Exploring variation in textural properties in blackcurrant germplasm

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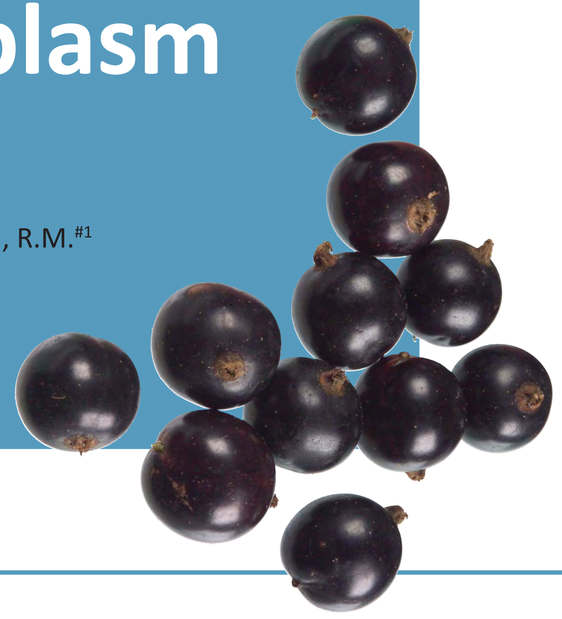

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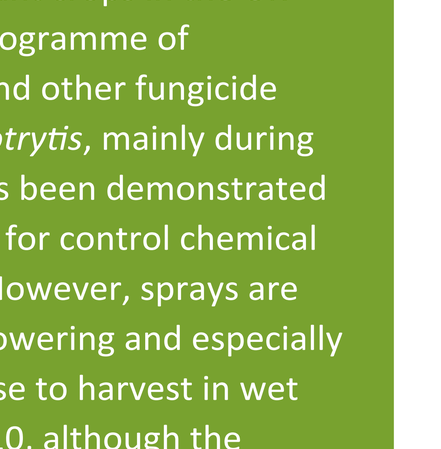
Introduction

As part of a project to explore options for sustainable pest and disease management in blackcurrant production systems, factors affecting susceptibility of blackcurrants to *Botrytis* were examined. *Botrytis* is an important disease pathogen in blackcurrant, and causing significant reductions in fruit quality at harvest and processing problems during juice production. Additionally, the prospect of a rapid degeneration in ripening fruit due to developing fungal infection can cause growers to harvest the crop prematurely before optimal sugar and pigment levels have been achieved.

Currently blackcurrant crops in the UK receive a routine programme of pyrimidine-based and other fungicide sprays to control *Botrytis*, mainly during flowering as this has been demonstrated as an effective time for control chemical application (1, 2). However, sprays are also applied post-flowering and especially to ripening fruit close to harvest in wet seasons such as 2010, although the efficacy of late treatment is unclear.

Cultivar differences in susceptibility of blackcurrant cultivars to *Botrytis* have been reported (3, 4), although complete resistance is thought to be improbable. However, one factor that is thought to affect the relative susceptibility of blackcurrant cultivars to *Botrytis* infection is the skin strength of the fruit (5), and this can be heavily influenced by preharvest weather conditions.

To identify germplasm that is less susceptible to *Botrytis* infection for future breeding purposes, a range of blackcurrant genotypes were assessed for skin strength and thickness.



Acknowledgements

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References

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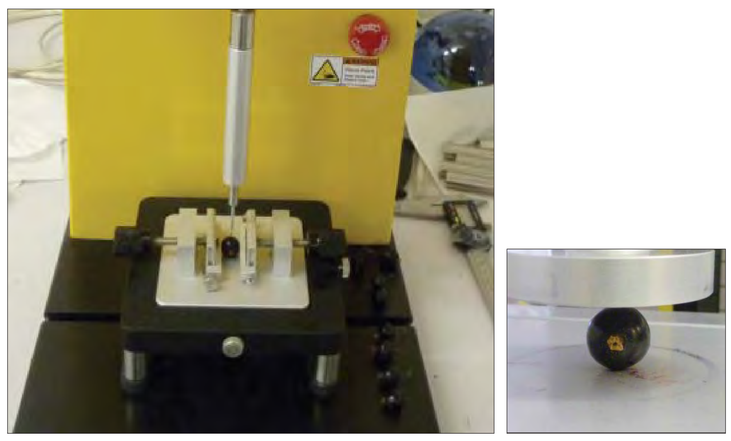
Methodology

All tests were carried out using texture analysers (models CT3 and QTS25, Brookfield Engineering, Harlow, UK). Initially, 18 different blackcurrant selections were subjected to a puncture test using a 2mm rod inserted to a depth of 4mm at 0.5 mm sec^{-1} (Figure 1).

The skin thickness (cuticle and three inner cell layers) was measured microscopically on sections (10 µm) cut using a Leica 1100 cryostat and mounted on polysine slides.

The skin of selected blackcurrant cultivars and breeding lines were isolated and ground to a powder in liquid nitrogen. After repeated extraction using 0.5 M NaCl in 100 mM Tris HCl, the insoluble crude cell walls were washed with ultrapure water and 50% ethanol. The weight of crude cell walls was obtained after lyophilysation.

Figure 1 Texture analyser set-up with puncturing and compression probes

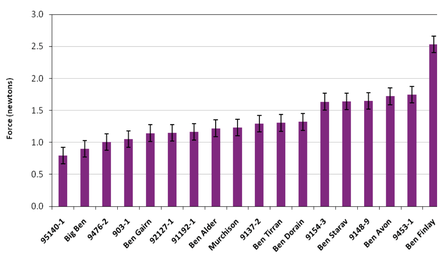


In a further test, 16 different blackcurrant selections were compressed to 30% of their diameter using a flat plate probe (40mm diameter) at 0.5 mm sec-1 at two sample dates.

Results

The force required to puncture the blackcurrants was highly significantly different between berries of different genotypes (with SED 0.1277).

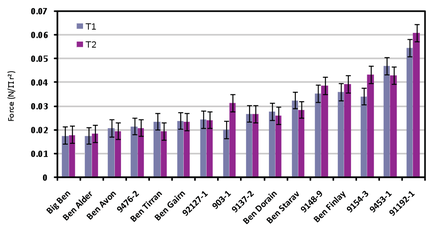
Figure 2 Force required to deform berries in puncture test



The force required to compress the blackcurrants to 30% diameter was significantly different between genotypes (SED = 0.003614), with no significant variation in these characteristics across different sampling dates.

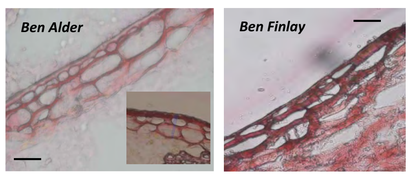
The puncture test and the compression measurements did not give a similar ranking of berry deformability highlighting the fact that they are recording different aspects and physical properties of skin strength. Therefore, we need to identify which of, or indeed whether either of, these physical properties are correlated with *Botrytis* infection.

Figure 3 Force required to deform to 30 % diameter corrected for berry size. T1 and T2 are the different sampling times.



There was no significant correlation between berry size and ease of deformation.

Figure 4 Cryostat section of berry skins



The insert shows where the measurements were made. There were 30 separate measurements of each section and 3 sections were examined for some genotypes (bars = 50 µm).

Figure 5 Skin thickness (cuticle + 3 cell layers)

There were substantial and significant differences in skin thickness between the genotypes, with Ben Finlay and the fresh-market cultivar 9476-2 having thickest skins.

As the blackcurrant genotypes showed substantial differences in skin thickness, an estimate of the weight of crude cell walls was carried out for 5 cultivars.

Table 1 Estimation of crude cell wall content

Variety	Wt (g) crude cell walls per 5 g skin
Ben Alder	0.16
Ben Avon	0.18
Ben Dorain	0.26
Ben Finlay	0.33
Ben Gairn	0.32

Ben Finlay and Ben Gairn yielded approximately twice the crude cell wall content of Ben Alder and Ben Avon. These results do not correlate well with the skin thickness measurements but this probably reflects differences in the overall bulk of the cell walls between blackcurrant lines (e.g. compare the thickness of cell walls of Ben Alder and Ben Finlay; Figure 4).

Discussion

The developed methods identified significant differences in the mechanical strength of the skins of different blackcurrant cultivars, and suggests that these differences may be related to the thickness of the cell walls. Therefore, these methods are suitable for further studies of the relationship between skin strength and thickness and susceptibility to *Botrytis*. Such studies will also address the effect of ripening time on the textural properties of the different lines, and should also provide considerable information that can be utilised in the breeding of new cultivars with skin properties suitable for pathological and environmental challenges.