



**Interim Report 2019-20**

**Processing variety trial to assess  
varietal suitability for ethylene and  
low temperature storage**

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**Sutton Bridge Crop Storage Research**

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# 1. Summary

It is not possible to simply ‘plug and play’ a new product into the gap left by CIPC, the sprout suppressant that has served the potato industry for the last 70 years, which lost its approval for use in 2020.

None of the new actives that the industry in GB currently has access to works in the same way; the products need a wider appreciation of their limitations and appropriate adjustment of the environment within the store to get the best possible results. Many of the new chemistry options are very volatile and require specific management to get the best performance from each product. Some, like ethylene, are continuously applied so measures are needed to avoid excess loss through the ventilation system, particularly in ambient stores.

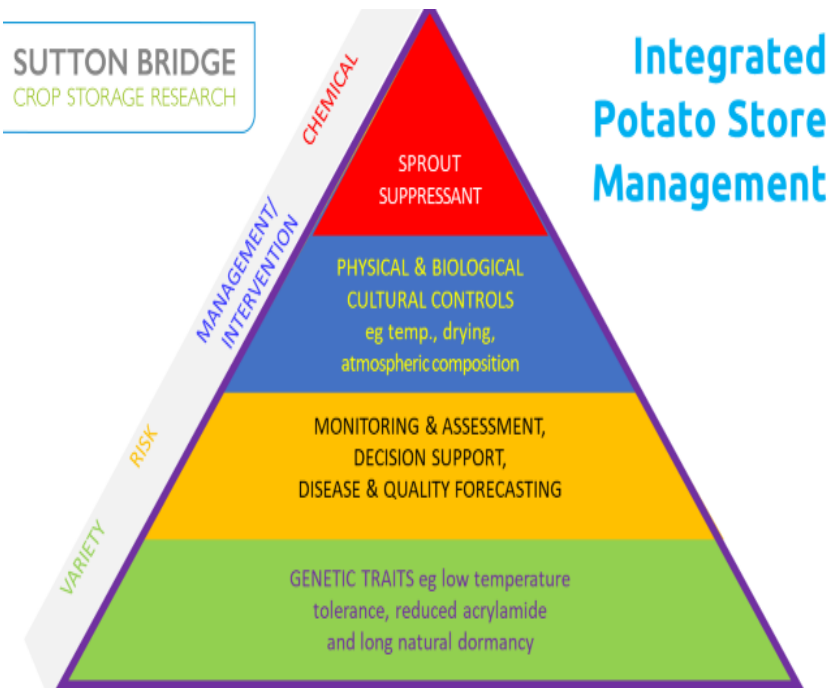
The bottom line is that there is now a much greater need for integrated management of the potato store (see graphic) and this trial is being run to help gather data to support the decision making processes that will form part of that management.

Ethylene, as a plant hormone, has a strong interaction with variety but this is an area of knowledge which is poorly documented across many varieties at present and one driver for this trial to try to identify those which perform best with the treatment.

Cost has a big part to play in the new potato storage strategies being adopted and, with some sprout suppressant products costing as much as four times the price of a regular dose of CIPC, there is a need to identify processing varieties with better cold temperature tolerance as these will offer storage options which need fewer chemical inputs.

This first year’s trial was set up to begin to capture information on ethylene performance and low temperature storage (6°C) tolerance in a single piece of work, using crops held at 8°C treated with a single sprout suppressant (DMN) as a control.

Indicative interim data was obtained from the work, but variability between lots supplied from industry was high and there were inconsistencies such as maleic hydrazide treatment to take into account. These data will be supplemented by further trials in Years 2 & 3. It is too early to draw firm conclusions on options for either ethylene treatment or colder storage on the basis of this trial alone.



## 2. Introduction

Sutton Bridge Crop Storage Research was commissioned by AHDB to investigate the reaction of numerous stocks and varieties of processing potato to storage under lower temperatures or under ethylene to effect satisfactory sprout control. Following the withdrawal of approval for Chlorpropham (CIPC) to be used as a sprout suppressant in early 2020, alternative measures for the control of sprouting will be required from harvest 2020 onwards.

In summer 2019, processors, growers and plant breeders were invited to submit stocks for a storage trial under three regimes. Ethylene, low temperature and a typical standard processing temperature. The scale of the study was kept small in order to be able to evaluate many varieties replicated at intake and at 2 sampling occasions from storage.

Sprout control by ethylene was considered as it is already an approved product and a cost-effective option to replace CIPC. For the other storage regimes 1-4, dimethylnaphthalene (DMN) was chosen as the sprout suppressant. Although not currently approved for use in the UK, its registration is pending and it may be available for the 2020/21 season, so information on variety response could prove useful.

All stocks were evaluated for weight loss, sprouting (length of longest sprout) and processing quality (crisp or French fry, as advised by the supplier of the crop), on two sampling occasions, planned after approximately 15 and 30 weeks' storage.

## 3. Materials and methods

A total of 50 individual lots of potatoes were gathered from various suppliers and loaded into store for long term storage under either, ethylene, low temperature storage with DMN or normal temperature storage under DMN. Storage regimes are listed in table 1

**Table 1: Storage regimes**

Treatment	Storage Temperature	Sprout Suppression
DMN 6	6.0 C	DMN 1-4 SIGHT
DMN 8	8.0 C	DMN 1-4 SIGHT
Ethylene	8.0 C	Restrain Ethylene

Stores (3x 12 tonne units) were loaded between 30<sup>th</sup> September and 22<sup>nd</sup> November 2019.

Loading dates are given alongside each stock listed in Table 2.

**Table 2: Stocks held in storage 2019/20**

Stock	Variety (*MH treated)	Supplier	Loading Date	Nominated End Use
1	Taurus	KP / Mercian	30/9/19	Crisps
2	Corsica	Agrico	1/10/19	Crisps
4	Arsenal	Argico	1/10/19	Crisps
8	Pirol	Pepsico	2/10/19	Crisps
9	VR808	Pepsico	2/10/19	Crisps
10	Shelford	Pepsico	2/10/19	Crisps
11	Brooke	Pepsico	2/10/19	Crisps
16	Opal	Spearhead	16/10/19	Crisps
17	Thalessa	Spearhead	16/10/19	Crisps
18	Verdi	Spearhead	16/10/19	Crisps
22	Taurus	Greenvale AP	17/10/19	Crisps
23	Olympus	WCM	22/10/19	Crisps
24	Opal	WCM	22/10/19	Crisps
30	Edony	WCM	23/10/19	Crisps
31	Endeavour	WCM	23/10/19	Crisps
32	Lady Alicia	Meijer	23/10/19	Crisps
33	Lady Amarilla	Meijer	23/10/19	Crisps
34	Lady Claire	Meijer	23/10/19	Crisps
36	Brooke*	Cockerills	23/10/19	Crisps
37	SHC909	Cockerills	23/10/19	Crisps
38	Taurus*	Cockerills	23/10/19	Crisps
39	VR808*	Cockerills	23/10/19	Crisps
40	Pirol*	Cockerills	23/10/19	Crisps
45	Lady Claire	KP / Mercian	24/10/19	Crisps
47	Opal	Solana	29/10/19	Crisps
48	Caruso	Solana	29/10/19	Crisps
49	Verdi	Solana	29/10/19	Crisps
50	Hereclea	BVP / Kettle	22/11/19	Crisps

Stock	Variety (*MH treated)	Supplier	Loading Date	Nominated End Use
3	Lugano	Agrico	1/10/19	French Fry
5	Babylon	Agrico	1/10/19	French Fry
6	Miranda	Solana	1/10/19	French Fry
7	Edison	Solana	1/10/19	French Fry
12	Asterix*	Greenvale AP	2/10/19	French Fry
13	Desiree*	Greenvale AP	7/10/19	French Fry
14	Innovator*	Greenvale AP	7/10/19	French Fry
15	Jelly (T)*	Greenvale AP	15/10/19	French Fry
19	Jelly (D)*	Greenvale AP	16/10/19	French Fry
20	Fontaine*	Greenvale AP	16/10/19	French Fry
21	Agria*	Greenvale AP	17/10/19	French Fry
25	Innovator	HZPC	22/10/19	French Fry
26	Ivory Russet	HZPC	22/10/19	French Fry
27	Challenger	HZPC	22/10/19	French Fry
28	Eurostar	Means	22/10/19	French Fry
29	Alverstone Russet	HZPC	22/10/19	French Fry
35	Lady Anna	Meijer	23/10/19	French Fry
41	Divaa	Caithness	24/10/19	French Fry
42	Marvel	Caithness	24/10/19	French Fry
43	Russet Burbank	McCain	24/10/19	French Fry
44	Kingsman	Cygnet	24/10/19	French Fry
46	Amanda	Solana	24/10/19	French Fry

Stocks supplied were divided to provide 3 replicate samples for each treatment across two sampling occasions plus a set for intake assessment. Samples were stored in ventilated 10kg-capacity plastic trays (600x400x120mm) and placed in blocks on mobile racks within controlled environment stores.

Store temperature control was initiated on 7<sup>th</sup> October 2019 at 16.0 C and set for immediate temperature pull down at 0.3 C per day. Holding conditions of 8.0 C storage were attained on 3<sup>rd</sup> November 2019 and the 6.0 C storage temperature was reached on 11<sup>th</sup> November 2019.

### Treatment equipment

Treatments were applied at the rates and dates shown in Table 3. Post-harvest applications of DMN were made using an electric CEDAX Electrofog machine (Figure 1) with fans operating at low speed pushing the chemical as it was applied through the crop via the ventilation plenum.

Ethylene was added as a continuous treatment, aiming to maintain an atmosphere concentration of 10 ppm ethylene within the store at all times after a pre-programmed start-up 'ramp'. This process introduces ethylene at a very low dose and gradually increases this over a period of 21 days until the 10 ppm level is reached.

**Table 3. Sprout suppressant application details**

Store	Product	Rate	Date (1)	Date (2)
DMN 8 (control)	1,4 SIGHT DMN	(1) 20ml/t, (2) 20ml/t	19/11/19	12/02/20
DMN 6	1,4 SIGHT DMN	20ml/t	19/11/19	
Ethylene	Restrain	Ramped start then 10ppm continuously	29/11/19	



**Figure 1. CEDAX Electrofog EWH-3000 used for application of DMN.**

## 4. Results

Sprouting at intake was minimal with only a few stocks showing any signs of early sprout development; these are listed below in Table 4.

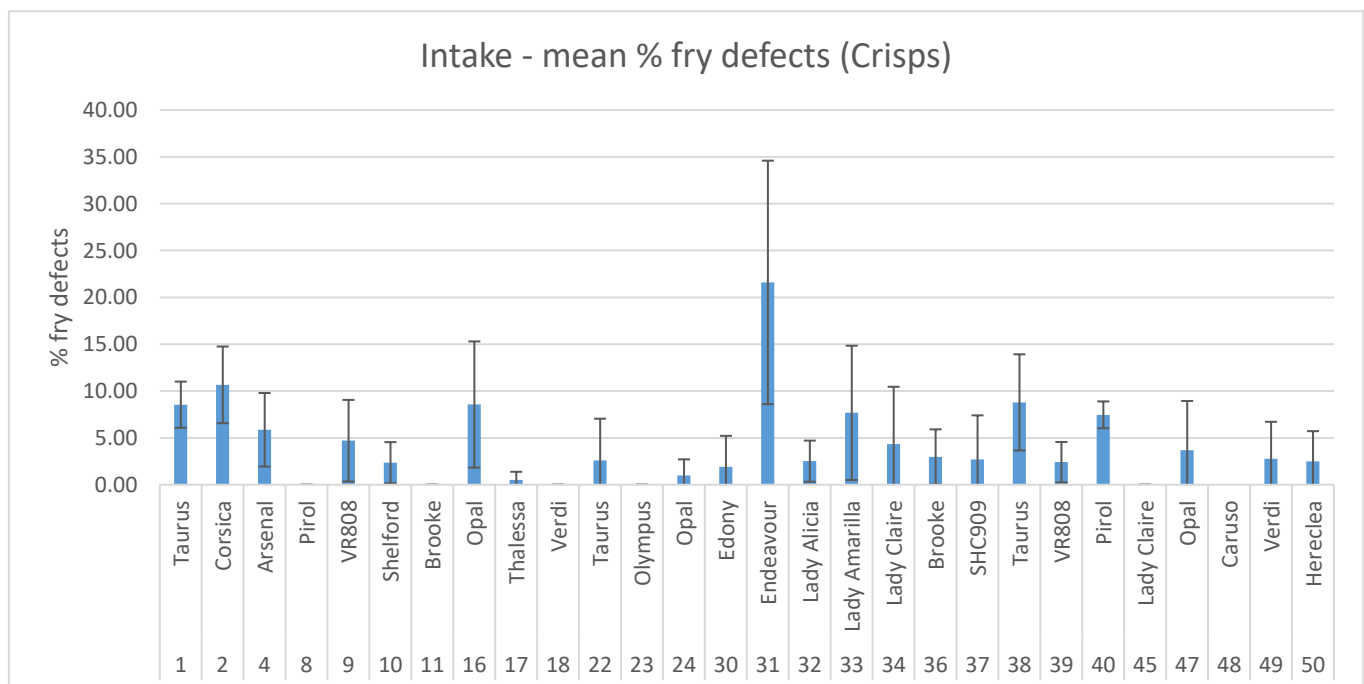
**Table 4: Stocks exhibiting sprouting at intake**

Stock	Variety	Mean longest sprout (mm)	SD
13	Desiree*	0.35	2.13
14	Innovator*	0.01	0.12
21	Agria*	0.04	0.35
24	Opal	0.04	0.26
25	Innovator	0.12	0.46
28	Eurostar	0.12	0.49
35	Lady Anna	0.04	0.20
47	Opal	0.66	1.47
48	Caruso	0.44	0.58
50	Hereclea^	0.92	2.08

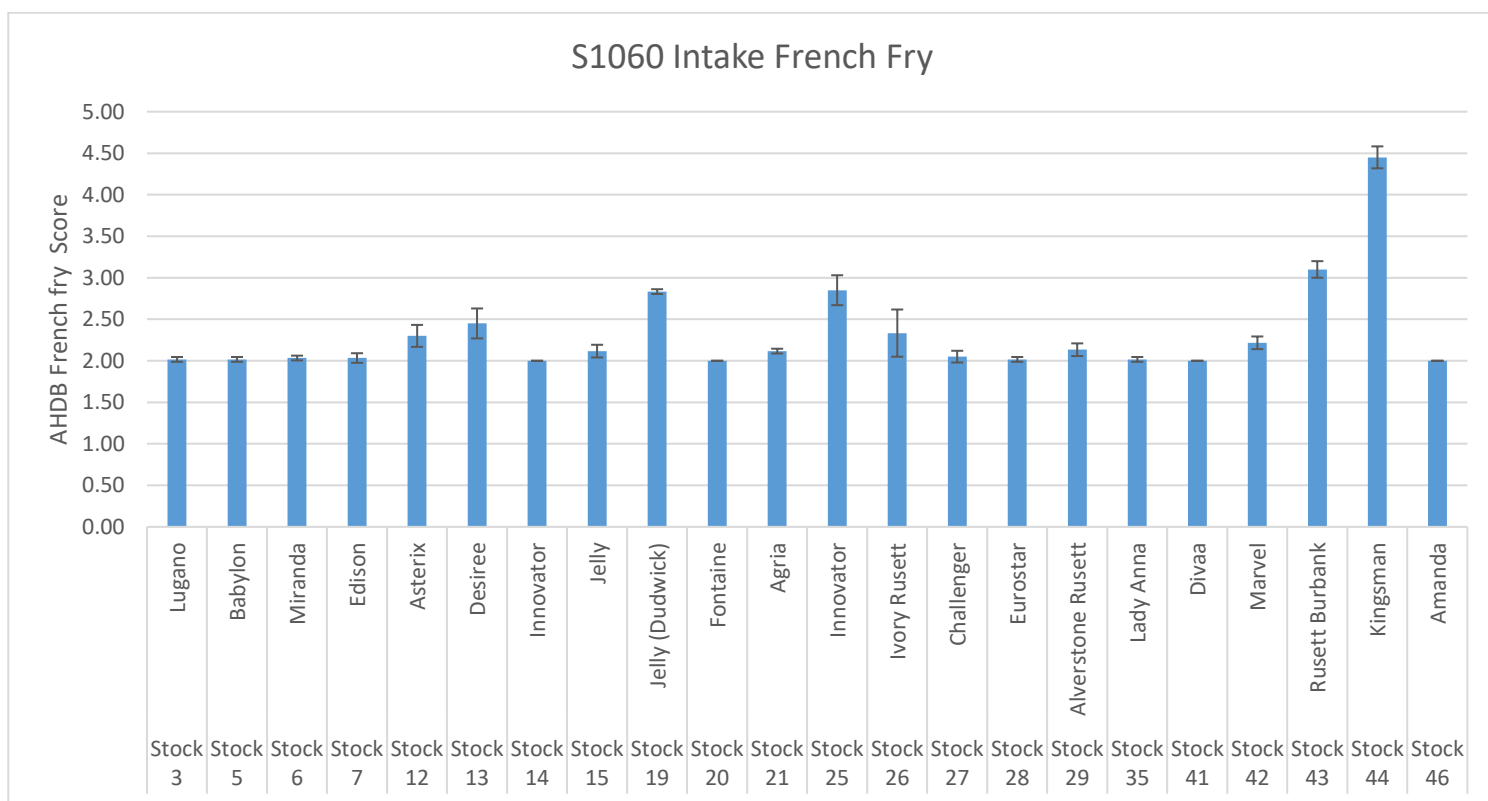
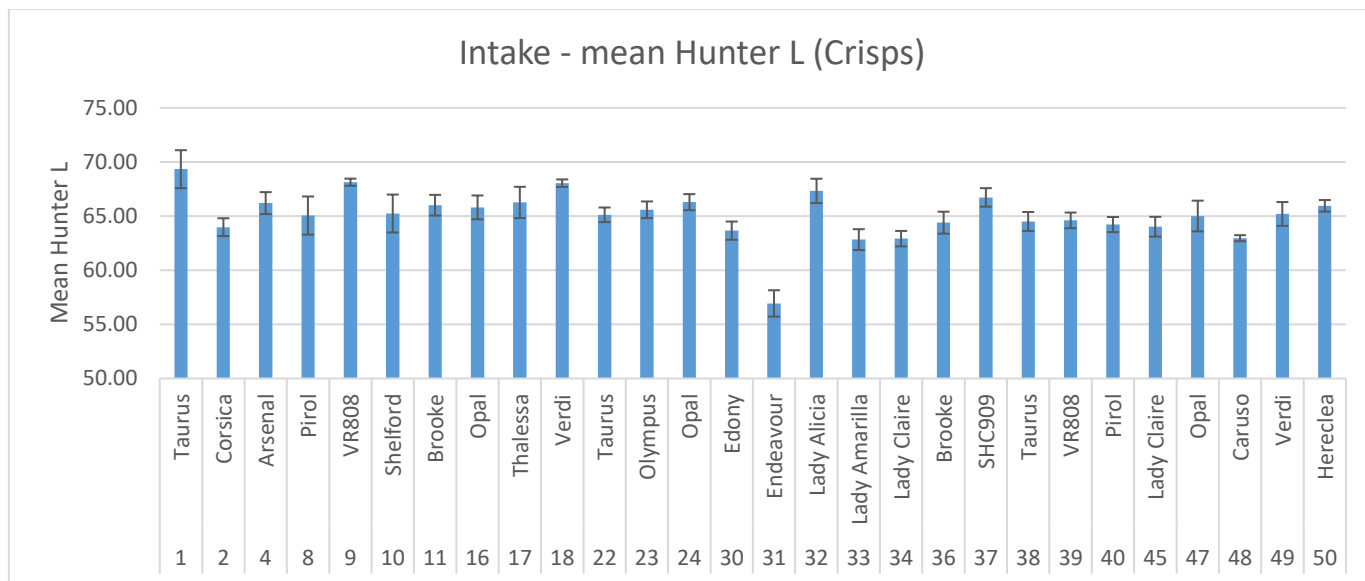
\*MH treated.

^Note - Stock 50 Hereclea was loaded into store late (22/11/19) and missed the first direct application of DMN made on 19/11/19 in both the 6°C and 8°C temperature regimes. It was however loaded into the already treated store as soon as the crop was available.

At intake, all crops were assessed for fry colour as crisps or French fry according to the nominated end use (Table 2).



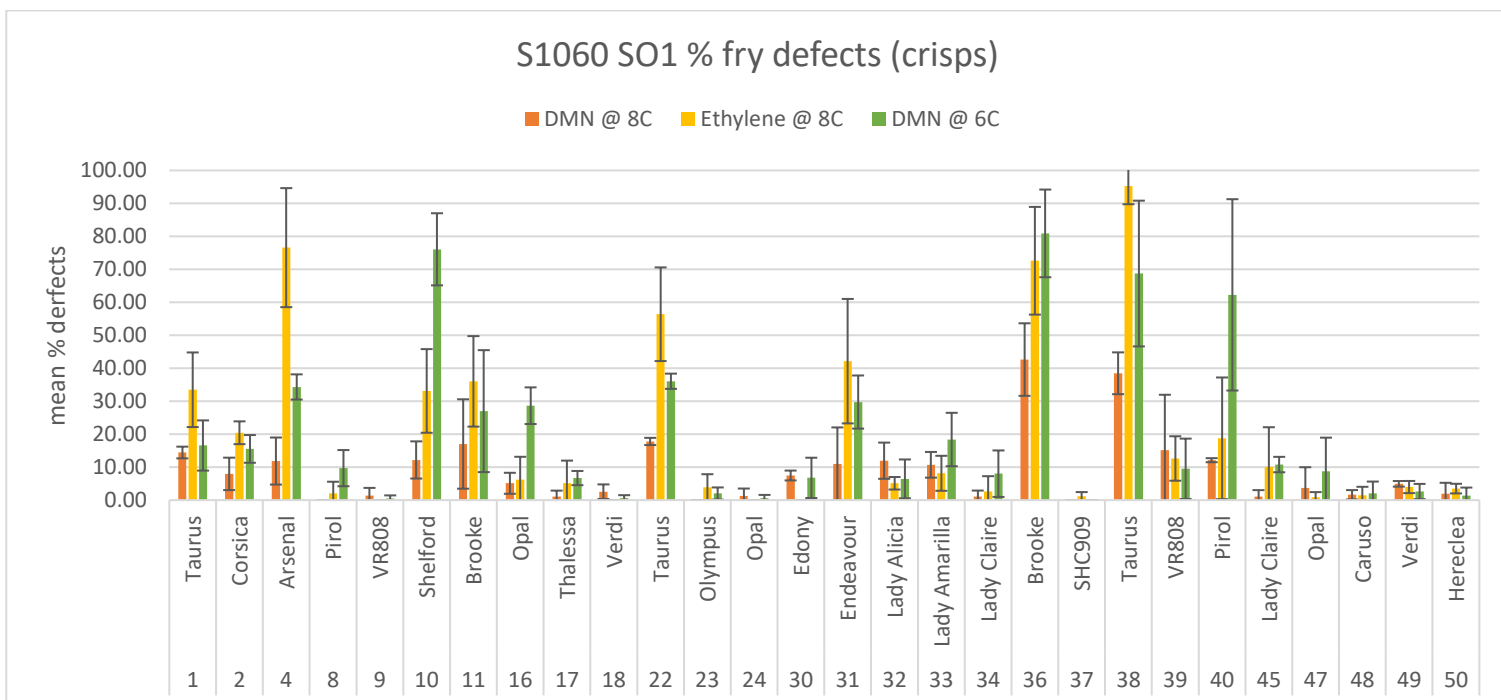
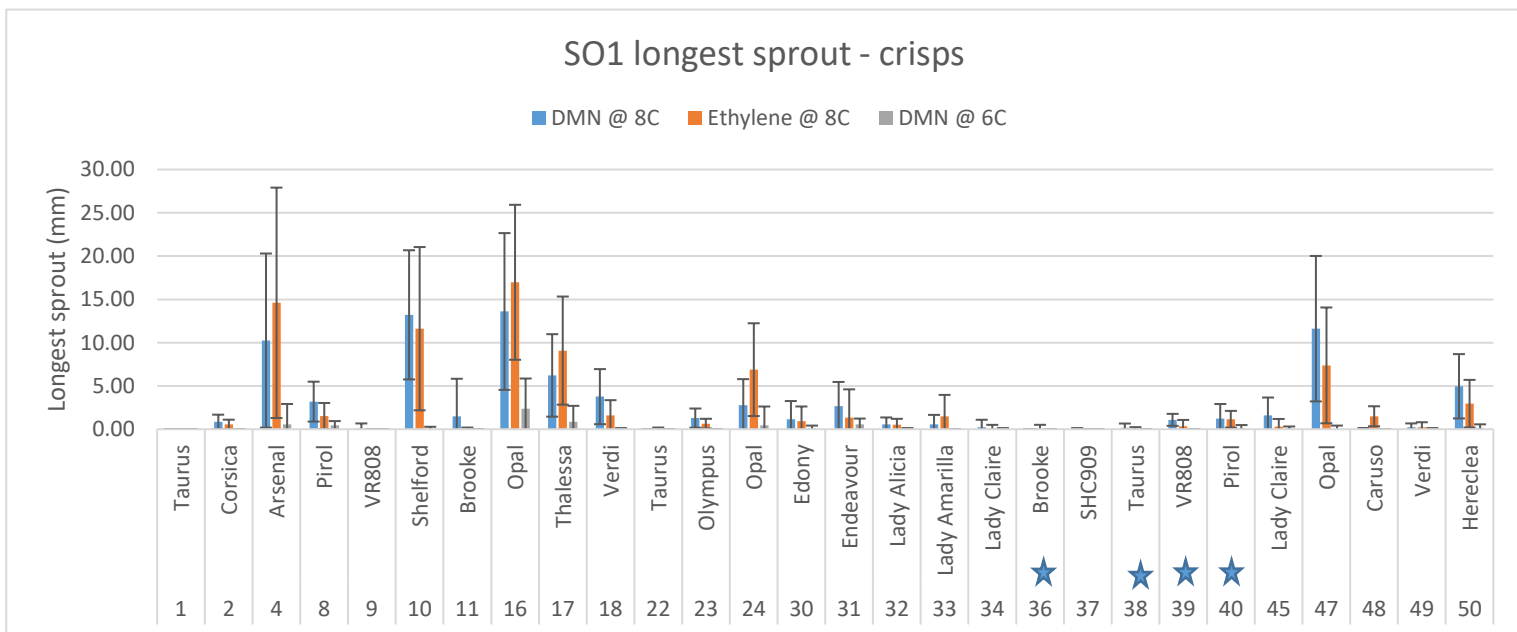




Conversion of AHDB French fry score to USDA

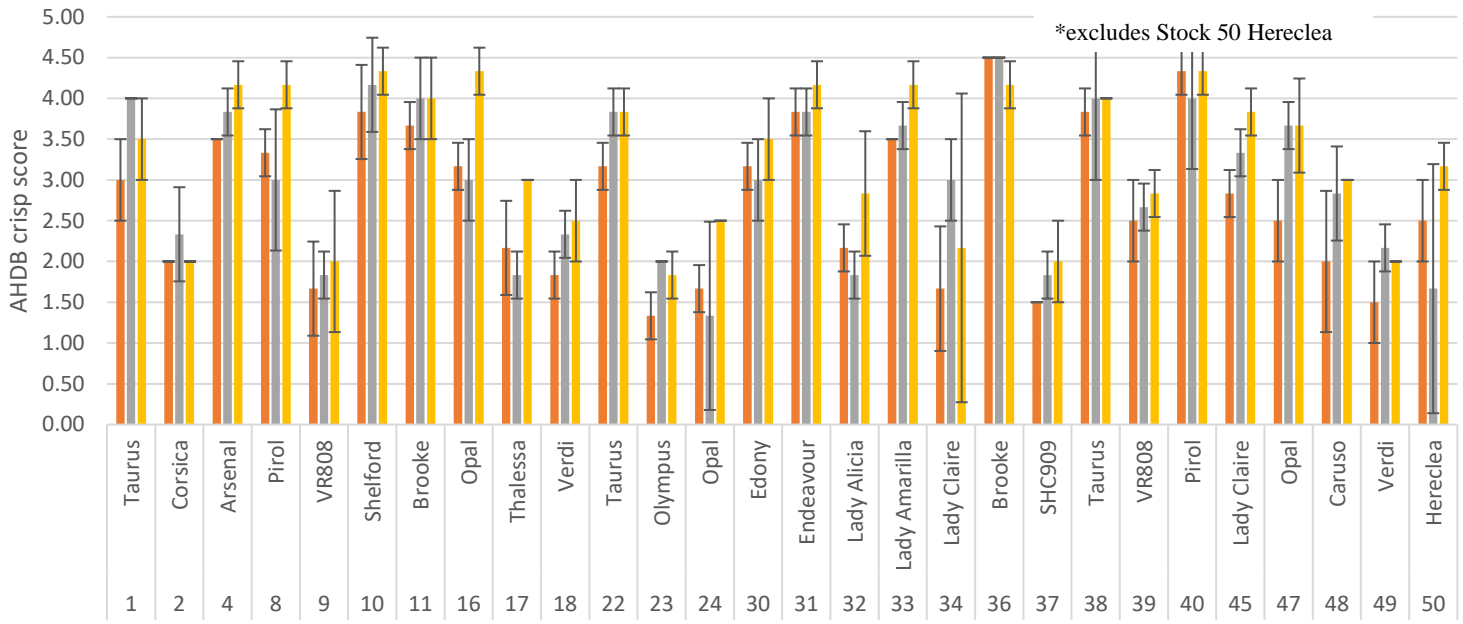
AHDB	1	2	3	4	5	6	7
USDA	000	00	0	1	2	3	4

**SAMPLING OCCASION 1 : from 27<sup>th</sup> January 2020 (13 to 17 weeks in store\*, ★ denotes MH trmt)**



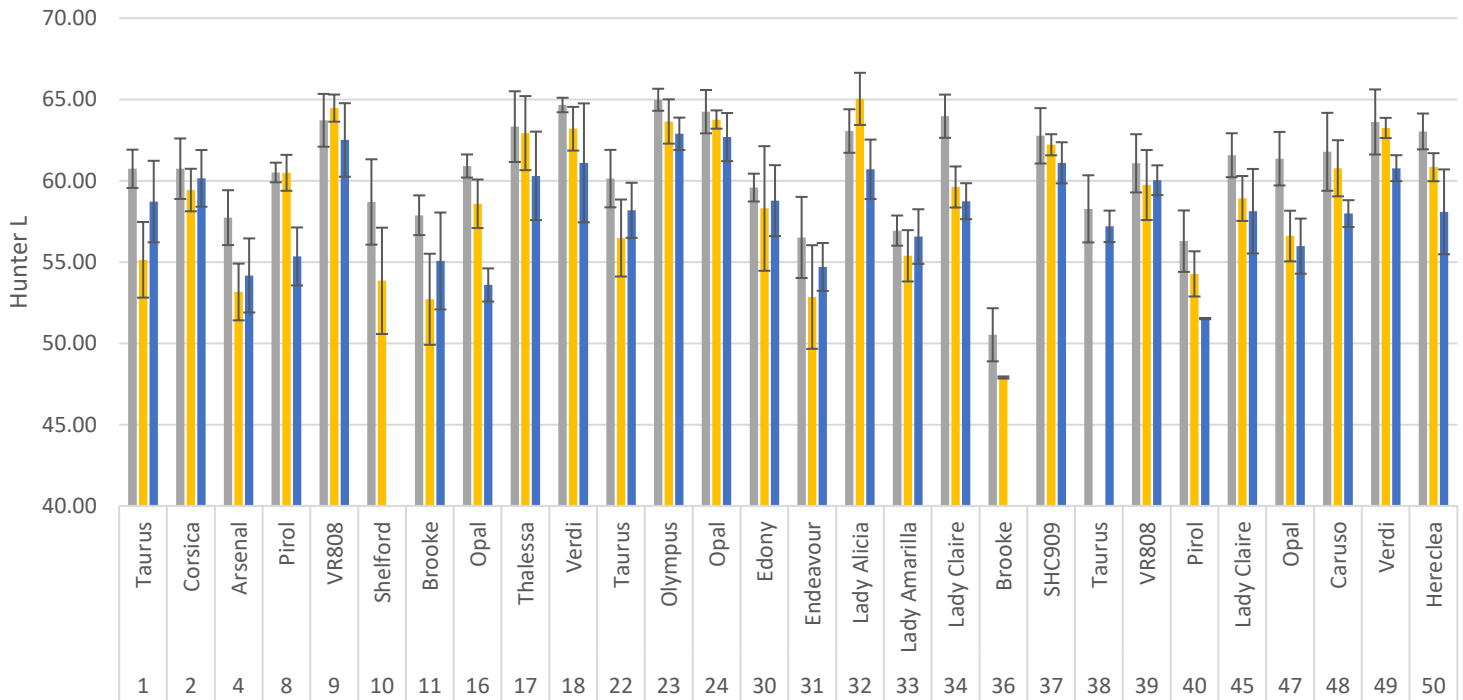
### S1060 SO1 AHDB fry colour (crisps)

DMN @ 8C   Ethylene @ 8C   DMN @ 6C

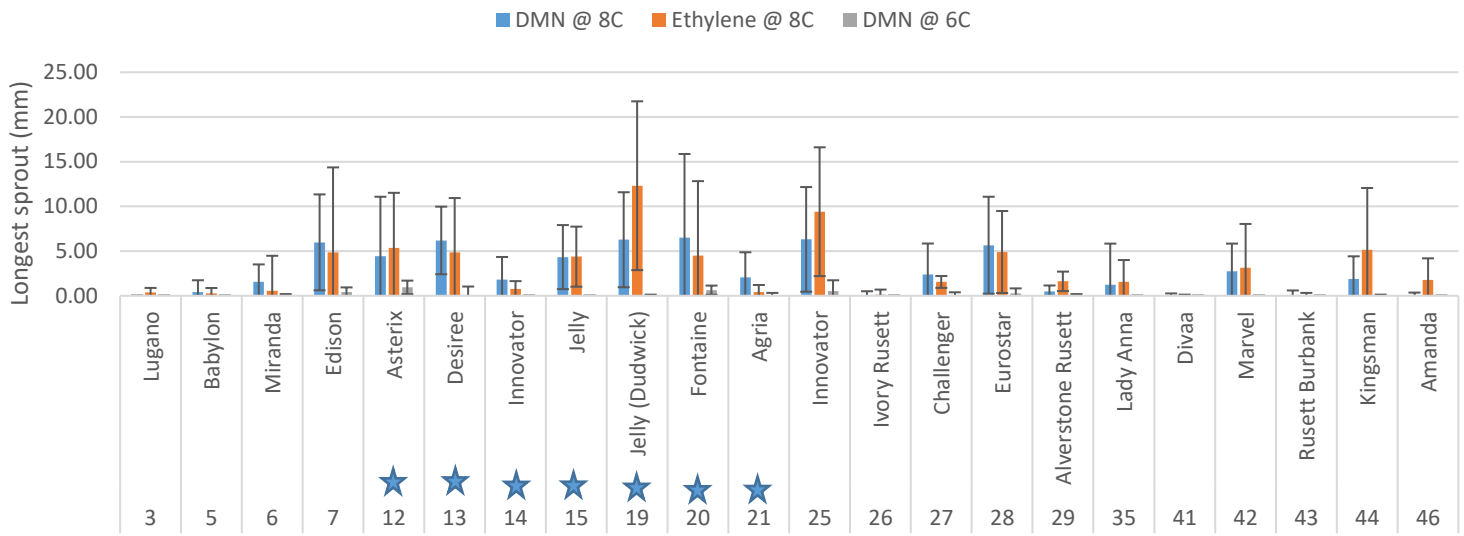


### S1060 SO1 Hunter L

DMN @ 8C   Ethylene @ 8C   DMN @ 6C

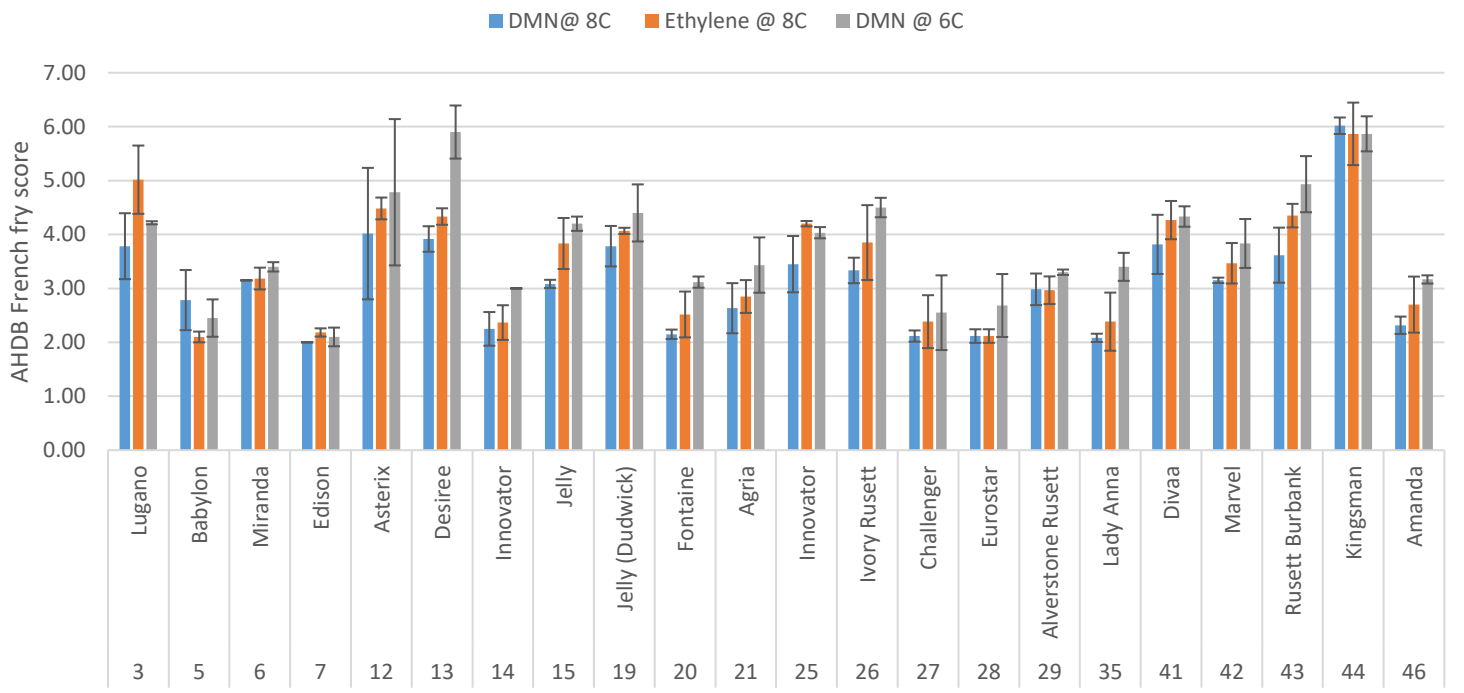


### SO1 longest sprout - French fry

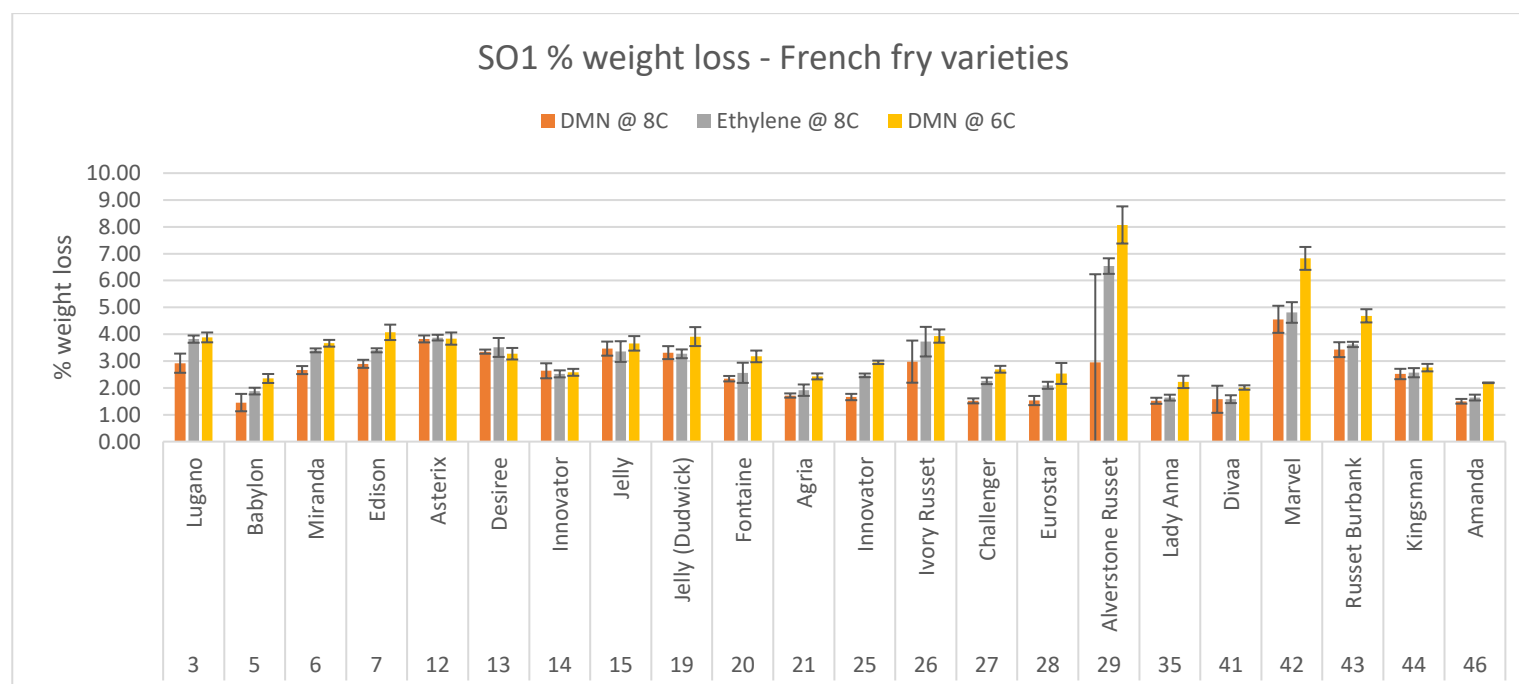
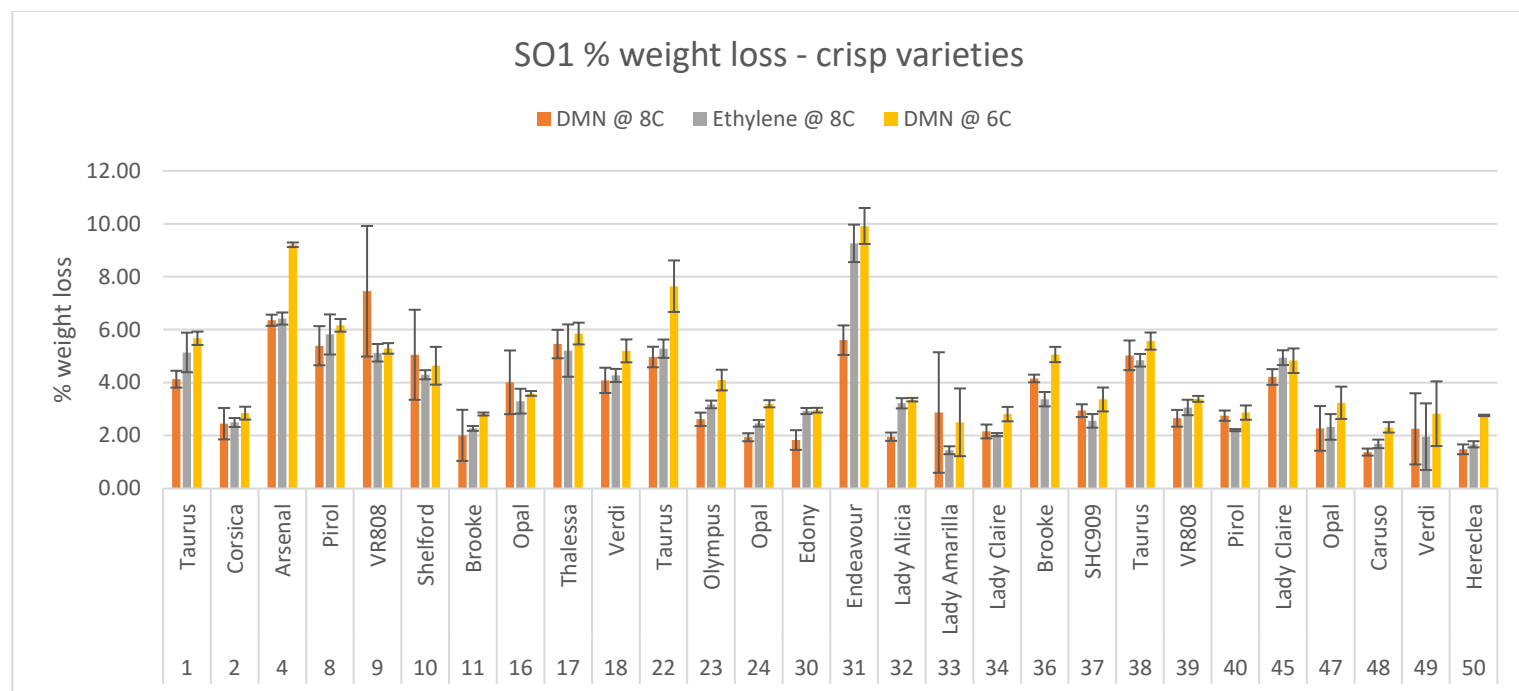


MH treated★

### SO1 French fry colour

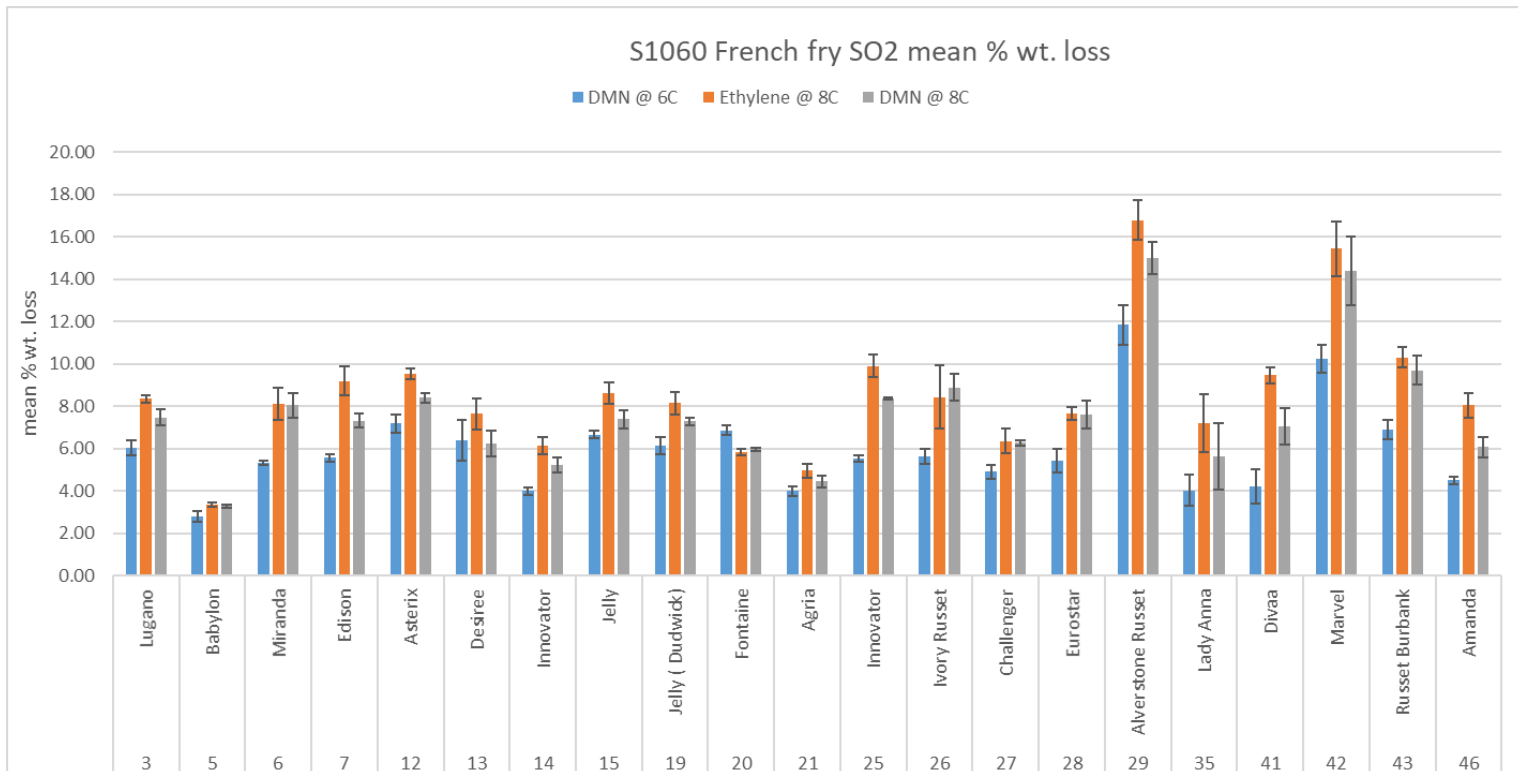
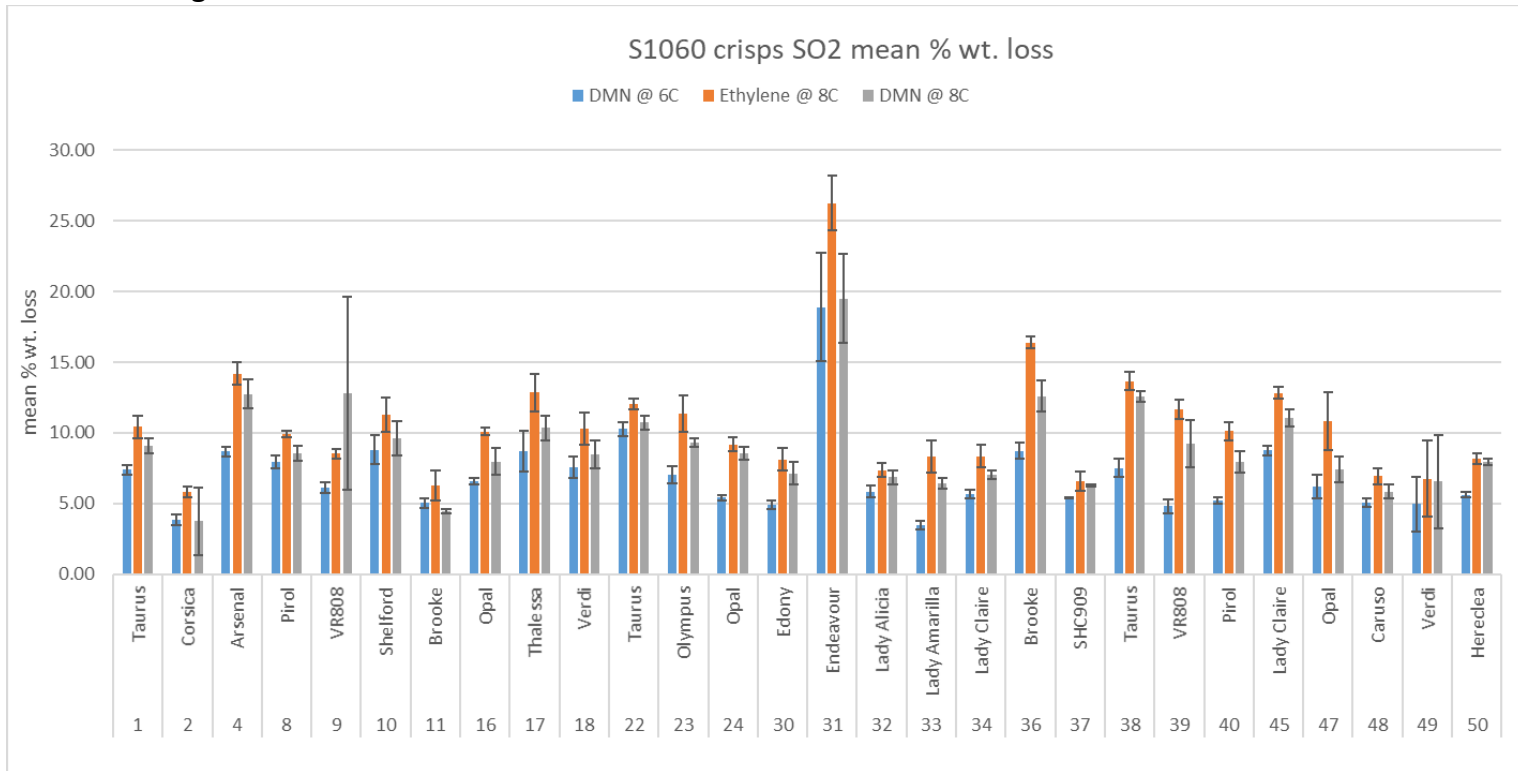


## Weight loss



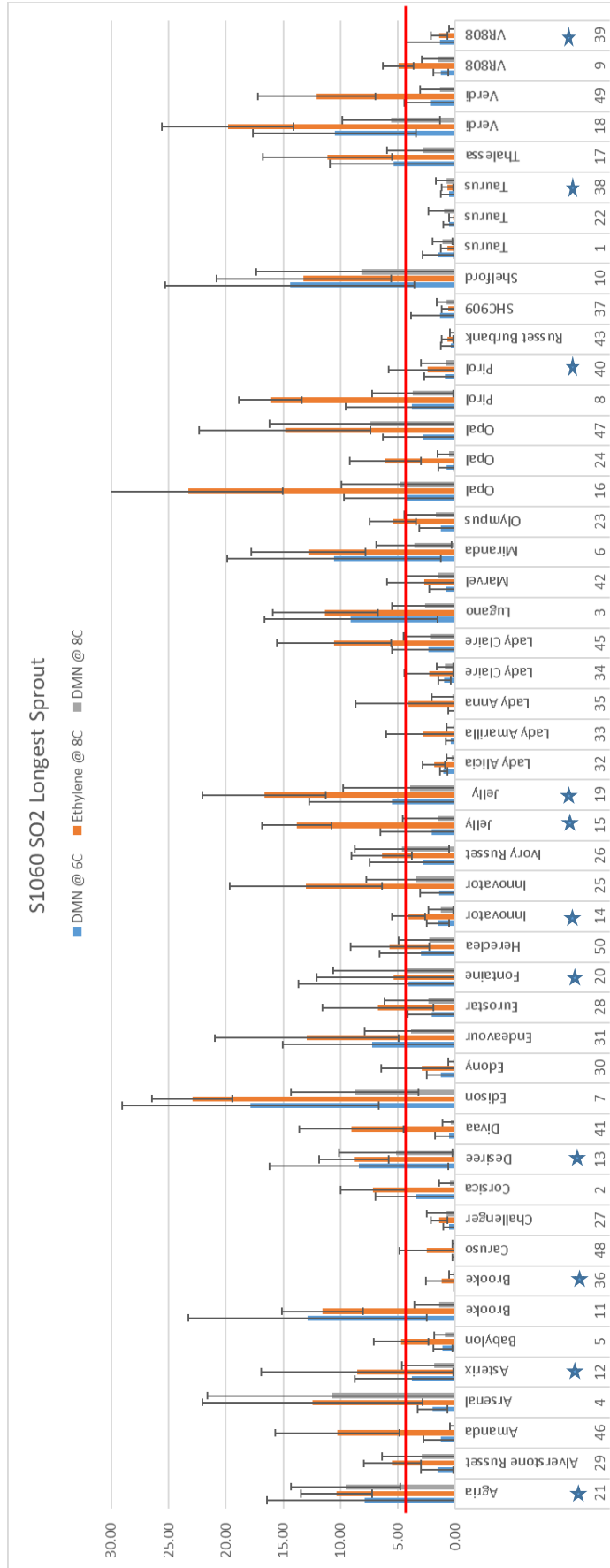
## SAMPLING OCCASION 2 (from 27<sup>th</sup> May 2020)

### Weight loss

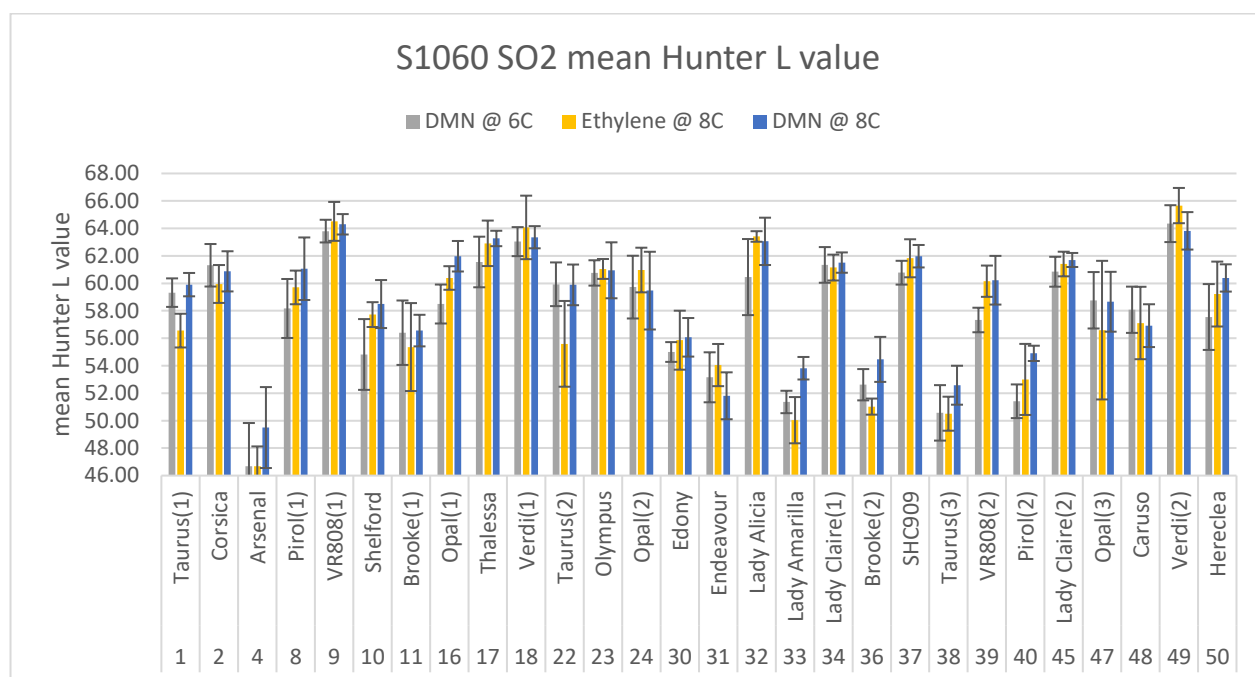


# Sprouting

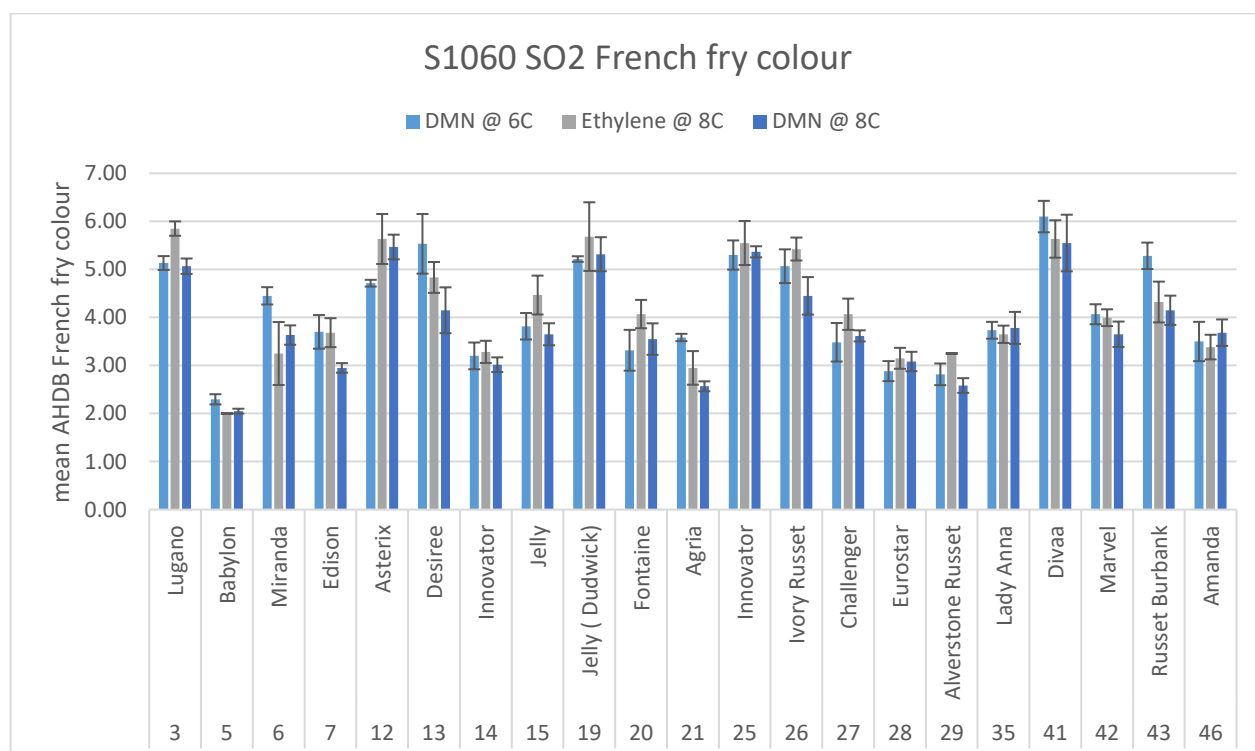
★ MH



## Fry colour: crisping varieties



## Fry colour: chipping varieties



□ Some data are presented slightly differently for the two sampling occasions. SO2 had to be conducted and analysed under COVID-19 restrictions with limited access to resources.



## 5. Discussion

As this is an interim report after just a single year's trial, the data have been summarised in two tables which have been colour coded to indicate where there have been successful findings. At the **two sampling occasions**, the varieties shown in Tables 5 & 6 produced good or best quality (low defects) and colours.

**Table 5. Crisping varieties: successful storage**

[1] indicates quality at SO1 (Feb). [2] indicates quality at SO2 (May). **Yellow** lines achieved best quality for ethylene *and* cooler storage. **Green**: ethylene only. **Blue**: cooler storage only. \*MH treated.

Variety	Storage in ethylene at 8°C		Storage with DMN at 6°C		Storage with DMN at 8°C (control)	
	defects <10% Hunter L>58 <b>Good</b>	defects <10% Hunter L>61 <b>Best</b>	defects <10% Hunter L>58 <b>Good</b>	defects <10% Hunter L>61 <b>Best</b>	defects <10% Hunter L>58 <b>Good</b>	defects <10% Hunter L>61 <b>Best</b>
Arsenal						
Brooke (11)						
Brooke (36)*						
Caruso	1		2			1
Corsica**						
Edony		1	1		1	
Endeavour**					1	
Hereclea	1, 2		1		2	1
Lady Alicia		1, 2	2	1	2	
Lady Amarilla						
Lady Claire (34)	1	2	1	2		1, 2
Lady Claire (45)		2	2			1, 2
Olympus	2	1	2	1	2	1
Opal (16)	2		2		1	2
Opal (24)	2	1	2	1	2	1
Opal (47)			2		2	1
Pirol (8)	1, 2			2	1, 2	
Pirol (40)*						
SHC909		1, 2	2	1		1, 2
Shelford					2	
Taurus (1)			2		2	
Taurus (22)			2		2	
Taurus (38)*						
Thalessa		1, 2		1, 2		1, 2
Verdi (18)		1, 2		1, 2		1, 2
Verdi (49)		1, 2	1	2		1, 2
VR808 (39)*	1, 2		1		2	1
VR808 (9)		1, 2		1, 2		1, 2

Table 5: \*\*Note varieties Corsica (2) and Endeavour (31) had greater than 10% defects at intake, 10.7 and 21.6 respectively. Endeavour (31) also had an intake Hunter L value less than the acceptability threshold of L61 (56.9). Crisp results are based on replicate 2 only at this occasion.

**Table 6. French fry varieties:**

[1] indicates quality at SO1 (Feb). [2] indicates quality at SO2 (May). **Yellow** lines achieved best quality for ethylene *and* cooler storage. **Green**: ethylene only. **Blue**: cooler storage only. \* MH treated.

Variety	Storage in ethylene at 8°C		Storage with DMN at 6°C		Storage with DMN at 8°C (control)	
	mean <USDA1 <b>Good</b>	Better than 8°C gr. mean# <b>Best</b>	mean <USDA1 <b>Good</b>	Better than 8°C gr. mean# <b>Best</b>	mean <USDA1 <b>Good</b>	Better than 8°C gr. mean# <b>Best</b>
Lugano					1	
Babylon		1, 2		1, 2		1, 2
Miranda	1	2	1		1	2
Edison		1, 2		1, 2		1, 2
Asterix*						
Desiree*					1, 2	
Innovator (14)*		1, 2		2		1, 2
Jelly (15)*	1			2	1	2
Jelly (19)*					1	
Fontane*		1	1	2		1, 2
Agria*		1, 2	1	2		1, 2
Innovator (25)		2		1, 2	1	2
Ivory Russet	1				1, 2	
Challenger		1		1, 2		1, 2
Eurostar		1, 2		1, 2		1, 2
Alverstone Russet		1, 2	1	2		1, 2
Lady Anna		1, 2	1	2		1, 2
Divaa					1	
Marvel	1, 2		1		1	2
Russet Burbank					1, 2	
Amanda		1	1	2		1, 2

#8°C storage control treatment grand mean: SO1 = AHDB 3.0 (USDA 0); SO2 = AHDB 3.9 (USDA 1) cv. Kingsman fry colour at intake was AHDB score 4.5 (USDA >1) and was withdrawn from the study by the supplier

It is encouraging that several varieties produced both a positive outcome to ethylene treatment and were able to be stored successfully at cooler temperature, especially for longer term storage (30 weeks). A few varieties responded to ethylene without responding well to storage at 6°C and

a smaller number still did not respond to ethylene but did give satisfactory storage under the cooler storage regime.

It must be noted that there was a high degree of variation in the data so it must be treated cautiously. The inclusion of some stocks treated with MH was a contributing factor in this. It is difficult to draw conclusions after a single trial. There are undoubtedly other factors at play. Stocks, even of the same variety and irrespective of MH treatment, did behave differently and this was not unexpected given variation in harvest date and crop condition on intake.

Storage in trays on trollies was also not entirely successful given the variation in tuber size and skin set which led to softening and weight loss.

For the second year's trial, steps have been taken to try to regulate some of these points more closely to try to achieve more consistency across what is a large trial, with over 50 different stocks now included. MH is being adopted as a standard across the trial where possible to reflect the change in commercial practice for 2020/21 onwards.

Storage in Year 2 will no longer be in trays; instead stocks will be held in randomised and replicated nets within a bulk of crop to simulate commercial conditions more closely.

## **6. Acknowledgements**

AHDB is grateful to all of the organisations who have agreed to help with submission of stocks for this trial. Thanks also to DormFresh Ltd for allowing use of (as yet unapproved) 1,4-DMN treatments for sprout suppression in the colder storage and control regimes.