# Husk Adhesion in Barley Grains

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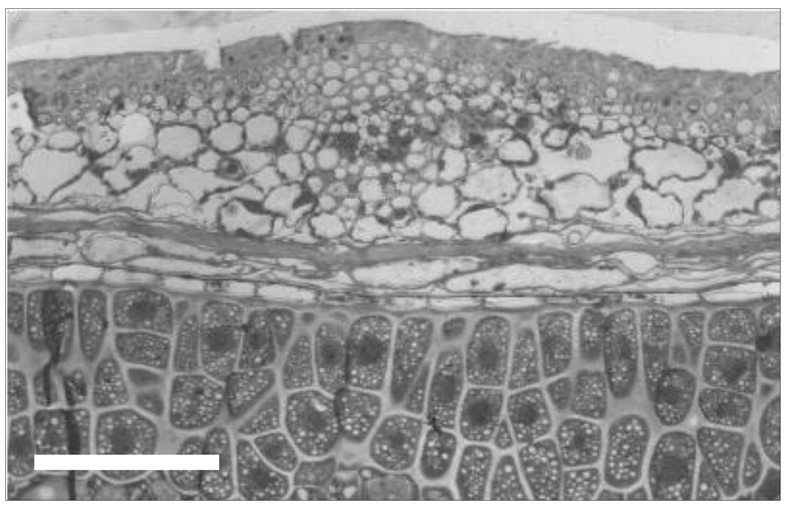
## Introduction

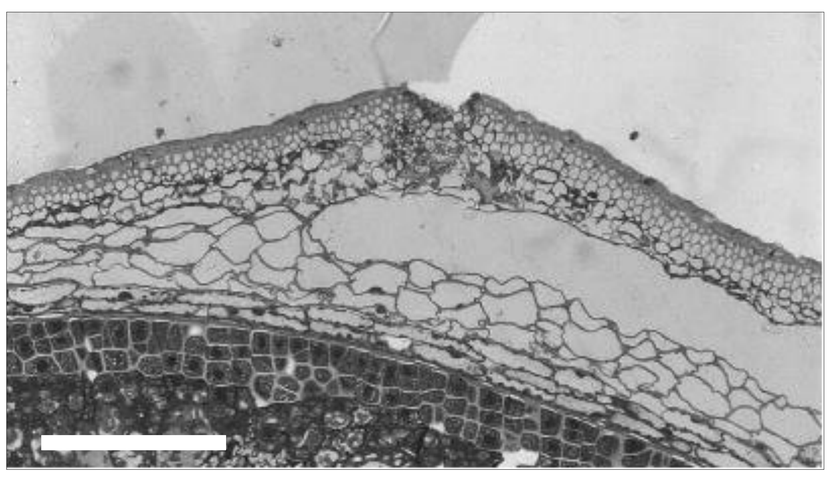
The barley grain at harvest is composed of a caryopsis enclosed in a husk. The husk is made up of two glumes, the palea on the ventral side and the lemma on the dorsal side. Both the lemma and the palea adhere to the surface of the pericarp. Husk adherence to the caryopsis is of considerable significance in both malting and brewing. If, in a batch of barley, there are grains with loose or detached husks these grains will germinate more rapidly than those with firmly adhering husks. Grains without husks are also likely to sustain embryo damage and give rise to mould growth. The consequences of poor husk adhesion or ‘skinning’ are uneven malting, loss of malting efficiency and lower malt production. Our current knowledge of husk adhesion is outlined below, with methods described in Hoad *et al*. 2003.

## Husk and Grain Adhesion

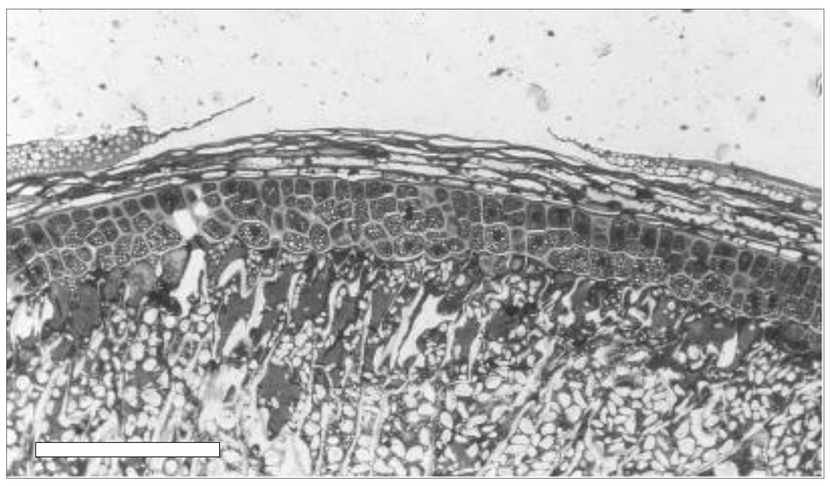
1. In this light microscope section the husk (lemma) is adhered to the pericarp that encloses the aleurone layer (block-like cells) and the starchy endosperm within. All images are the variety Chariot at 45 days after anthesis. Bar = 100 µm.



2. When the husk separates from the caryopsis i.e. when skinning takes place, the cementing layer is thought to separate from the husk and remain attached to the pericarp. The image below shows the husk (lemma) losing contact with the underlying pericarp at the dorsal area of a grain. Bar = 300 µm.

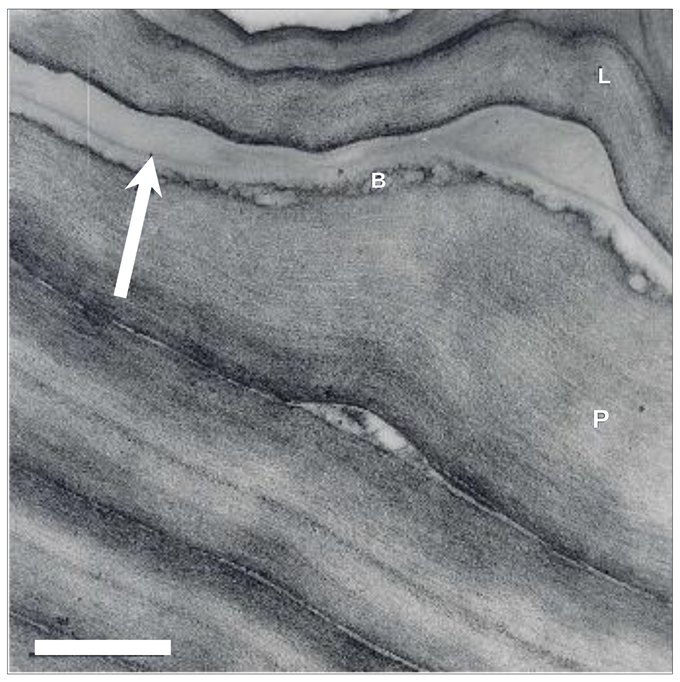


3. Gape between the lemma (left) and palea (right) overlying the pericarp may be a precursor to skinning. Gape is influenced by both husk condition and the amount of grain filling. Bar = 300 µm.



## Understanding the Cementing Layer

4. The outermost cuticular layer between the pericarp (P) and the lemma (L), has an irregular, 'bubbly‘ (B) outline on the side next the pericarp, and a smooth, slightly electron dense edge next the lemma. The bubbly layer is evidence of globular masses of cutin (Jeffree 1996). It is possible that most or all of the cuticular material in the cementing layer (arrow) originates in the pericarp epidermis as proposed by Gaines *et al.* (1985). Bar = 500 nm.




5. The cause of skinning could be inadequate fusion of the cuticle proper of the pericarp epidermis with that of the inner epidermis of the glumes, or a failure of cuticular material (from the pericarp) to adhere to the surface of the inner epidermis of the glumes (palea or lemma). Whichever is the cause, the critical processes appears to take place very early in grain development, possibly starting before anthesis, and to involve the synthesis of cuticular material.

## References

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Gaines RL, Bechtel DB and Pomeranz Y (1985). A microscopic study on the development of a layer in barley that causes hull-caryopsis adherence. Cereal Chemistry, 62: 35-40.

Jeffree CE (1996). Structure and ontogeny of plant cuticles. In: Plant Cuticles, ed. G. Kersteiens, Oxford: Bios Scientific Publishers Limited, pp. 33-82.

## Acknowledgements

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