

## Tree-to-silo impacts on whole kernel

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### Reason for the project

We have all heard the recent discussion in the industry on the need to maintain and improve quality. Many would be aware of the price premiums that whole kernels have been receiving in the market in recent years, something in the order of \$2.50 per kg. While we know wholes are a high value product, we don't have a lot of information on how to improve percent wholes. In particular, there is not much information on how handling by both growers and processors affects wholes. Some work by Cathy Cavaletto found that dropping from heights increases chips and other damage, but we were unsure as to how dropping might affect wholes. We were also unsure about what effect handling at different moisture contents might have on wholes.

Another point worth mentioning is the variety effect. The regional variety trials showed that there were differences in percent wholes between varieties. This raises a couple of questions, for example, does a variety that produces a lot of wholes produce less if it is frequently dropped or handled roughly? Does a variety that produces few wholes produce more if it is handled carefully? We aimed to find best-practice handling procedures that both growers and processors may use to maximise percent wholes.

### Methods

We subjected NIS to a range of handling treatments including:

- drops from different heights (0, 1, 4 m);
- drops at different NIS moisture contents (MC)
  - 15% (field MC);
  - 9-10% (farm and transport / handling MC);
  - 3% (cracking MC);
- drops onto a steel surface or onto a surface of NIS;
- multiple drops (0, 2, 4, 6 drops).

We chose two varieties: one that produces high % wholes (A38) and one that produces medium-low % wholes (246). This was to see how the different varieties respond to handling.

### Results

The most significant findings were:

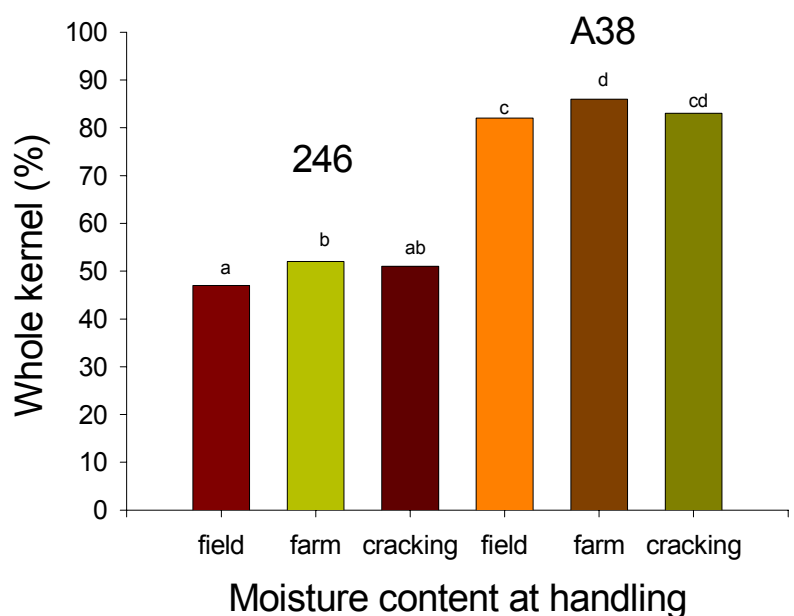
- wholes are mostly predetermined by variety;
- dropping at 15 % MC may reduce wholes by 0-5 %;
- dropping onto steel (rather than NIS) at 3 % MC reduces wholes;
- chips, shoulder damage and bruising are increased by dropping;
- the high whole variety had more “hooks” between the halves when viewed under the electron microscope.

#### Wholes are mostly predetermined by variety

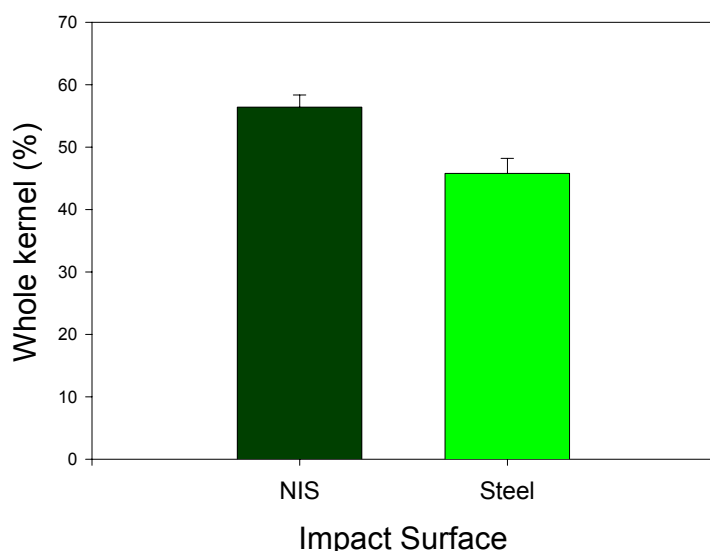
We found that wholes were mostly pre-determined by variety. Regardless of handling, A38 produced around 80-90% wholes and 246 produced around 50-60% wholes (Fig. 1). Rough handling did reduce wholes, but only by about 3-5 %. Wholes were reduced the most when NIS was handled at field (15%) MC. The worst handling practices, i.e. 6 drops or handling at 15 % MC, reduced wholes only by around 3-5 % for both varieties. Drop height had no effect on wholes.

#### Dropping onto steel at 3 % MC reduces wholes

The largest reduction we found in wholes was by dropping NIS at 3 % MC onto a steel surface, rather than onto a NIS surface. This reduced wholes by 10 % for a medium-low whole variety (246), from 56 % to 46 % (Fig. 2).



*Fig. 1. Whole kernels recovered after handling at field (15 %), farm (9-10 %) and cracking (3 %) NIS moisture content.*



**Fig. 2. Whole kernels recovered after dropping onto a steel surface and NIS surface for 246 at 3 % NIS moisture content.**

kernel, we examined the break zone using light microscopy and electron microscopy. We found cells in the break zone have a thick surface cuticle. A high whole variety had a series of “hooks” in the cuticle (Fig. 3.), which may hold the halves together. A low whole variety had a smooth cuticle, with less “hooks”. Further work is required to confirm the role of these structures, and whether they can be selected in a breeding program or genetically engineered.

#### Recommendations for the industry

- Variety is the most important factor for producing high wholes.
- Reduce the number of drops on farm. This will reduce chips, shoulder damage and bruising of kernel.
- Handle nuts at 15 % MC carefully. Rough handling, i.e. frequent drops, may reduce wholes by around 5 %.
- Avoid dropping NIS onto a steel surface at 3 % MC.

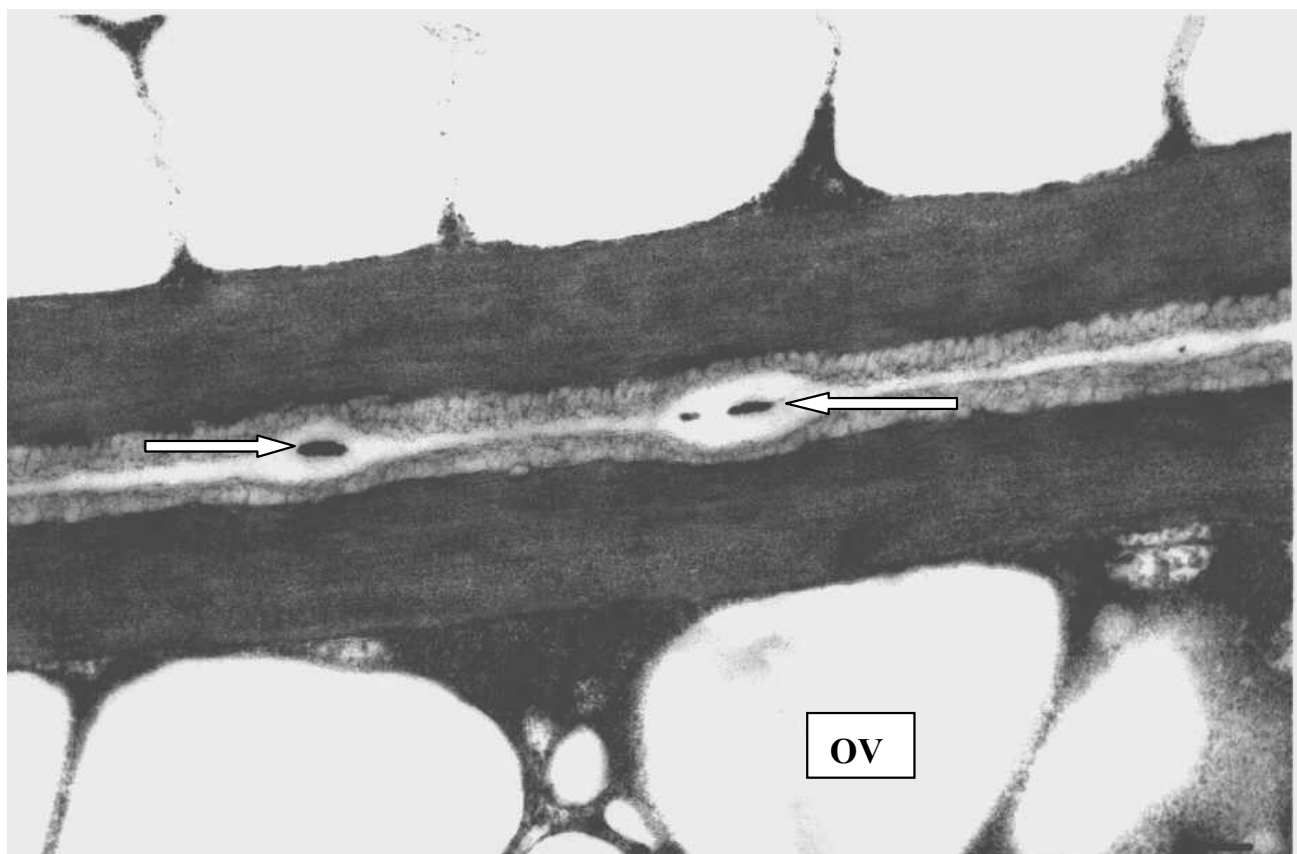
#### Chips, shoulder damage and bruising increased by dropping

Chips (measured as a % of kernel weight) were increased from 4.5% to 6 % by handling at 15 % MC for 246. Damage to shoulders of nuts also increased with increasing drop height and number of drops for both varieties. We are still working on this data and we will send an update to the bulletin when analysis is complete.

An interesting thing we noticed was bruising. Nuts that had been dropped frequently, i.e. six drops, or dropped several times from 4 m, had a definite layer of bruising. This was visible as discoloration of the kernel and oily secretion on the surface of the nut. We did not follow up on this, but it would be interesting to find what happened to these nuts when roasted, and if the shelf life of bruised nuts was less than normal.

#### Why are there differences between varieties?

To find out why there is a strong variety influence on whole



**Fig. 3. Whole kernel of 835 (high whole variety) showing “hooks” (white arrows) in the cuticle zone between the two halves. Oil vacuoles (OV) containing oil are also visible.**