

Scotland's Rural College

Phenotype screening tests for grain skinning

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Introduction

Barley grains have an adherent outer husk. An intact husk is an important characteristic of grain quality in malting barley, as it protects the underlying caryopsis and plays a key role in water uptake and germination during the malting process. An undesirable condition called grain skinning occurs when the husk becomes partially or wholly detached from the outer layer of the caryopsis, the pericarp. This physical defect causes serious inefficiencies during the malting process. The development of phenotype screening tests to differentiate susceptible and resistant varieties is a key objective of the BBSRC CIRC project on Causes and Control of Grain Skinning in Malting Barley (BB/J019623/1). Methods are being developed to quantify varietal differences under field and glasshouse environments. Growth conditions that mimic high skinning years, and potentially influence a lipid cementing layer (Gaines et al. 1985) between the husk and pericarp are being trialled, coupled with post-harvest mechanical treatments of grains to further induce skinning.

How to score grain skinning

Visual estimation of the proportion of husk loss is subjective, but good consensus of skinning in samples of 100 grains can be achieved using a threshold that defines a skinned grain with $\geq 20\%$ of husk loss. Skinned grains can be categorised as indicated in Figure 1.

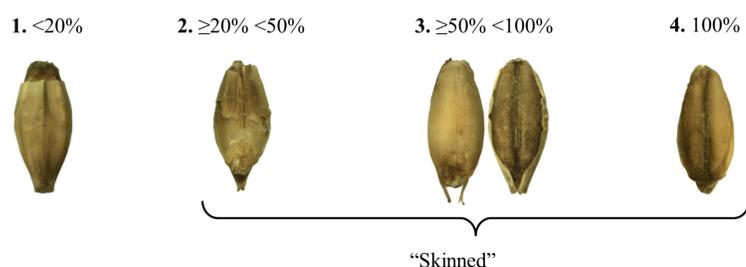


Figure 1. Grains with less than 20% of the husk area lost are classed as intact, whereas those that have lost 20% or more of the husk are classed as skinned. For variety comparisons, skinned grains were further categorised as above.

A screen of 200 field grown spring barley varieties (AGOUEB collection) from harvest 2012 indicated that the 20% threshold – blue bars in Figure 2 – could be used to differentiate varieties. Many of which on the 2013/2014 HGCA Recommended List had high proportions of skinned grains – denoted by the red stars.

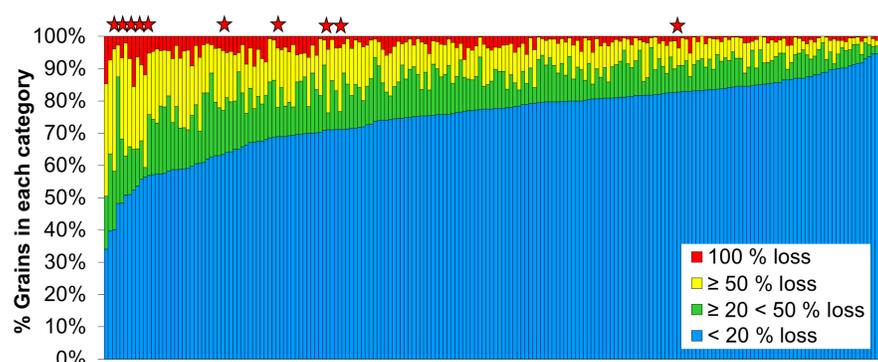


Figure 2. Wide variation in skinning levels was found in samples from harvest 2012, with values ranging from less than 4% skinning to 67% skinning.

Mechanical induction of skinning

Grains must be subjected to a mechanical force to distinguish varietal susceptibility to skinning (Olkku et al. 2005). The cumulative proportion of skinned grains from hand-harvested ears was determined by:

(1) hand-threshing, (2) threshing for 5 s in a Wintersteiger LD180 and (3) threshing for 20 s. Some varieties were more susceptible to husk loss after sustained mechanical force (Figure 3). Hand threshing alone was not sufficient to induce skinning.

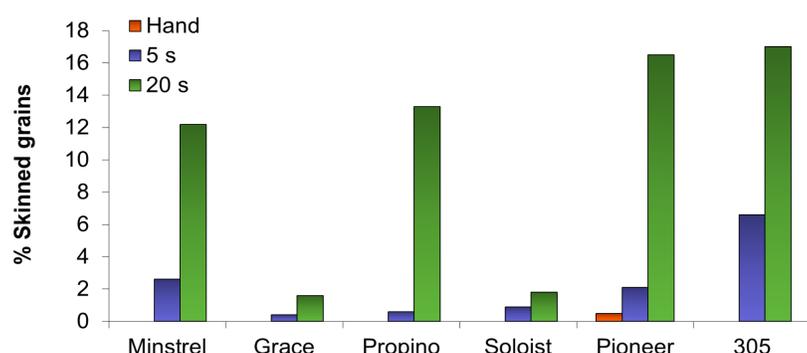


Figure 3. Subjecting grains to mechanical force by hand threshing, 5 s and 20 s in a Wintersteiger thresher.

Screening tests

Controlled environment screens to help industry to select against varieties that are prone to skinning are being compared. A misting treatment post-anthesis was used to simulate a summer of wet and dry spells. A shading treatment post-anthesis was used to simulate low radiation or poor grain-filling, as evident in season 2012 (Figure 4).

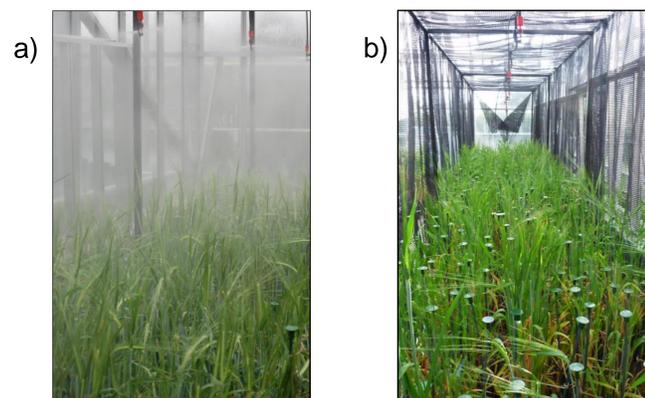


Figure 4. Controlled environment screens in a glasshouse. a) plants misted for 3 min three times a day to replicate rainfall and b) plants shaded to induce poor grain-filling.

Misting treatment significantly increased the proportion of skinned grains among a set of control varieties (Figure 5). The shading treatment had had a strong effect on grain-filling compared with unshaded controls: these samples are currently being evaluated.

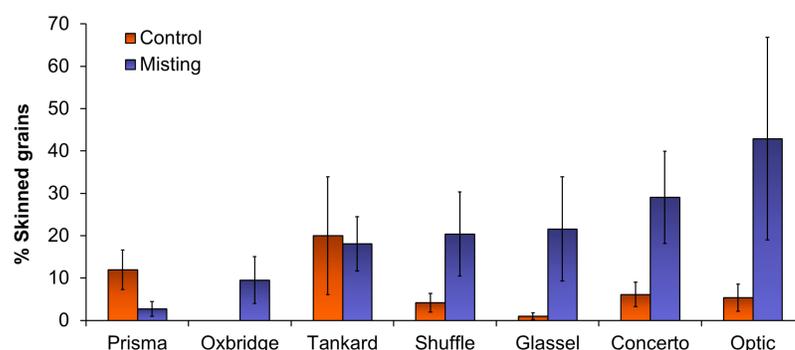


Figure 5. The misting treatment increased skinning in five out of seven varieties.

Screens and the husk adhesion process

Plant cuticle structure and composition are known to be influenced by the environment, and the controlled environment screens may influence development of the lipid cementing layer. In-depth work on the effect of the environment on this layer is on-going and will be used to inform development of the phenotype screening tests.

References

Gaines, R.L., D.B. Bechtel and Y. Pomeranz. 1985. A microscopic study on a layer in barley that causes hull-caryopsis adherence. *Cereal Chemistry* 62: 35-40
 Olkku, J., E. Kotaviita, M. Salmenkallio-Marttila, H. Sweins and S. Home. 2005. Connection between structure and quality of barley husk. *Journal of the American Society of Brewing Chemists* 63: 17-22

Acknowledgements

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