# Grower Summary

## FV 439

To identify pre-harvest, harvest and post-harvest management practices capable of reducing losses of pumpkins during storage

Annual 2015

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# *GROWER SUMMARY*

## Headlines

- Pumpkin varieties differ in their keeping qualities. Further studies in this project will identify the key factors affecting the storage potential of pumpkins.
- US growers' perceptions are that the stalk provides an entry route for rotting pathogens and that this is greater where stalks are damaged by infection with mildew. A field trial will be conducted this season to determine the impact of spraying against mildew on post-harvest pumpkin losses.

## Background

The UK market for decorative (carving) pumpkins, currently estimated at £14-15M per year, is growing at a rate of 20% annually, and the market for culinary (edible) pumpkins is growing at an even faster rate from a much lower sales base. However, the levels of pumpkin losses are estimated to be 15-20% of the initially harvested crop which equates to an annual loss of £2-3M. This project seeks to identify the causes of losses and test practices to reduce these losses.

There is currently very little information on the relative importance of different causes of loss and the impact of pre-harvest, harvest and post-harvest management practices on these losses. This project is working with UK growers to understand the current situation through detailed and structured observations on-farm. Recommendations provided to and practices used by growers in the USA will be reviewed, both through the literature and by direct consultation. By studying a range of decorative and culinary varieties, the characteristics associated with good storage potential will be identified.

## Summary

### Overall project Aim

To identify pre-harvest, harvest and post-harvest management practices capable of reducing losses of both edible and carving pumpkins during storage.

Specific project objectives are:

<u>Year 1</u>

1. To collate and disseminate information on management of the pumpkin crop in the US, and associated research relevant to the UK industry.

2. To determine and rank the main forms of post-harvest loss (Tissue breakdown, latent infection, post-harvest infection, harvest maturity) currently affecting pumpkins in the UK.

3. To determine and rank the key factors affecting the storage potential of pumpkins in the UK (harvest maturity, mineral nutrition, harvesting/post-harvest practices, storage environment/practices.)

All years

4. To determine the varietal characteristics that affect storage potential (including size, skin thickness, pericarp thickness, dry matter content)

Year 2

5. To identify and test pre-harvest management practices to improve storage potential.

6. To identify and test harvest/post-harvest management practices to improve storability, including the identification of maturity indicators to predict storage potential at harvest.

## To collate and disseminate information on management of the pumpkin crop in the US, and associated research relevant to the UK industry.

A review of information obtained from the scientific literature and extension information is presented separately from this report.

Key points of information obtained from discussion with Mark Dillinger of Tozer US are as follows:

- The perception of US growers is that the pumpkin stalk provides an important route into the fruit for postharvest rotting pathogens, and that this is greater where stalks have been damaged by infection with mildew. There are two US practices that would reduce this; firstly US growers aim to keep the foliage as long as possible and actively spray to manage the powdery mildew with a range of actives and will also apply a potassium bicarbonate every 7 days as part of the spray program, and secondly they leave as long a handle as possible, by tearing the vine at the attachment point and letting this wound which is smaller seal up naturally.
- The stalk colour is a sign of good fruit quality, a dark green stalk will mean that there is no powdery mildew present. Powdery mildew present when the fruit is growing also leads to the stalk twisting when it is forming and encourages breakdown at the point the stalk joins to the fruit. US pumpkin breeders aim to select for varieties with improved attachment of the stalk to the fruit, as a means of reducing entry of pathogens. Figure A illustrates varieties with good and bad attachment characteristics.

- US grower will not lift a fruit from the field until it has initially cured (they use a slap test and if a hollow echo then ready if a dull thud then not). They are also using the colour as a good guide as to fruit maturity as if the orange has not got any depth to it then the fruit has not yet started to ripen.
- US growers consider a decent nutrition program essential for the fruits to store. They use a nutrition program is made up from a combination of base dressing top dressing and foliar feed. Colour is a good indication of nutrition. If a good fungicide and nutrition program are used then the fruit will recover from and seal over any wounds on the fruit skin reducing breakdown issues.

**Figure A.** Pumpkin fruit from varieties with good stalk attachment (LH picture) and poor stalk attachment (RH picture).

## Preliminary storage trial conducted to compare four key varieties

Table A shows the data obtained from a single bin of each of Mars, Terraflyn Magician and Gomez assessed after approximately one month of storage under cover. Pumpkins were assessed as saleable or unsaleable. In almost all cases where a pumpkin was defined as unsaleable, it was due to rotting. Although, in this preliminary trial there was only one bin per variety and therefore a statistical analysis cannot be carried out, there was a considerable different in % losses with Gomez having more than four times the loss compared to Mars.

**Table A.** An assessment of pumpkins within a single bin of each of four varieties following one month's storage under cover under ambient conditions during October/November 2014 in Kent.

| Variety | #saleable pumpkins | #nonsaleable pumpkins | Total # pumpkins | % unsaleable | % soft stalk |
|---|---|---|---|---|---|
| **Mars** | 132 | 3 | 135 | **2.2** | 87.9 |
| **Terra Fin** | 156 | 7 | 163 | **4.3** | 59.0 |
| **Magician** | 115 | 11 | 126 | **8.7** | 70.9 |
| **Gomez** | 187 | 19 | 206 | **9.2** | 39.8 |

## Growers perceptions of pumpkin varieties

A questionnaire on varietal behaviour was circulated to pumpkin growers. Responses relating to keeping quality indicated that growers consistently regard Mars as a good storer, but are less clear about Terra Fin and Magician. This is consistent with the findings of the preliminary storage trial. However, the two respondents who grew Gomez regarded this as a good storer, whereas this variety had the highest percentage of unsaleable pumpkins in our trial.

Levels of loss this year were quoted as ranging from 7 – 35% in the field and 5 – 35% during storage.

## Preliminary post-harvest characterisation of varieties

This year a preliminary assessment of the post-harvest characteristics of a range of varieties was carried out. To our knowledge no such characterisation of UK varieties exists. The aim is to find out which characteristics relate to keeping qualities so that this information can be used for varietal selection, and also improvement of crop management. Key varietal characteristics assessed are set out in Figures B (skin strength, flesh firmness and whole pumpkin firmness). Values for moisture and sugar content, fruit dimensions, flesh and skin colour and mineral content were also collected.

Our first year of analysis, in what was a particularly poor season due to an early maturing crop, represents an initial benchmark which we can compare to future seasons. However, our initial observations indicate that there is a wide range of traits in the pumpkin cultivars that are statistically significant including skin strength, flesh firmness and overall fruit firmness among varieties (Figure B). Likewise there is a wide range in moisture content from 89 – 96%. Not surprisingly there is a strong negative correlation between moisture

content, whole fruit firmness (r = -0.77) and flesh firmness (r = -0.88), and with skin strength (r = -78)

Varieties with high moisture content tend to have lower sugar concentration per fresh weight essentially indicating a dilution effect with water uptake into the fruit.

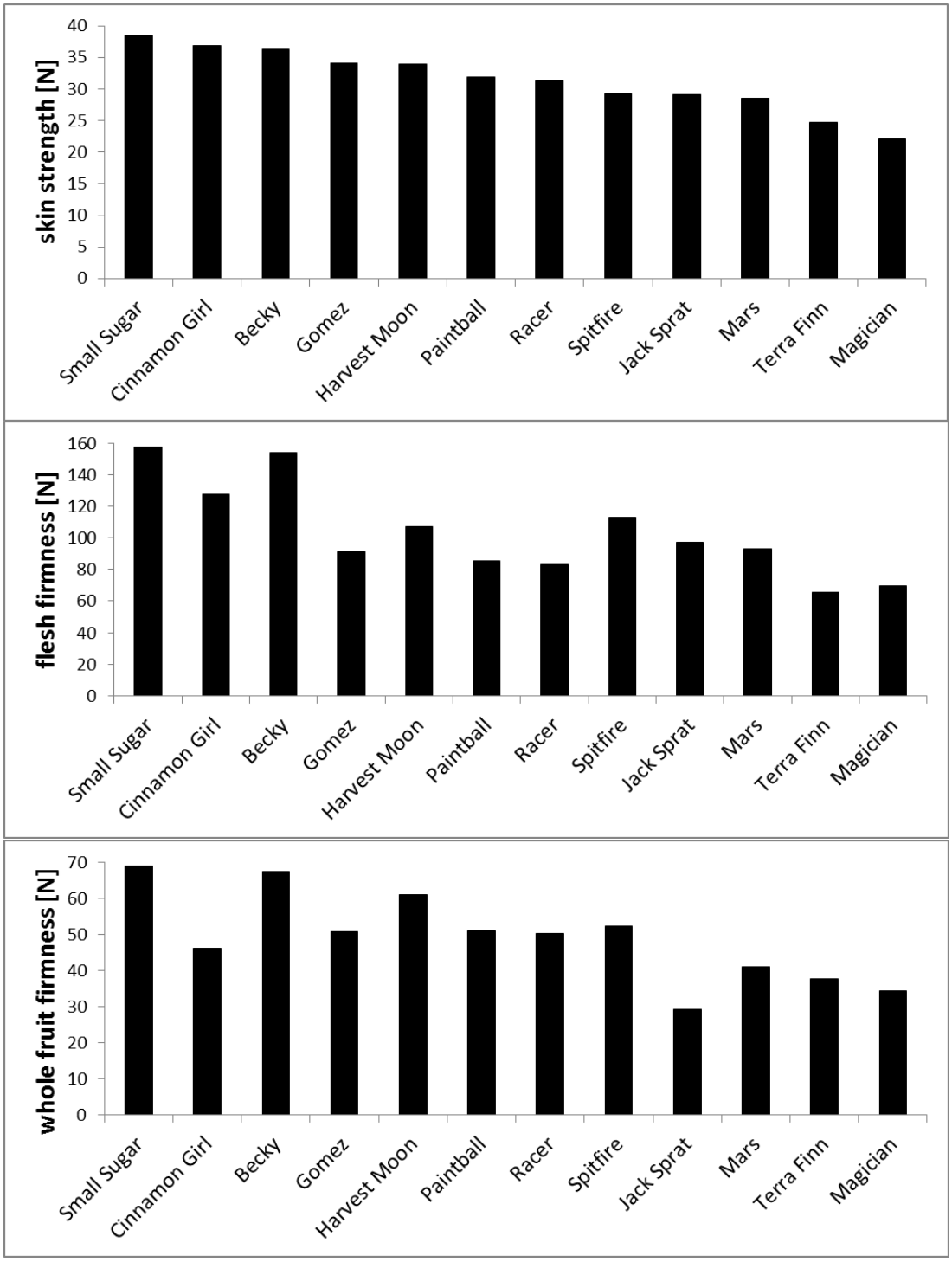


**Figure B.** skin strength, flesh firmness, whole fruit firmness measured by TA.XT plus Texture Analyser. Each data point is the mean for four measurements on 3-5 pumpkins. Varietal effect was significant ($p<0.001$) for all three characteristics with Least Significant Difference ($p<0.05$) of 6.7, 35.0, 16.9 respectively.

## Rot samples collected and analysed

Samples of rotting pumpkins were collected from the field and also from the storage trial conducted at Dan Mackelden, and were analysed to identify the rotting pathogens. The main pathogens identified were *Botrytis cinerea*, *Phoma cucurbitacearum*, *Rhizopus stolonifera*, *Colletotrichyn coccodes*, *Fusarium acuminatum*, *Mucor hiemalis*. Diagnostic photographs of these rots are shown in Appendix 1.

The proportion of rots identified is given in Figure C, together with a summary of the weighting of the rots for samples from East Anglia and the South East. However, this data should be treated with great caution as the samples were collected for identification purposes and were not proportional to the incidents observed. Nevertheless the notable difference between the two regions is probably an indication of a real difference.

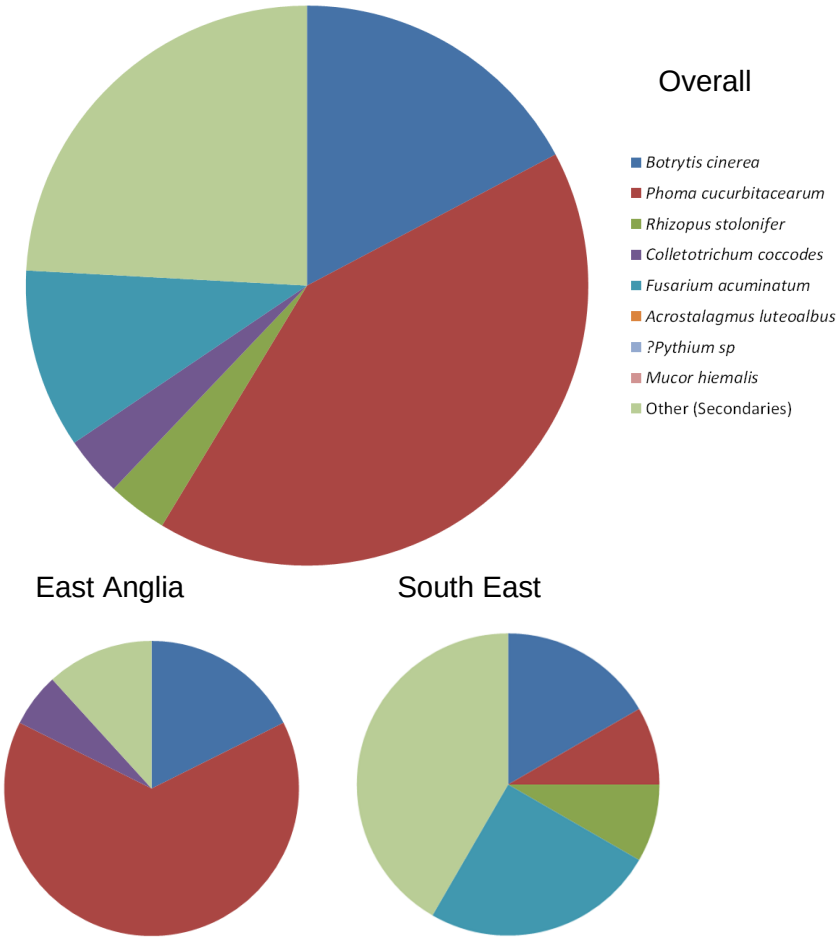


**Figure C**. The rots identified as a proportion of all samples analysed, and separated into those collected in East Anglie and in the South East. This data is an indication of incidence

only, as samples were collected for identification purposes and not for quantification of incidence.

Particular attention was paid to the pumpkin stalk, which has been implicated as a route of the entry of rotting pathogens. The main pathogens isolated from the stalks were *Acrostalagmus luteoalbus*, *Fusarium acuminatum* and *Botrytis cinerea.* Using the current methodology it is not possible to determine whether powdery or downey mildew are present, as these are obligate biotrophic pathogens and can therefore not be grown on artificial media. We have been informed (Mark Dellinger personal communication) that a twisted stalk is diagnostic of infection. However, it will be necessary to make observations in the field about the prevelance of these two pathogens.

Samples were also taken from the border between stalk and fruit. The pathogens isolated from 19 samples are illustrated in Figure D. The most prevalent in this limited survey was *Fusarium acuminatum*, which may suggest that this pathogen enters through the stalk.

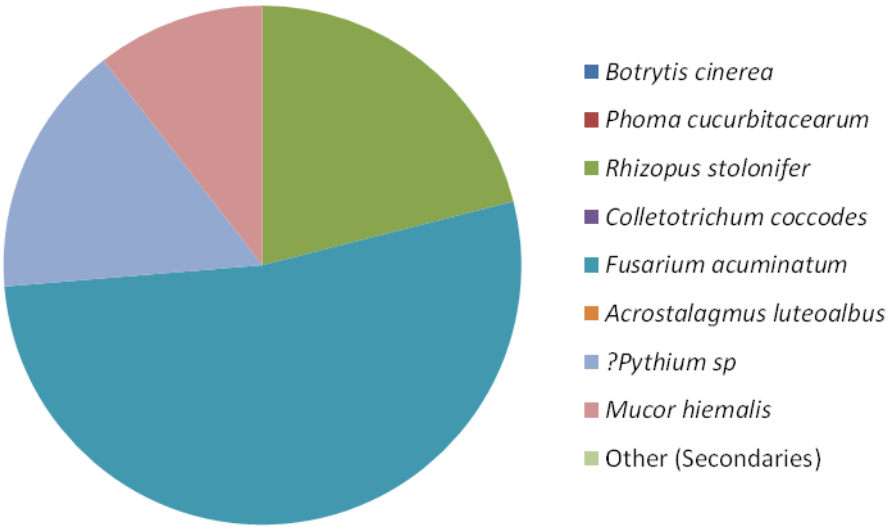


**Figure D**. Rotting pathogens isolated from the border between stalk and fruit for 19 samples of pumpkin fruit.

## Future plans

The data presented in this report are mostly of a preliminary nature, as they have been collected from a single season only, and a season that was unusual as the pumpkin fruit maturation was so early. However, the findings so far have helped to clarify the priorities for season 2.

1. A review of the relevant information available within the scientific literature and extension services outside the UK (especially from the US) will be presented separately from this report. Peter Waldock will visit US 3-9 October, after which the review will be updated.
2. On the basis of information obtained on growers' practices in the US, a trial will be set up, hosted by Oakley farms, to determine the effect of spraying against Mildew in terms of reducing losses due to post-harvest/post-cutting rots. The trial will include three varieties; Racer, Mars and Harvest Moon, with one acre per variety (0.5 acres with treatment, and 0.5 acre control). The chemical programme to be used is still to be decided, but the potato blight forecast model will be used to determine timing of applications. In the absence of mildew it will be necessary to use chemicals to trigger canopy senescence at an appropriate time.
3. A programme of field observations during crop development will be conducted on selected fields, focusing on cultivars Racer, Mars and Harvest Moon. The purpose is to investigate factors affecting relative incidence of key pathogens in different regions. An understanding of the epidemiology of the main pathogens will help to inform future control strategies. The observations will include recording of aborted fruit and rots, and information on nearby crops. A draft crop walker's guide has been developed by East Malling (Appendix 2.)
4. Observations of harvest and storage conditions will be undertaken, including assessment of levels of loss when stores dismantled.
5. The survey of varietal post-harvest characteristics will continue in 2015, and will be linked to storage trials of the same varieties. In this second season it will be useful to have control over the harvest maturity.

## Financial Benefits

Too early in the project to predict benefits

## Action Points

None at this stage of the project