 90.63 |
| AHDB9923 | 71.46 | 89.89 |
| Serenade | 70.90 | 89.29 |
| AHDB9937 | 70.61 | 88.97 |
| AHDB9956 | 70.48 | 88.83 |

# Analysis of variance

Variate: a%Post_trimming_wt Post-trimming weight (28 heads) as a percentage of   stored weight (angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 986.43 | 109.60 | 1.39 | 0.375 |
| Residual | 5 | 394.55 | 78.91 | 2.98 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 546.35 | 60.71 | 2.29 | 0.038 |
| Residual | 36 | 952.91 | 26.47 | | |
| | | | | | |
| Total | 59 | 2880.24 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
| Treatment | 0.167 | |
| Block.*Units* stratum | | |
| Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | |
|---|---|---|
| Block 13 | 5.30 approx. s.e. | 2.56 |
| | | |
| Block 6 *units* 1 | -10.45 approx. s.e. | 3.99 |
| Block 6 *units* 2 | 9.01 approx. s.e. | 3.99 |
| Block 7 *units* 2 | 9.20 approx. s.e. | 3.99 |
| Block 7 *units* 4 | -11.98 approx. s.e. | 3.99 |

# Tables of means

Variate: a%Post_trimming_wt Post-trimming weight (28 heads) as a percentage of   stored weight (angular transformation)

Grand mean  53.76

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 48.89 | 54.27 | 56.98 | 54.69 | 50.86 | 58.04 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 57.20 | 56.57 | 50.43 | 49.70 |

# Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 3.254 |

# Least significant differences of means (5% level)

| Table | Treatment |
|-------|-----------|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 6.599 |

| Treatment | mtab | btmtab |
|-----------|------|--------|
| Water | 48.89 | 56.77 |
| Rovral WG | 54.27 | 65.90 |
| AHDB9925 | 56.98 | 70.31 |
| AHDB9924 | 54.69 | 66.60 |
| AHDB9927 | 50.86 | 60.16 |
| AHDB9926 | 58.04 | 71.97 |
| AHDB9923 | 57.20 | 70.65 |
| Serenade | 56.57 | 69.66 |
| AHDB9937 | 50.43 | 59.42 |
| AHDB9956 | 49.70 | 58.16 |

# Analysis of variance

Variate: a%Dehydration_loss Weight loss due to dehydration as a percentage of   stored weight (angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 11.4711 | 1.2746 | 0.33 | 0.927 |
| Residual | 5 | 19.0911 | 3.8182 | 6.10 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 14.0643 | 1.5627 | 2.50 | 0.025 |
| Residual | 36 | 22.5220 | 0.6256 | | |
| | | | | | |
| Total | 59 | 67.1484 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
| Treatment | 0.167 | |
| Block.*Units* stratum | | |
| Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | | | |
|---|---|---|---|---|
| Block 7 *units* 4 | | 1.72 | approx. s.e. | 0.61 |
| Block 8 *units* 2 | | 1.73 | approx. s.e. | 0.61 |
| Block 14 *units* 1 | | -2.17 | approx. s.e. | 0.61 |

# Tables of means

Variate: a%Dehydration_loss Weight loss due to dehydration as a percentage of   stored weight (angular transformation)

Grand mean  18.90

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 19.34 | 18.50 | 19.25 | 18.36 | 19.21 | 17.83 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 18.54 | 19.10 | 19.39 | 19.52 |

# Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 0.500 |

# Least significant differences of means (5% level)

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 1.015 |

| Treatment | mtab | btmtab |
|---|---|---|
| Water | 19.34 | 10.96 |
| Rovral WG | 18.50 | 10.07 |
| AHDB9925 | 19.25 | 10.87 |
| AHDB9924 | 18.36 | 9.92 |
| AHDB9927 | 19.21 | 10.83 |
| AHDB9926 | 17.83 | 9.37 |
| AHDB9923 | 18.54 | 10.11 |
| Serenade | 19.10 | 10.71 |
| AHDB9937 | 19.39 | 11.03 |
| AHDB9956 | 19.52 | 11.17 |

# Analysis of variance

Variate: a%Trimming_loss Weight loss due to trimming as a percentage of stored   weight (angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 986.43 | 109.60 | 1.39 | 0.375 |
| Residual | 5 | 394.55 | 78.91 | 2.98 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 546.35 | 60.71 | 2.29 | 0.038 |
| Residual | 36 | 952.91 | 26.47 | | |
| | | | | | |
| Total | 59 | 2880.24 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
|   Treatment | 0.167 | |
| Block.*Units* stratum | | |
|   Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | |
|---|---|
| Block 13 | -5.30 approx. s.e.  2.56 |
| | |
| Block 6 *units* 1 | 10.45 approx. s.e.  3.99 |
| Block 6 *units* 2 | -9.01 approx. s.e.  3.99 |
| Block 7 *units* 2 | -9.20 approx. s.e.  3.99 |
| Block 7 *units* 4 | 11.98 approx. s.e.  3.99 |

# Tables of means

Variate: a%Trimming_loss Weight loss due to trimming as a percentage of stored   weight (angular transformation)

Grand mean  36.24

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 41.11 | 35.73 | 33.02 | 35.31 | 39.14 | 31.96 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 32.80 | 33.43 | 39.57 | 40.30 |

# Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 3.254 |

# Least significant differences of means (5% level)

| Table | Treatment |
|-------|-----------|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 6.599 |

| Treatment | mtab | btmtab |
|-----------|------|--------|
| Water | 41.11 | 43.23 |
| Rovral WG | 35.73 | 34.10 |
| AHDB9925 | 33.02 | 29.69 |
| AHDB9924 | 35.31 | 33.40 |
| AHDB9927 | 39.14 | 39.84 |
| AHDB9926 | 31.96 | 28.03 |
| AHDB9923 | 32.80 | 29.35 |
| Serenade | 33.43 | 30.34 |
| AHDB9937 | 39.57 | 40.58 |
| AHDB9956 | 40.30 | 41.84 |

# Analysis of variance

Variate: a%Trimming_loss_ps Weight loss due to trimming as a percentage of   post-storage weight (angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 1387.18 | 154.13 | 1.62 | 0.308 |
| Residual | 5 | 474.55 | 94.91 | 2.72 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 697.40 | 77.49 | 2.22 | 0.044 |
| Residual | 36 | 1257.71 | 34.94 | | |
| | | | | | |
| Total | 59 | 3816.84 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
|   Treatment | 0.167 | |
| Block.*Units* stratum | | |
|   Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | |
|---|---|---|
| Block 13 | -5.65 approx. s.e. | 2.81 |
| | | |
| Block 6 *units* 1 | 11.78 approx. s.e. | 4.58 |
| Block 6 *units* 2 | -10.57 approx. s.e. | 4.58 |
| Block 7 *units* 4 | 12.94 approx. s.e. | 4.58 |

# Tables of means

Variate: a%Trimming_loss_ps Weight loss due to trimming as a percentage of   post-storage weight (angular transformation)

Grand mean  31.30

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 36.96 | 30.95 | 27.33 | 30.35 | 34.47 | 26.92 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 27.38 | 27.83 | 34.95 | 35.86 |

# Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 3.738 |

## Least significant differences of means (5% level)

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 7.582 |

| Treatment | mtab | btmtab |
|---|---|---|
| Water | 36.96 | 36.15 |
| Rovral WG | 30.95 | 26.45 |
| AHDB9925 | 27.33 | 21.08 |
| AHDB9924 | 30.35 | 25.54 |
| AHDB9927 | 34.47 | 32.02 |
| AHDB9926 | 26.92 | 20.50 |
| AHDB9923 | 27.38 | 21.15 |
| Serenade | 27.83 | 21.79 |
| AHDB9937 | 34.95 | 32.81 |
| AHDB9956 | 35.86 | 34.31 |

# Analysis of variance

Variate: a%Marketable_no Number of marketable heads (disease free) (out of 28)   (angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 3591.78 | 399.09 | 1.52 | 0.337 |
| Residual | 5 | 1315.33 | 263.07 | 2.98 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 1814.21 | 201.58 | 2.29 | 0.038 |
| Residual | 36 | 3174.57 | 88.18 | | |
| | | | | | |
| Total | 59 | 9895.88 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
| Treatment | 0.167 | |
| Block.*Units* stratum | | |
| Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | |
|---|---|
| Block 6 *units* 1 | -21.3 approx. s.e.  7.3 |
| Block 6 *units* 2 | 20.8 approx. s.e.  7.3 |
| Block 13 *units* 2 | 17.4 approx. s.e.  7.3 |

# Tables of means

Variate: a%Marketable_no Number of marketable heads (disease free) (out of 28)   (angular transformation)

Grand mean  68.7

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 58.4 | 68.8 | 74.9 | 68.4 | 63.4 | 75.1 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 75.6 | 75.3 | 63.3 | 63.5 |

# Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 5.94 |

# Least significant differences of means (5% level)

| Table | Treatment |
|-------|-----------|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 12.05 |

| Treatment | mtab | btmtab |
|-----------|------|--------|
| Water | 58.40 | 72.54 |
| Rovral WG | 68.78 | 86.90 |
| AHDB9925 | 74.95 | 93.26 |
| AHDB9924 | 68.35 | 86.39 |
| AHDB9927 | 63.37 | 79.91 |
| AHDB9926 | 75.14 | 93.42 |
| AHDb9923 | 75.56 | 93.78 |
| Serenade | 75.34 | 93.60 |
| AHDB9937 | 63.26 | 79.76 |
| AHDB9956 | 63.51 | 80.11 |

# Analysis of variance

Variate: a%Botrytis_discard_no Number of Botrytis discard heads (out of 28)   (angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum |  |  |  |  |  |
| Treatment | 9 | 2849.75 | 316.64 | 1.96 | 0.237 |
| Residual | 5 | 806.17 | 161.23 | 1.88 |  |
|  |  |  |  |  |  |
| Block.*Units* stratum |  |  |  |  |  |
| Treatment | 9 | 1901.97 | 211.33 | 2.46 | 0.027 |
| Residual | 36 | 3090.36 | 85.84 |  |  |
|  |  |  |  |  |  |
| Total | 59 | 8648.25 |  |  |  |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum |  |  |
|   Treatment | 0.167 |  |
| Block.*Units* stratum |  |  |
|   Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

Block 6 *units* 1                                          27.5 approx. s.e.   7.2

# Tables of means

Variate: a%Botrytis_discard_no Number of Botrytis discard heads (out of 28)   (angular transformation)

Grand mean  18.3

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
|  | 29.8 | 18.6 | 13.9 | 20.5 | 25.6 | 9.3 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
|  | 12.6 | 11.6 | 19.5 | 21.8 |

## Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 5.86 |

## Least significant differences of means (5% level)

| Table | Treatment |
|---|---|

| | | |
|---|---|---|
| rep. | | 6 |
| d.f. | | 36 |
| l.s.d. | | 11.88 |

| Treatment | mtab | btmtab |
|---|---|---|
| Water | 29.78 | 24.68 |
| Rovral WG | 18.62 | 10.19 |
| AHDB9925 | 13.93 | 5.80 |
| AHDB9924 | 20.49 | 12.25 |
| AHDB9927 | 25.57 | 18.63 |
| AHDB9926 | 9.32 | 2.62 |
| AHDb9923 | 12.56 | 4.73 |
| Serenade | 11.64 | 4.07 |
| AHDB9937 | 19.50 | 11.15 |
| AHDB9956 | 21.81 | 13.80 |

# Analysis of variance

Variate: a%Phytophora_discard_no Number of Phytophora discard heads (out of 28)
(angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 617.78 | 68.64 | 0.28 | 0.954 |
| Residual | 5 | 1231.28 | 246.26 | 4.87 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 426.64 | 47.40 | 0.94 | 0.505 |
| Residual | 36 | 1820.08 | 50.56 | | |
| | | | | | |
| Total | 59 | 4095.77 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
|   Treatment | 0.167 | |
| Block.*Units* stratum | | |
|   Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

| | | |
|---|---|---|
| Block 5 *units* 2 | -13.33 approx. s.e. | 5.51 |
| Block 6 *units* 2 | -12.40 approx. s.e. | 5.51 |
| Block 6 *units* 3 | 15.28 approx. s.e. | 5.51 |
| Block 7 *units* 2 | -12.88 approx. s.e. | 5.51 |
| Block 11 *units* 4 | 12.34 approx. s.e. | 5.51 |

# Tables of means

Variate: a%Phytophora_discard_no Number of Phytophora discard heads (out of 28)
(angular transformation)

Grand mean 5.24

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | 7.97 | 5.48 | 1.78 | 1.47 | 3.83 | 5.66 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 3.06 | 4.96 | 11.83 | 6.38 |

# Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 4.497 |

# Least significant differences of means (5% level)

| Table | Treatment |
|-------|-----------|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 9.120 |

| Treatment | mtab | btmtab |
|-----------|------|--------|
| Water | 7.965 | 1.920 |
| Rovral WG | 5.480 | 0.912 |
| AHDB9925 | 1.785 | 0.097 |
| AHDB9924 | 1.470 | 0.066 |
| AHDB9927 | 3.826 | 0.445 |
| AHDB9926 | 5.656 | 0.971 |
| AHDB9923 | 3.063 | 0.286 |
| Serenade | 4.965 | 0.749 |
| AHDB9937 | 11.828 | 4.202 |
| AHDB9956 | 6.381 | 1.235 |

# Analysis of variance

Variate: a%Canker_discard_no Number of Canker discard heads (out of 28)   (angular transformation)

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---|---|---|---|---|---|
| Block stratum | | | | | |
| Treatment | 9 | 443.09 | 49.23 | 4.61 | 0.054 |
| Residual | 5 | 53.43 | 10.69 | 0.72 | |
| | | | | | |
| Block.*Units* stratum | | | | | |
| Treatment | 9 | 192.82 | 21.42 | 1.44 | 0.207 |
| Residual | 36 | 534.97 | 14.86 | | |
| | | | | | |
| Total | 59 | 1224.31 | | | |

# Information summary

| Model term | e.f. | non-orthogonal terms |
|---|---|---|
| Block stratum | | |
| Treatment | 0.167 | |
| Block.*Units* stratum | | |
| Treatment | 0.833 | Block |

*Message: the following units have large residuals.*

Block 15 *units* 4                                     8.31 approx. s.e.   2.99

# Tables of means

Variate: a%Canker_discard_no Number of Canker discard heads (out of 28)   (angular transformation)

Grand mean  1.86

| Treatment | Water | Rovral WG | AHDB9925 | AHDB9924 | AHDB9927 | AHDB9926 |
|---|---|---|---|---|---|---|
| | -0.23 | 3.27 | 1.86 | 0.54 | 0.54 | 4.65 |

| Treatment | AHDB9923 | Serenade | AHDB9937 | AHDB9956 |
|---|---|---|---|---|
| | 1.32 | -0.23 | 1.09 | 5.82 |

# Standard errors of differences of means

| Table | Treatment |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| s.e.d. | 2.438 |

# Least significant differences of means (5% level)

| Table | Treatment |
|---|---|

| | |
|---|---|
| rep. | 6 |
| d.f. | 36 |
| l.s.d. | 4.945 |

*Warning 55, code CA 7, statement 5 in for loop*

Command: calc btmtab=iang(mtab)
Invalid value for argument of function.
The first argument of the IANGULAR function in unit  1 has the value -0.2304

| Treatment | mtab | btmtab |
|---|---|---|
| Water | -0.230 | * |
| Rovral WG | 3.268 | 0.3250 |
| AHDB9925 | 1.864 | 0.1058 |
| AHDB9924 | 0.545 | 0.0090 |
| AHDB9927 | 0.545 | 0.0090 |
| AHDB9926 | 4.650 | 0.6573 |
| AHDB9923 | 1.320 | 0.0530 |
| Serenade | -0.230 | * |
| AHDB9937 | 1.089 | 0.0361 |
| AHDB9956 | 5.824 | 1.0295 |

```
409
410   endjob
```

End of analysis of SP16 - stored cabbage trial, SCEPTREPLUS, Carl Sharp.

**Appendix F – Trial Design**

**Trial Plan**

Top of stack

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17<br>7 | 18<br>9 | 19<br>1 | 20<br>5 | | 37<br>6 | 38<br>10 | 39<br>7 | 40<br>3 | | 57<br>1 | 58<br>8 | 59<br>6 | 60<br>10 |
| 13<br>4 | 14<br>6 | 15<br>7 | 16<br>5 | | 33<br>4 | 34<br>10 | 35<br>7 | 36<br>2 | | 53<br>5 | 54<br>4 | 55<br>8 | 56<br>3 |
| 9<br>8 | 10<br>2 | 11<br>5 | 12<br>10 | | 29<br>2 | 30<br>5 | 31<br>6 | 32<br>1 | | 49<br>7 | 50<br>9 | 51<br>8 | 52<br>2 |
| 5<br>4 | 6<br>1 | 7<br>3 | 8<br>2 | | 25<br>6 | 26<br>3 | 27<br>2 | 28<br>9 | | 45<br>9 | 46<br>1 | 47<br>4 | 48<br>10 |
| 1<br>1 | 2<br>3 | 3<br>7 | 4<br>8 | | 21<br>4 | 22<br>8 | 23<br>9 | 24<br>6 | | 41<br>5 | 42<br>10 | 43<br>9 | 44<br>3 |

Bottom of stack

**Appendix G – ORETO Certification**

# Certificate of

## Official Recognition of Efficacy Testing Facilities or Organisations in the United Kingdom

### This certifies that

**Allium and Brassica Agronomy Limited**
**Allium & Brassica Centre Limited**

complies with the minimum standards laid down in Regulation (EC) 1107/2009 for efficacy testing.

The above Facility/Organisation has been officially recognised as being competent to carry out efficacy trials/tests in the United Kingdom in the following categories:

**Agriculture/Horticulture**

| | |
|---|---|
| Date of issue: | 3 March 2017 |
| Effective date: | 23 February 2017 |
| Expiry date: | 22 February 2022 |

Signature _____
Authorised signatory

**Certification Number**
ORETO 376

HSE
Chemicals Regulation Division

Department of
Agriculture and
Rural Development