Trial Report 2019-20

Spearmint oil efficacy trial on PPA-submitted crisping varieties

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Sutton Bridge Crop Storage Research
Project Ref: 11140061

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1. Summary

Potatoes for processing have to be kept at relatively warm temperatures (typically 7-10 °C) to control sugar accumulation during storage. Use of colder regimes in most commonly-grown varieties would generally encourage low temperature sweetening. To accommodate this temperature range, it is necessary to control any sprouting after the break of dormancy by the use of a chemical sprout suppressant. The loss of approval for the use of CIPC (chlorpropham) during storage is therefore a major blow to the potato processing sector.

There are few alternatives to CIPC. Only maleic hydrazide (applied to the growing crop in the field) and ethylene or spearmint oil (applied in the store) are currently approved. Ethylene's suitability for use on crisping crop is poor as it has a tendency to increase sugar accumulation. As a consequence, it was anticipated that a combination of MH and spearmint oil will need to be used to control sprouting in most crisping crops in the 2020/21 storage season.

This trial, conducted in collaboration with the Potato Processors' Association, was established to evaluate the relative performance of crisping stocks when stored with spearmint oil sprout suppression. Varietal performance was very variable and changed with time across the duration of the trial. Four crops had received maleic hydrazide to assist with sprout control.

At intake, crops were generally of acceptable quality. However, by sampling occasion 1 after 15 weeks' storage, sprout control varied widely with only Markies, Verdi, Taurus, Lorimer and VR808 retaining sufficient control of sprouting to keep the mean longest sprout measurement below 10 mm. Of these VR808 had not received MH; the remainder had. Fry colour at this mid-term sampling point was generally good across the board, but there were several varieties with poor defect levels with Markies, Arsenal, Olympus, Lady Claire and Taurus all exceeding a 5% mean defect threshold.

At the second sampling occasion, in May 2020, after almost seven months' storage, only five varieties had adequate sprout control (longest sprout <10mm). These were Verdi, Markies, Taurus, Lorimer and VR808; only the latter was controlled without MH. However, the spearmint oil and MH combination worked well as a sprout control combination.

Nevertheless, fry colour was too dark (Hunter L <58) in Lorimer, Arsenal, Olympus and both stocks of Brooke. Of further concern, fry defects were only below a 5% threshold in two of the 12 stocks: this was in the varieties Verdi and Pirol. This may have been a consequence of sprout control but the relatively late loading date and the use of a single storage temperature may also have been factors.

2. Introduction

Following the confirmation in autumn 2019 that CIPC was to be withdrawn, a simple trial was organised at Sutton Bridge Crop Storage Research with the objective to assess the performance of spearmint oil as a sprout suppressant when used on a range of crisping varieties.

The crops were supplied by the Potato Processors' Association through various member companies and their supply chains.

The store had a capacity of 12 tonnes. One tonne of each of twelve stocks was stored. Sprouting and frying quality of each were monitored at three points across the storage period.

3. Materials and methods

Stocks from 12 established crisping varieties were supplied as per the table below (*denotes crop treated with maleic hydrazide (MH)). A single 1-tonne box of each variety was loaded into the store. The store was loaded on 29th October 2019. Initial storage temperature was 13.0 °C and crops were subjected to an immediate temperature pull down of 0.3 C per day to a holding temperature of 9.0 °C. This temperature was attained on 15th November 2019.

Variety	Supplier	Box Position
Arsenal	Pepsico	8
Brooke [C]	Pepsico	2
Brooke [S]	Pepsico	12
Lady Claire	KP Snacks	1
Lorimer*	Tayto	5
Markies*	Tayto	7
Olympus	Tayto	4
Pirol	Pepsico	11
Shelford	Pepsico	9
Taurus*	KP Snacks	10
Verdi*	Tayto	3
VR808	Pepsico	6

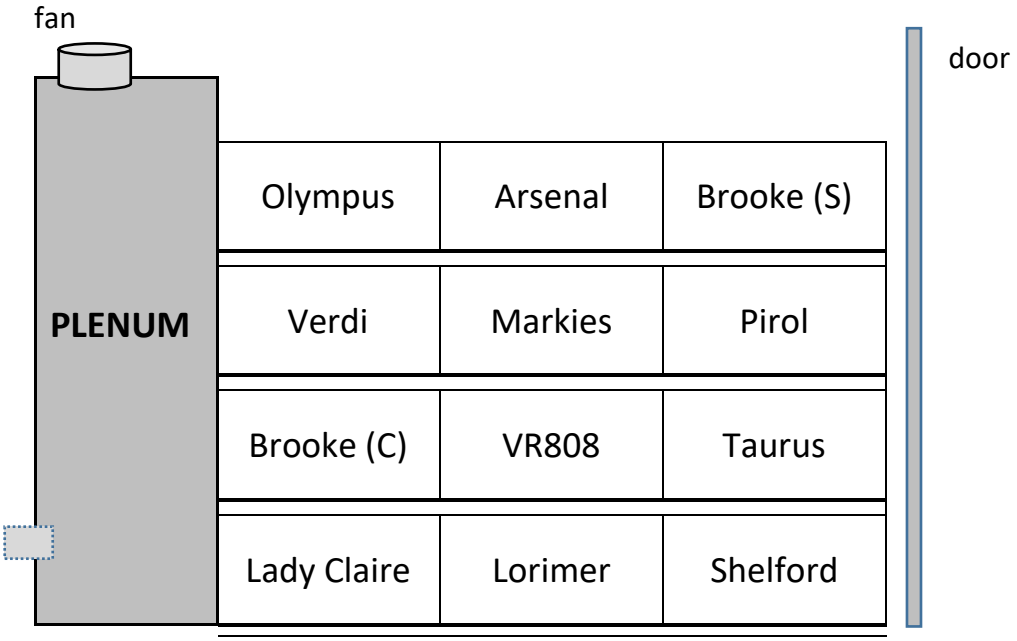


Fig 1: Schematic store layout (fogging port shown lower left into plenum)

Treatment with spearmint oil was arranged as required, with treatments taking place on the following dates:

Date	Interval	Application Rate	Notes
25th November 2019	27 days**	60 ml/t	**after loading
8th January 2020	43 days	60 ml/t	
19th February 2020	42 days	60 ml/t	
1st April 2020	42 days	60 ml/t	

All treatments were carried out using a Cedax Electrofog EWH-3000 machine [Cedax S.r.l., Via F. Guarini 15, 47100 Forli, Italy] (Figure 2) and applied at a target fog temperature of 185 – 190 °C. Temperature and humidity control were re-instated 48 hours after applications.

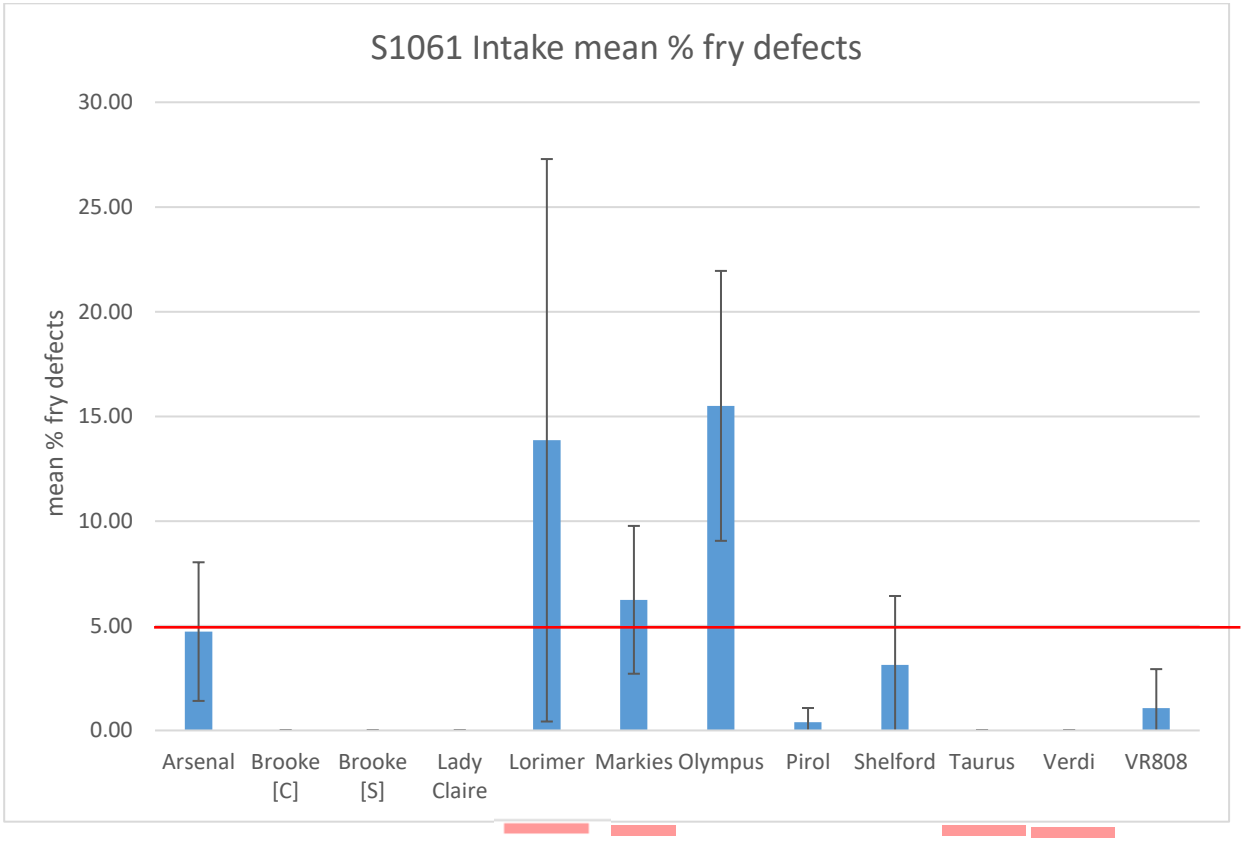
Crops were sampled on 3 occasions – at intake, on 17th February 2020 and finally on 13th May 2020, when they were assessed for sprouting (longest sprout) and processing quality (fry colour and defects).

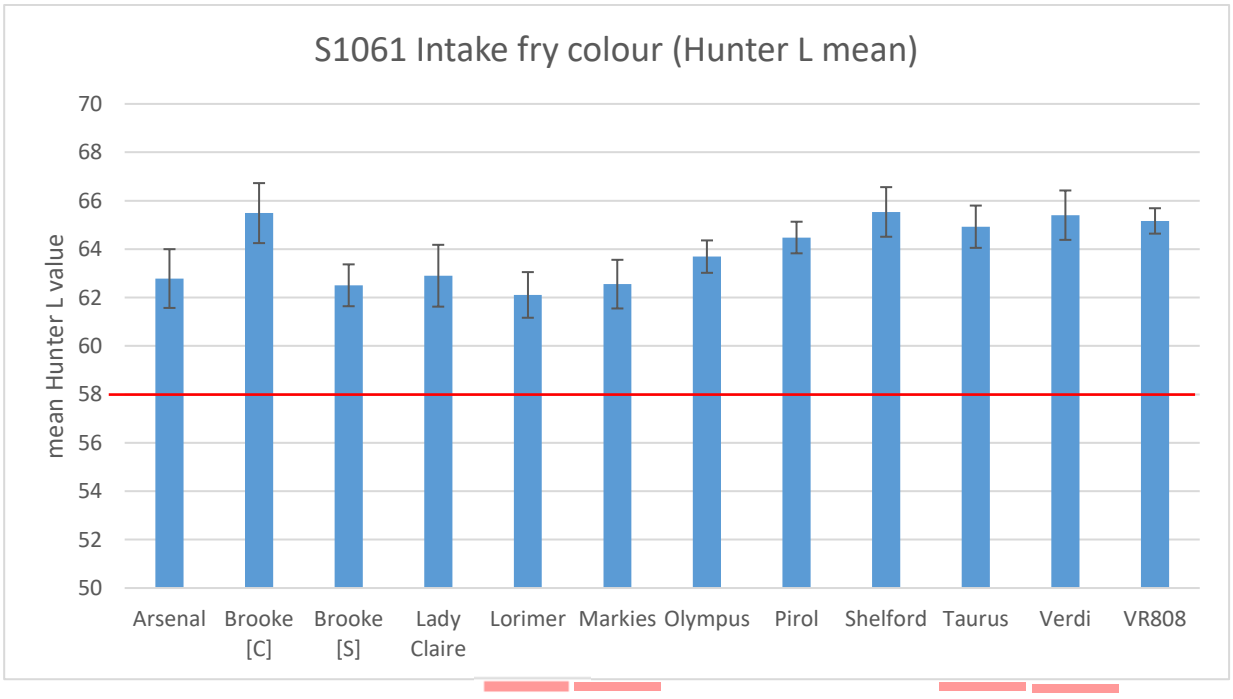
Figure 2. CEDAX Electrofog EWH-3000 for application of spearmint oil

Following application, stores were left sealed, with low level (c.10-12cfm/t) recirculative ventilation for 48 hours. Normal temperature (refrigeration), humidity and carbon dioxide control was resumed after this two day period. For both store loading and for recovery after application, temperature pull-down was limited to 0.3 °C/day. Store holding temperature was 9.0 °C +/- 0.5°C. Carbon dioxide was controlled at a maximum of 5000ppm (0.5%) from the end of January onwards. Relative humidity was maintained at 90%+.

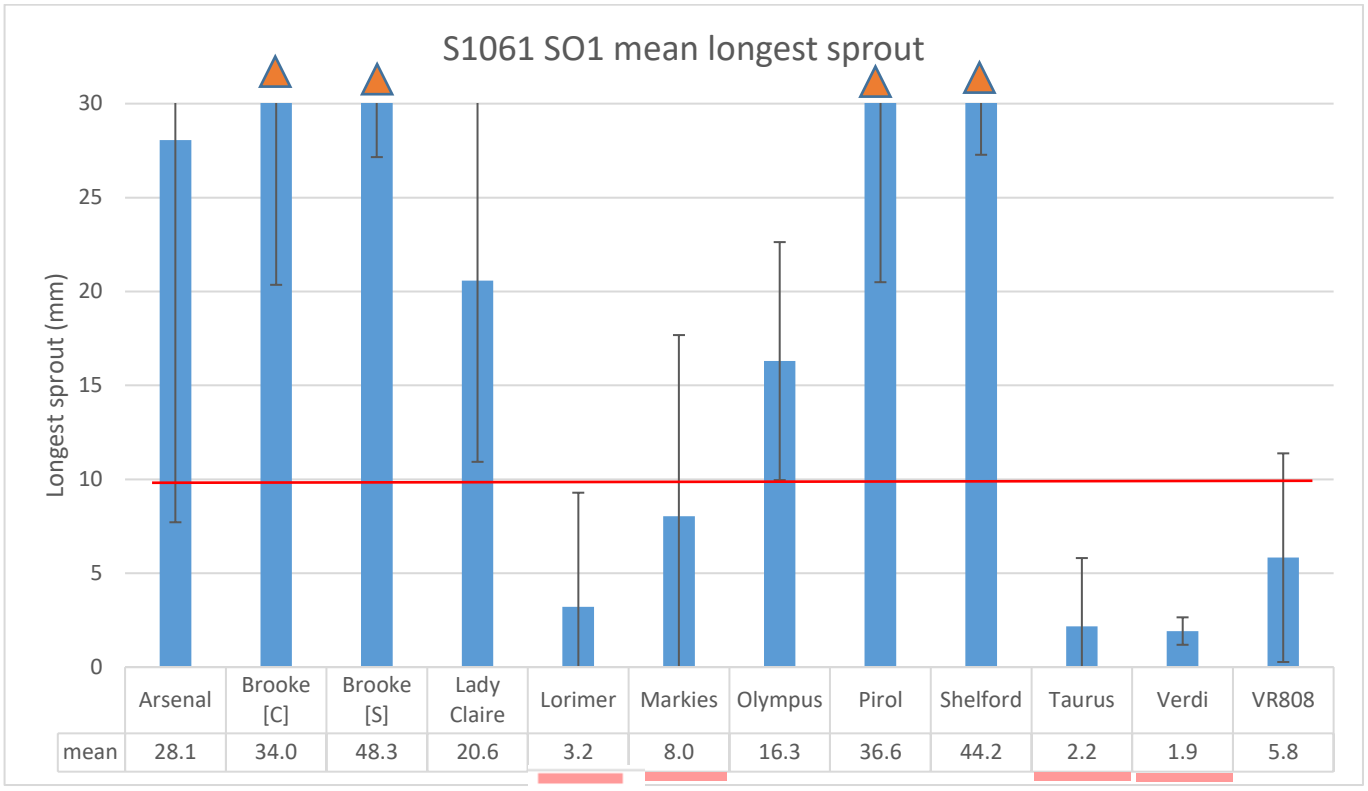
4. Results

INTAKE

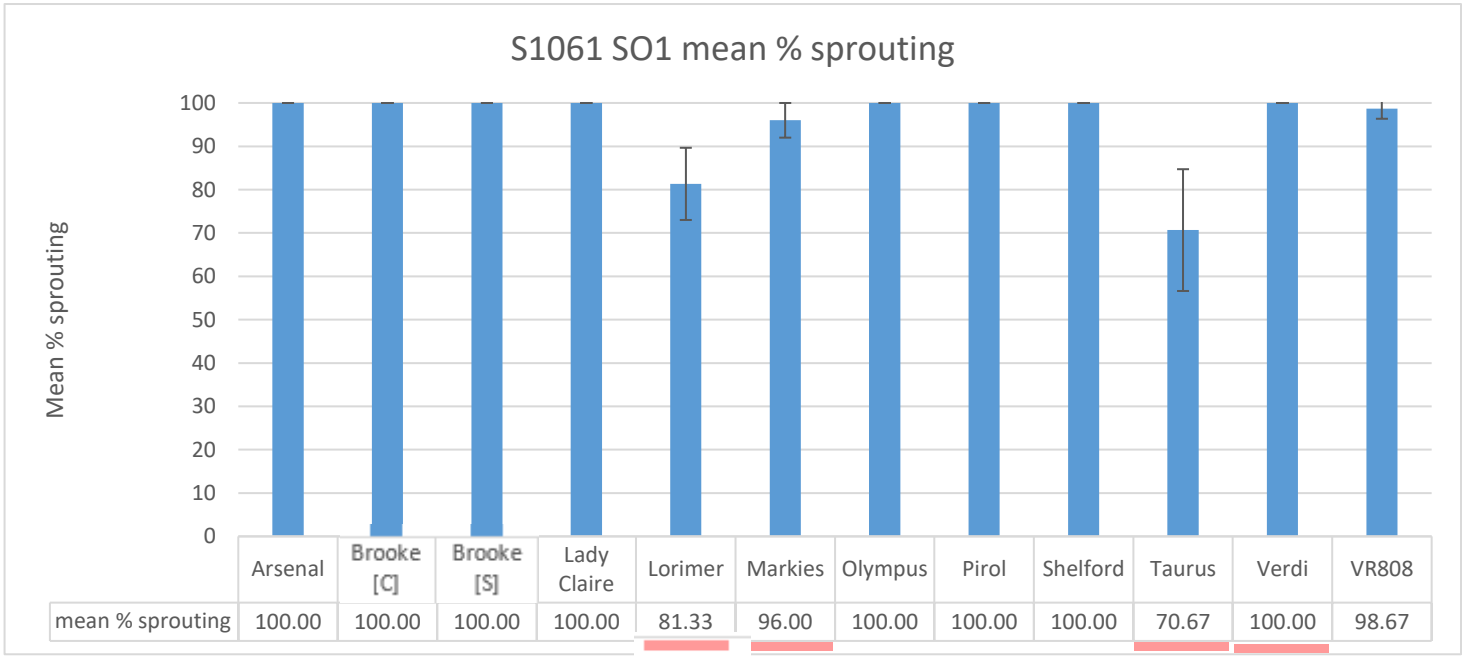




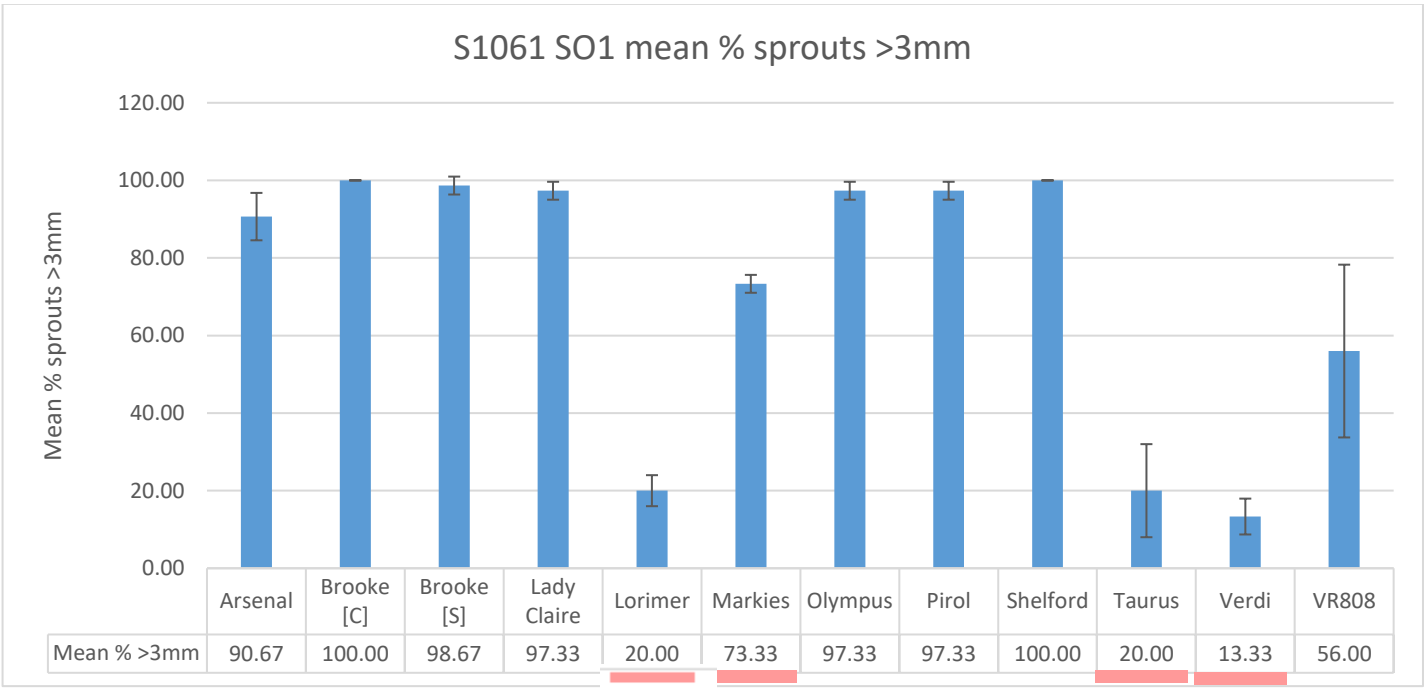
SAMPLING OCCASION 1 (after ~15 weeks' storage)



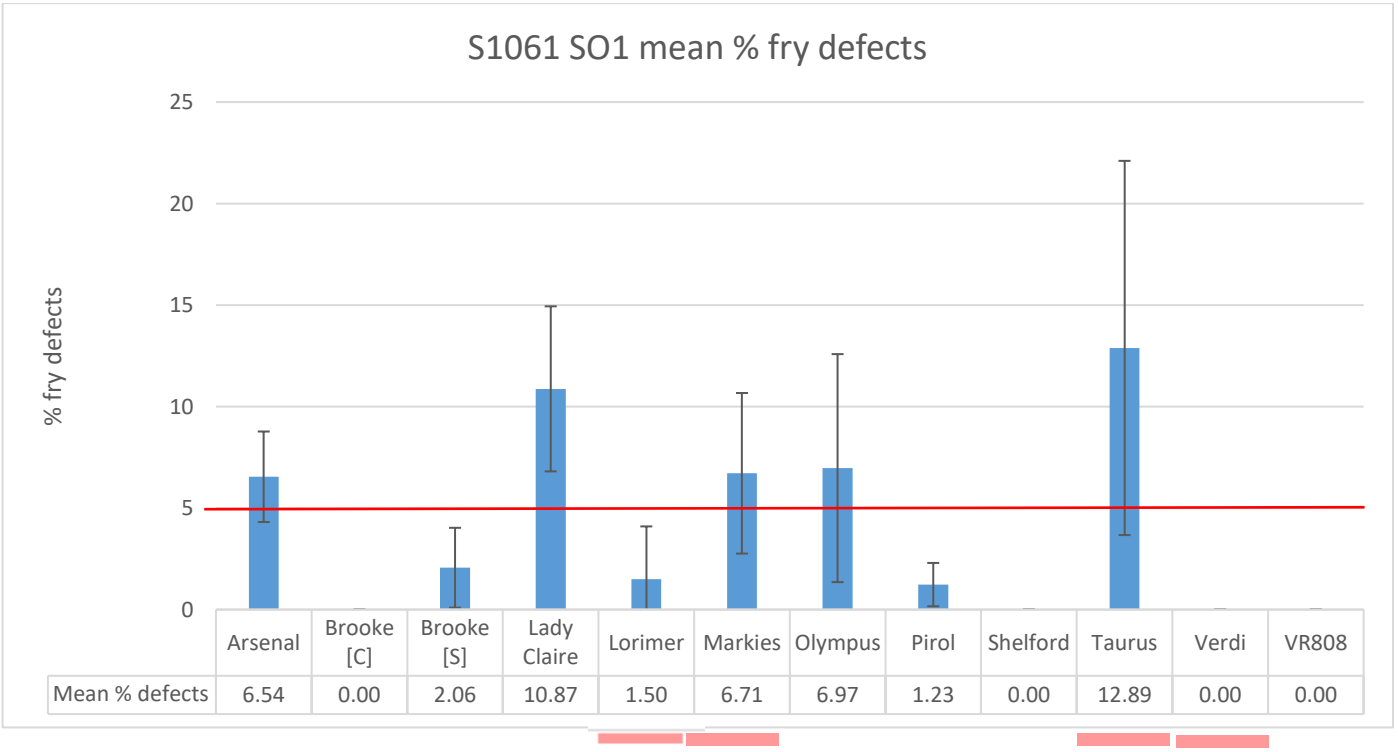
	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
mean	28.1	34.0	48.3	20.6	3.2	8.0	16.3	36.6	44.2	2.2	1.9	5.8



	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
mean % sprouting	100.00	100.00	100.00	100.00	81.33	96.00	100.00	100.00	100.00	70.67	100.00	98.67

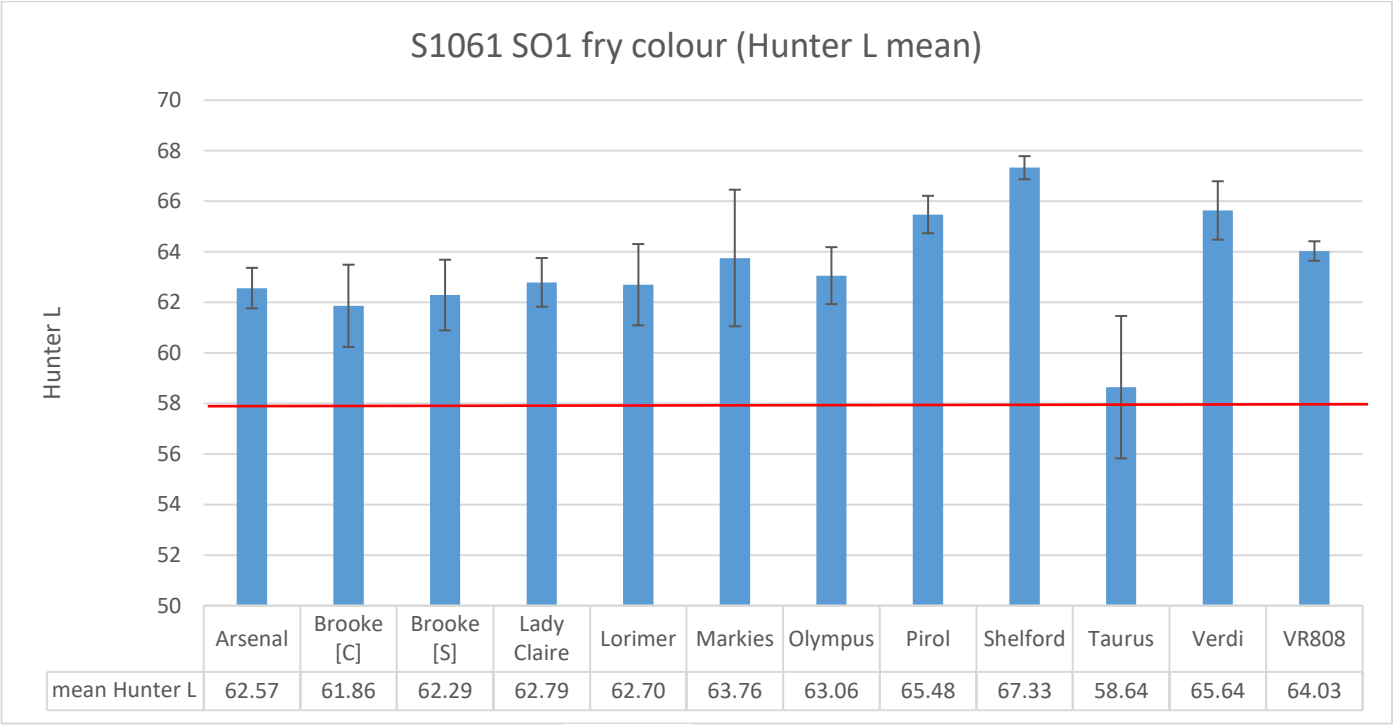


	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
Mean % >3mm	90.67	100.00	98.67	97.33	20.00	73.33	97.33	97.33	100.00	20.00	13.33	56.00



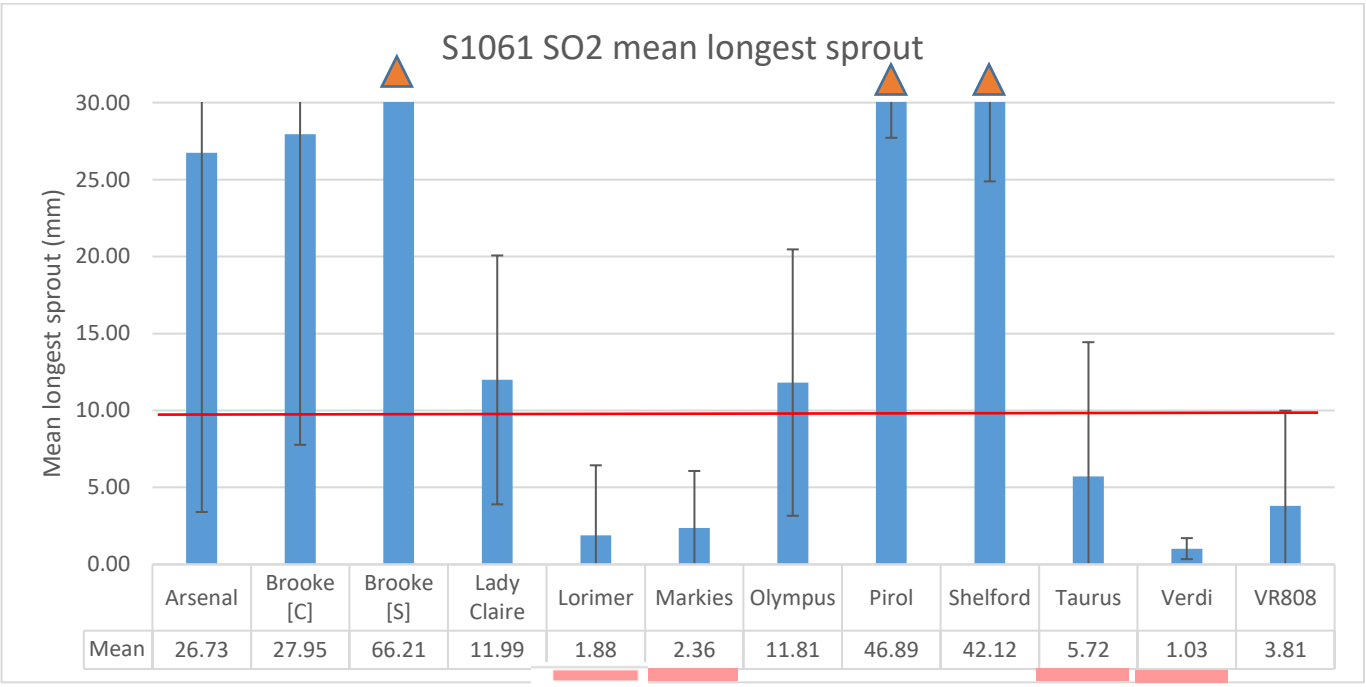
	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
Mean % defects	6.54	0.00	2.06	10.87	1.50	6.71	6.97	1.23	0.00	12.89	0.00	0.00

maleic hydrazide treated



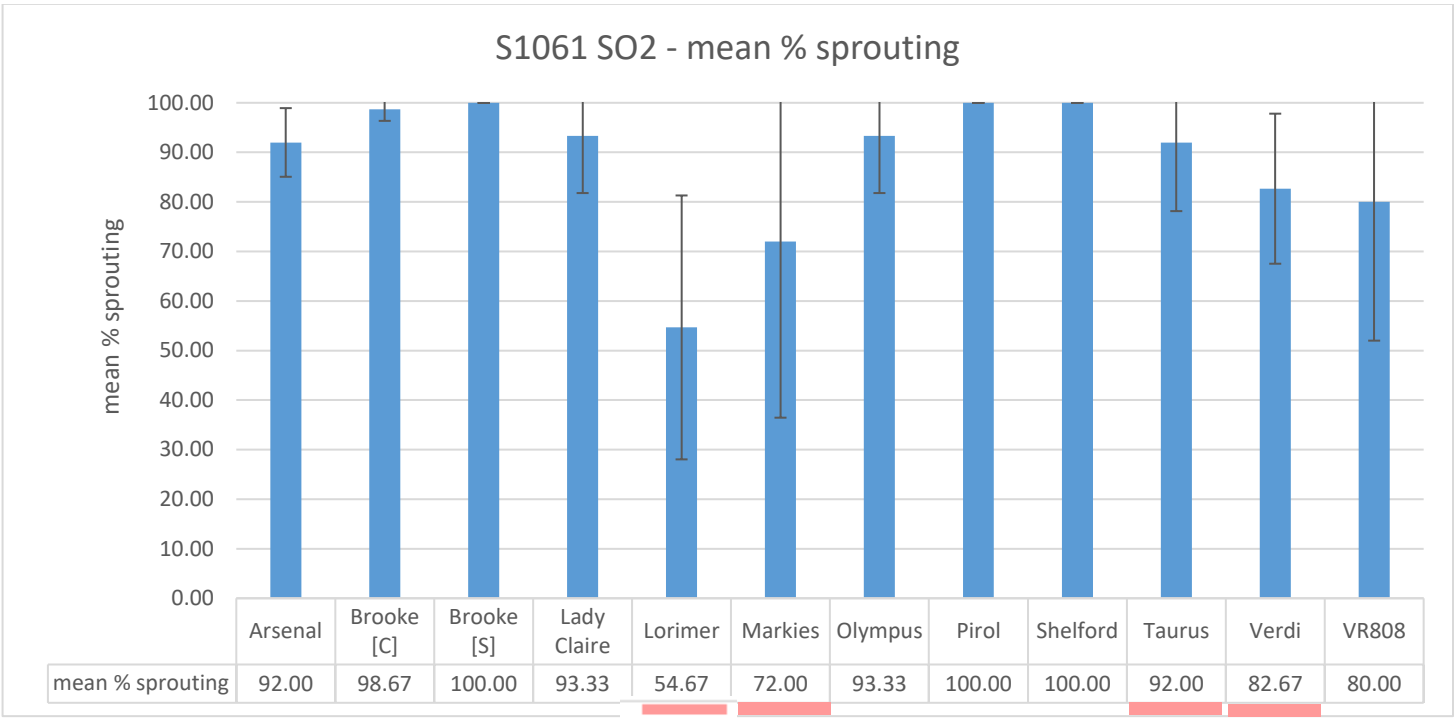
	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
mean Hunter L	62.57	61.86	62.29	62.79	62.70	63.76	63.06	65.48	67.33	58.64	65.64	64.03

SAMPLING OCCASION 2 (after ~ 30 weeks' storage)

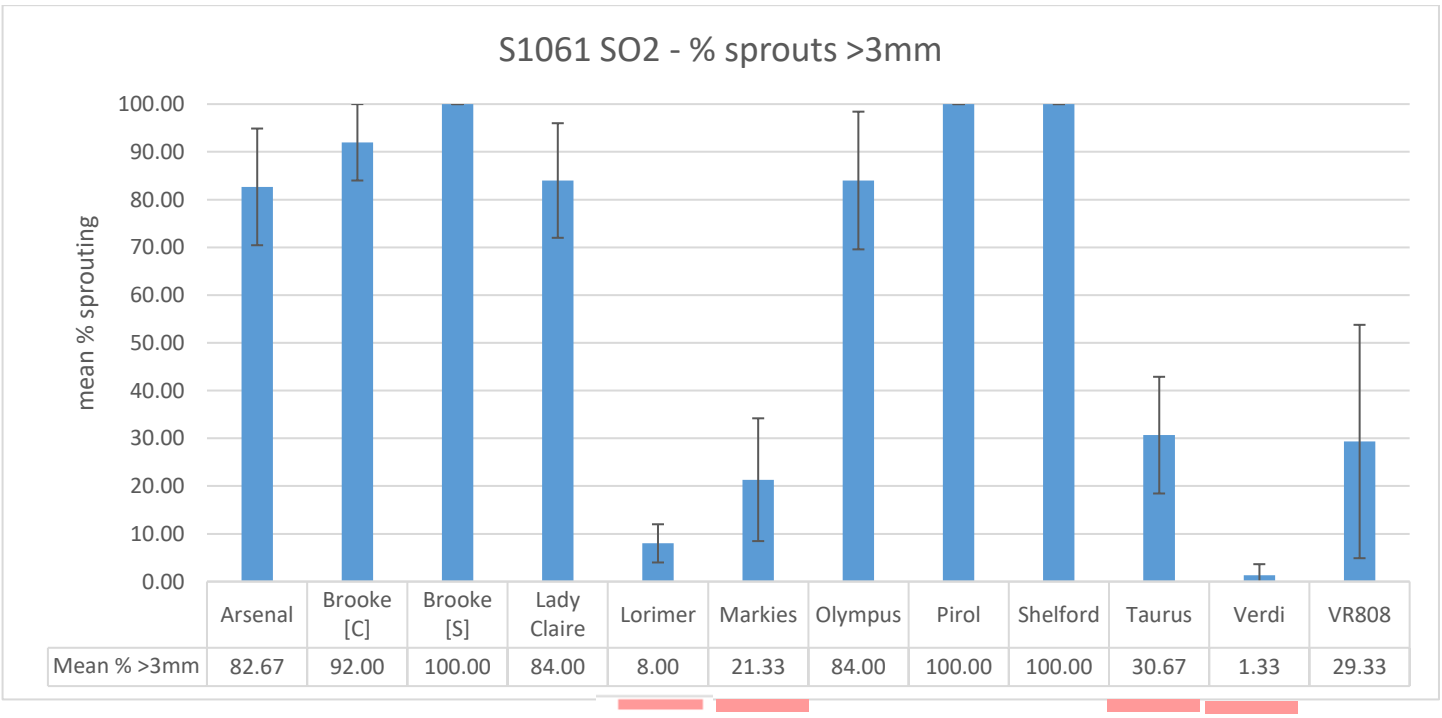


	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
Mean	26.73	27.95	66.21	11.99	1.88	2.36	11.81	46.89	42.12	5.72	1.03	3.81

maleic hydrazide treated

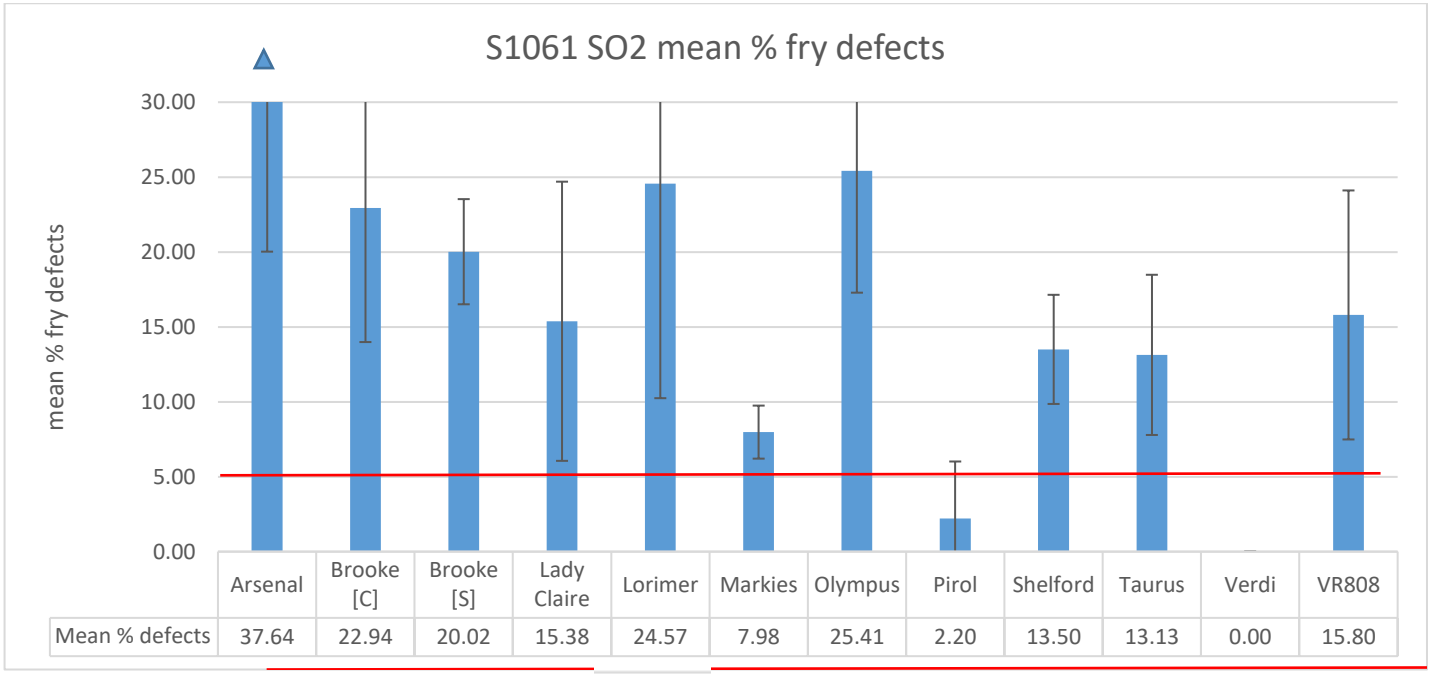


	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
mean % sprouting	92.00	98.67	100.00	93.33	54.67	72.00	93.33	100.00	100.00	92.00	82.67	80.00

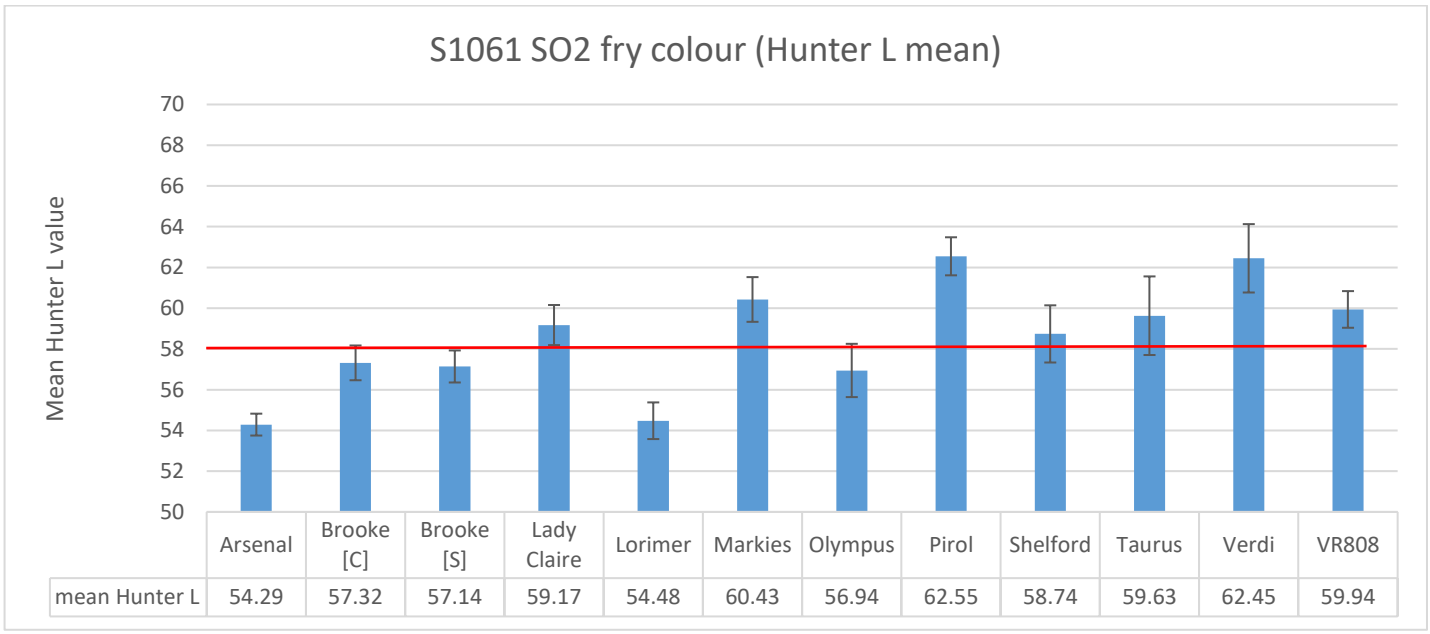


	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
Mean % >3mm	82.67	92.00	100.00	84.00	8.00	21.33	84.00	100.00	100.00	30.67	1.33	29.33

maleic hydrazide treated



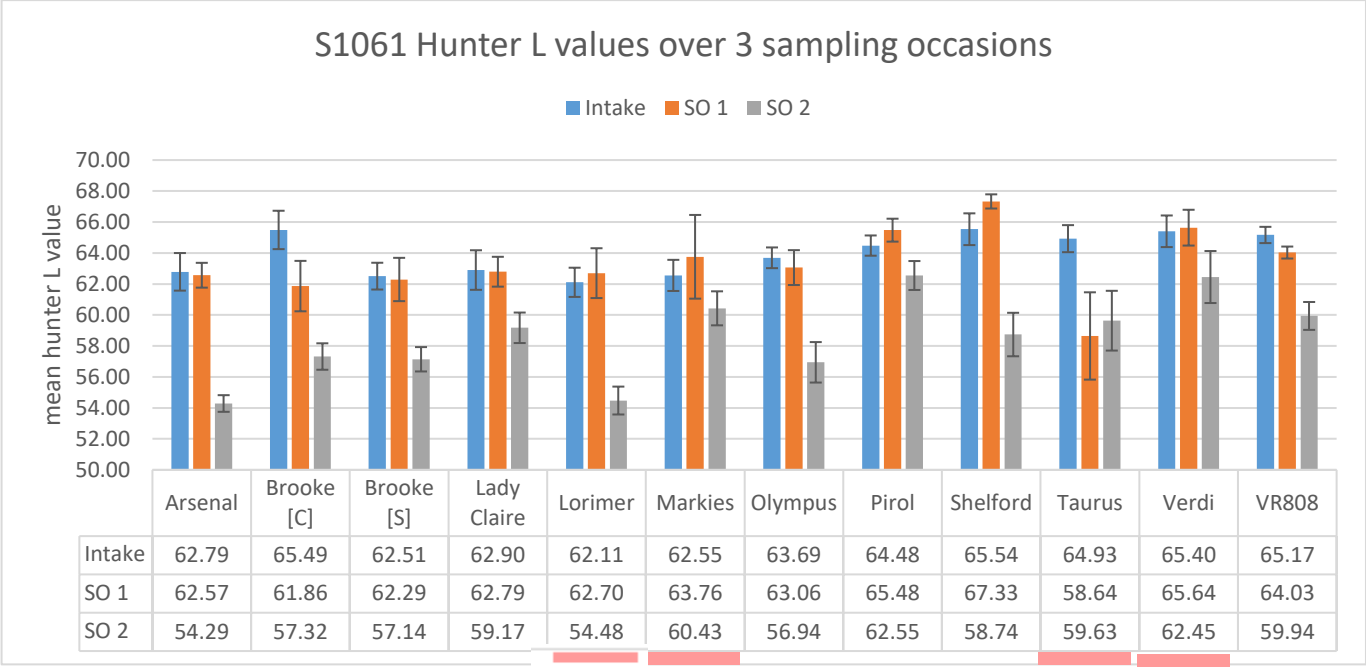
	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
Mean % defects	37.64	22.94	20.02	15.38	24.57	7.98	25.41	2.20	13.50	13.13	0.00	15.80



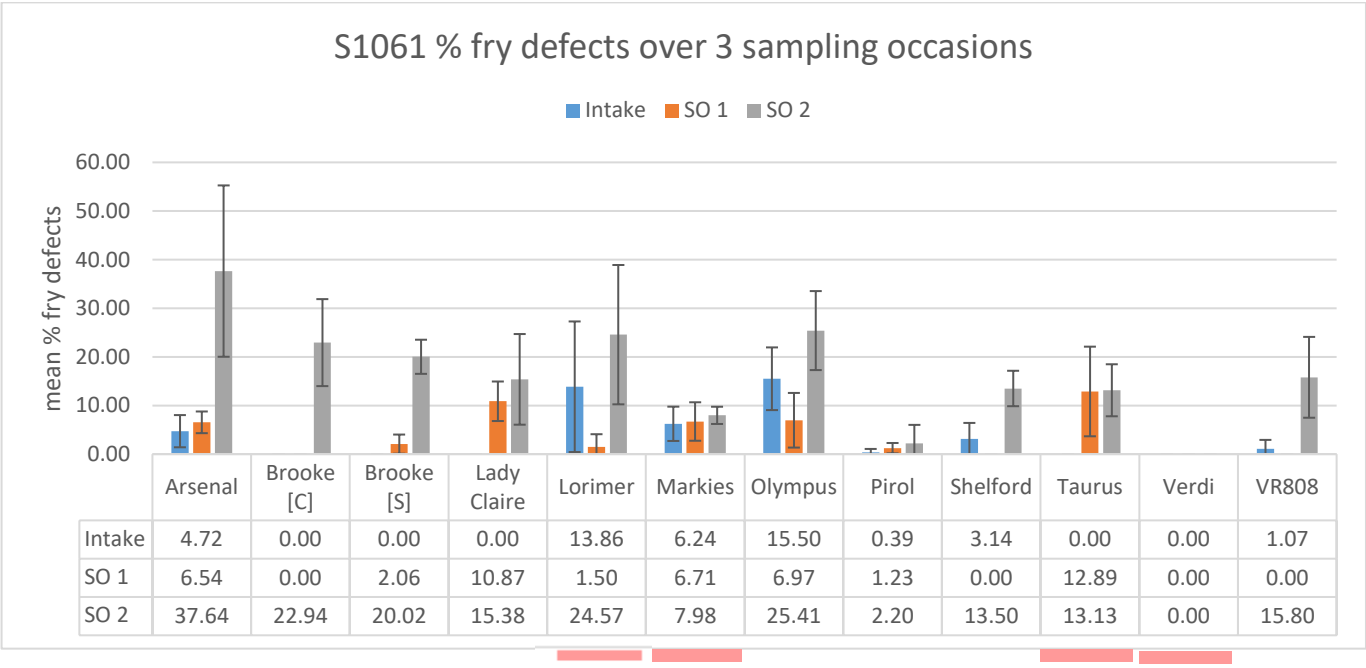
	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
mean Hunter L	54.29	57.32	57.14	59.17	54.48	60.43	56.94	62.55	58.74	59.63	62.45	59.94

maleic hydrazide treated

Comparison graphs

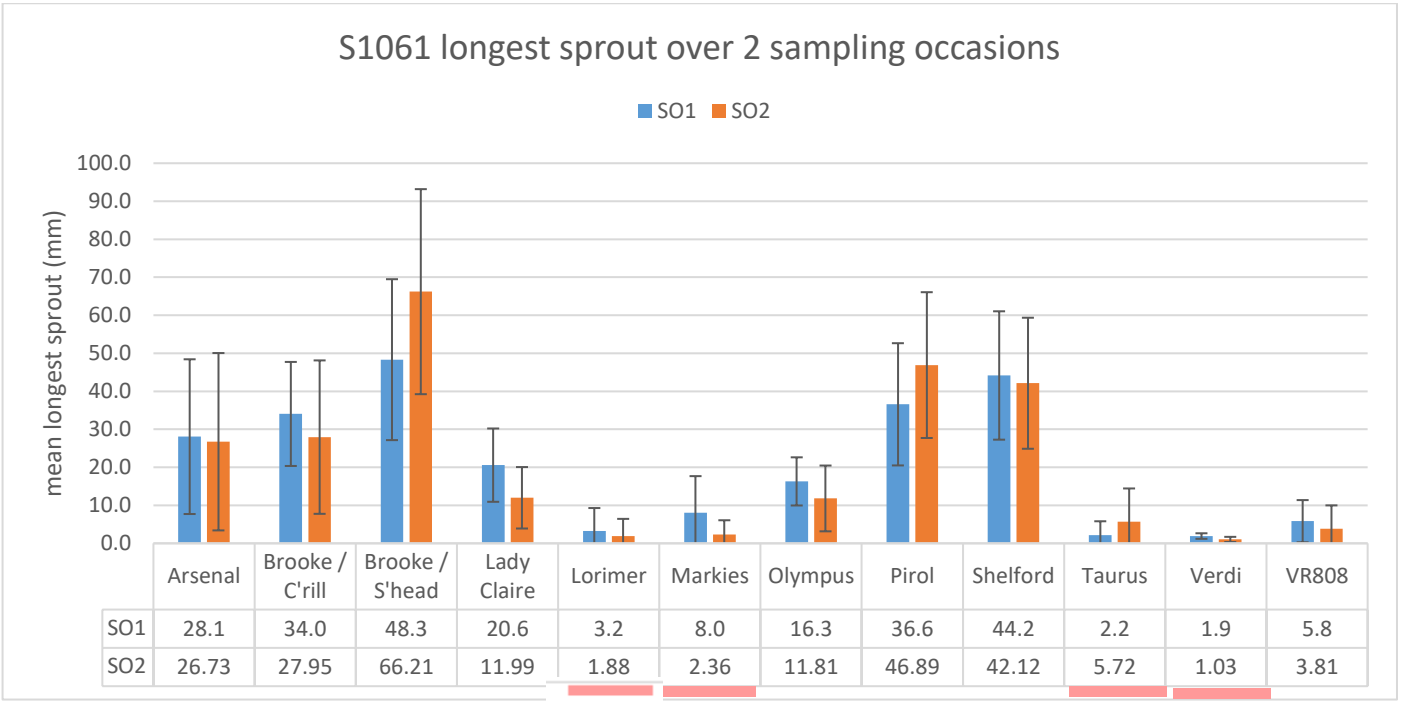


	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
Intake	62.79	65.49	62.51	62.90	62.11	62.55	63.69	64.48	65.54	64.93	65.40	65.17
SO 1	62.57	61.86	62.29	62.79	62.70	63.76	63.06	65.48	67.33	58.64	65.64	64.03
SO 2	54.29	57.32	57.14	59.17	54.48	60.43	56.94	62.55	58.74	59.63	62.45	59.94

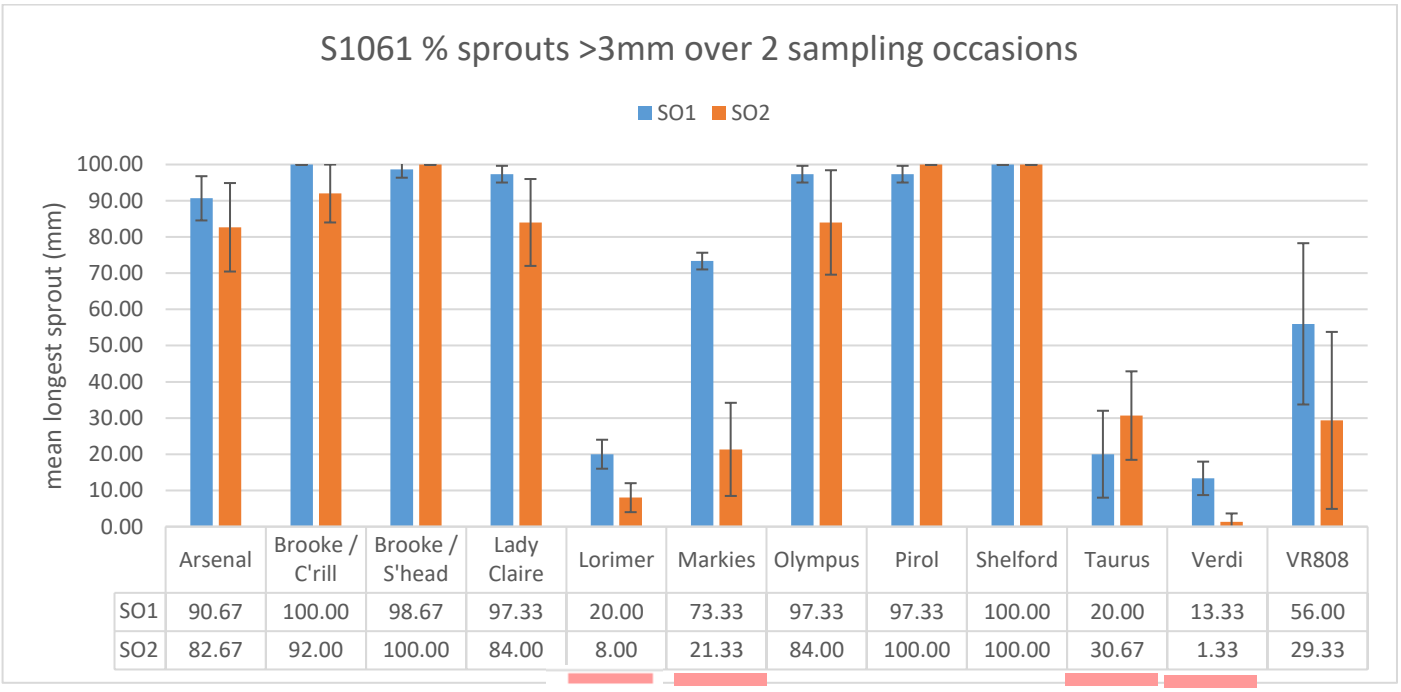


	Arsenal	Brooke [C]	Brooke [S]	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
Intake	4.72	0.00	0.00	0.00	13.86	6.24	15.50	0.39	3.14	0.00	0.00	1.07
SO 1	6.54	0.00	2.06	10.87	1.50	6.71	6.97	1.23	0.00	12.89	0.00	0.00
SO 2	37.64	22.94	20.02	15.38	24.57	7.98	25.41	2.20	13.50	13.13	0.00	15.80

maleic hydrazide treated



	Arsenal	Brooke / C'rill	Brooke / S'head	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
SO1	28.1	34.0	48.3	20.6	3.2	8.0	16.3	36.6	44.2	2.2	1.9	5.8
SO2	26.73	27.95	66.21	11.99	1.88	2.36	11.81	46.89	42.12	5.72	1.03	3.81



	Arsenal	Brooke / C'rill	Brooke / S'head	Lady Claire	Lorimer	Markies	Olympus	Pirol	Shelford	Taurus	Verdi	VR808
SO1	90.67	100.00	98.67	97.33	20.00	73.33	97.33	97.33	100.00	20.00	13.33	56.00
SO2	82.67	92.00	100.00	84.00	8.00	21.33	84.00	100.00	100.00	30.67	1.33	29.33

maleic hydrazide treated

5. Discussion

Varietal performance was very variable and changed with time across the duration of the trial. Crops were generally of acceptable fry colour at intake, although Markies, Olympus and Lorimer all exhibited more than 5% of fry defects.

At sampling occasion 1, after approx. 15 weeks' storage, sprout control varied widely with only Verdi*, Taurus*, Markies*, Lorimer* and VR808 retaining sufficient control of sprouting to keep the mean longest sprout measurement below 10 mm. (Note: * denotes MH-treated crops).

Fry colour at this point was generally good across the board, although Taurus had a markedly darker fry colour than the other varieties. There were however, several varieties with poor defect levels with Markies, Arsenal, Olympus, Lady Claire and Taurus all exceeding a 5% defect threshold.

At the second sampling occasion, only five varieties had adequate sprout control (longest sprout <10mm); these were Verdi*, Markies*, Taurus*, Lorimer* and VR808. Fry colour was not acceptable (Hunter L <58) in Lorimer, Arsenal, Olympus and both stocks of Brooke. Fry defects were only below a 5% mean threshold in Verdi and Pirol.

The results highlight some difficulties in the achievement of adequate and consistent control of potato quality in storage using existing varieties in conjunction with new chemistry which, in this case, was spearmint oil. This requires further work to resolve, either through the use of alternative products and/or combination treatments or more far-reaching solutions.

For the latter, it is probable that a more fundamental shift in position for long term potato storage for crisping is going to be required. Adoption of integrated potato store management principles (Figure 3) will be needed to reduce the reliance on chemical intervention. This means taking into account management interventions, risk factors and the genetic basis of crops far more to reduce the need for reliance on chemical control.

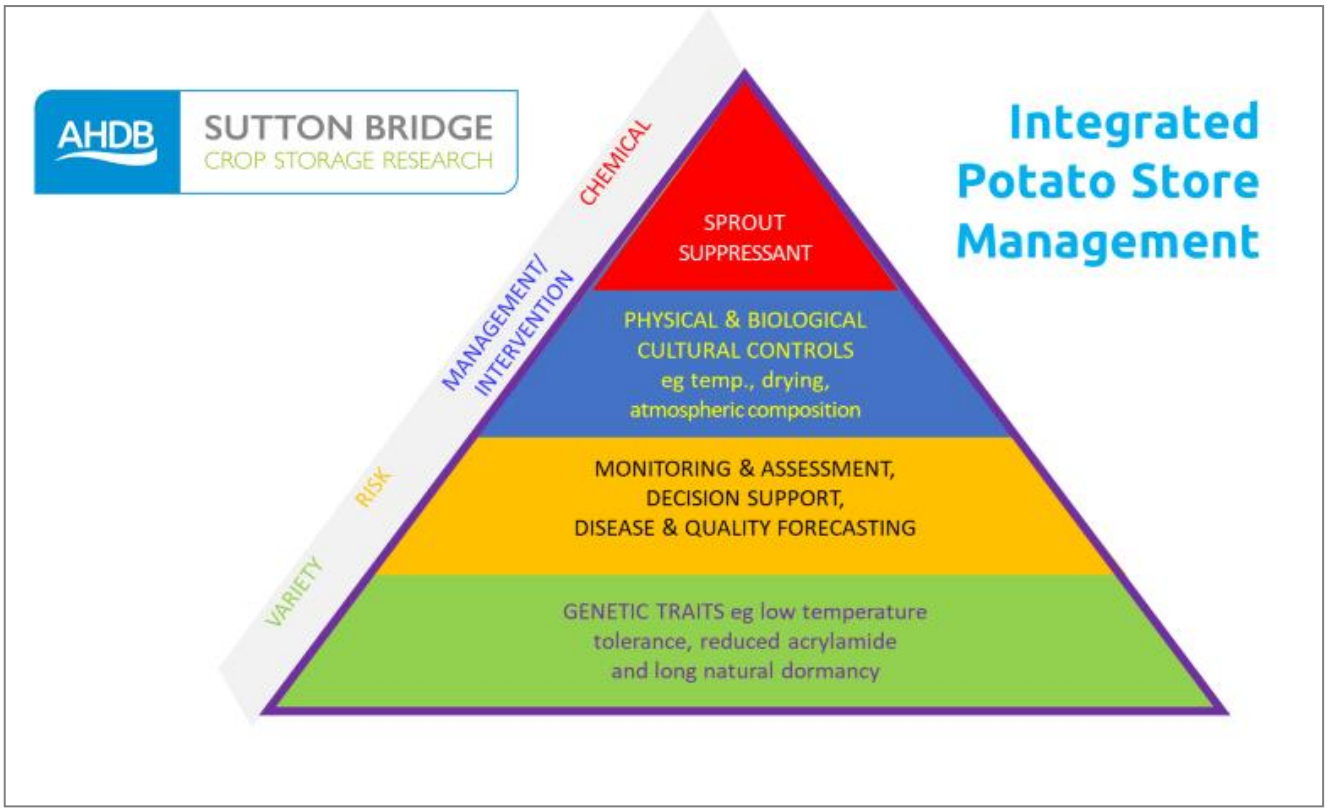


Figure 3: schematic representation of integrated potato store management factors

6. Acknowledgements

The assistance of Potato Processors' Association member companies and their supply chains is gratefully acknowledged.

Appendix

Temperature (top), RH (centre) and CO_2 (bottom) graphs