BRAUWELT®

Industrial single kernel sorting for improved quality, food safety and sustainability

NEW APPROACH | Our growing global population requires more food, but we have limited land available. Besides, the changing climate increases deviation of crop quality, leading to downgrades and threatening food safety and security. Optimizing the use of what is produced from our fields will be more and more important in the future, even crucial, from a sustainable and economic standpoint. The Swedish agri-tech company BoMill offers a new approach to grain sorting based on the individual kernels' inner properties. The article presents the technology applied to malting barley or wheat and describes how such technology can benefit the malting and brewing supply chain, with a focus on expanding markets or areas that may not yet be fully structured to grow barley.

GRAIN IS THE WORLD'S second most traded commodity after oil, and a critical staple food – facing a global challenge. Our planet's ever-increasing population demands more food, but our access to arable land is limited. Climate change, extreme weather and poor production conditions intensify prevalence of toxins and affect negatively crop quality, generating more waste and reducing our ability to feed the world in the future. Supply disruptions and rising energy costs are experienced today in certain parts of the world, which also contributes to dramatic price increases for cereals and their derived products. Additional challenges such as stricter regulations related to grain production and handling, or consumers' demand for cleaner and locally produced food put further strain on the industry. The grain value chain must find new ways to be more sustainable, reducing crop losses while improving supply and process efficiency.

Author: Denis Boissau, Marketing Manager, BoMill AB, Malmö, Sweden

Grain quality and sorting

When you look at a spike of barley, all kernels look the same, but even if they are genetically identical and have grown in the same conditions, there are significant quality differences between each and every kernel. These differences are often bigger than the quality variation within an entire field. Up until now the quality of a batch of grain is only determined by spot checks analysis, randomly picking small portions of grain from every truck load as it arrives at the receiving site. This approach only measures the mean value of an entire load and does not consider potential related to quality variation within that load. Furthermore, traditional grain sorting methods mostly focus on visual or morphological characteristics but are unable to judge the quality of the most valuable part of the kernel which defines its end-use specific attributes – the inner part. Consequently, a portion of top graded grains is often hidden in each batch, therefore lost, or misused. More production is needed to compensate this loss, leading to additional cost and more carbon emissions.

Fig. 1 NIR-T single kernel sorting equipment

Using NIR-T (near-infrared in transmission mode) spectroscopy, BoMill's latest advanced sorting solution, named BoMill InSight™ (fig. 1), looks inside every single kernel in a batch of grain to decide its classification. Unlike optical sorters, it can accurately segregate into two quality fractions, based on inner properties such as protein level (fig. 2). Through its modular design consisting of one to eight sorting units fitted on a frame, the equipment can sort at industrial speed, from 2 and up to 15 metric tons/hour (equivalent to 125 000 kernels per second), making it suitable for a wide range of segments and setups.

BoMill InSight™, launched earlier this year, is marketed towards large grain producers, cooperatives, grain elevators, industrial flour mills and malting plants. Two installations are already scheduled for the first half of the year.

The technology, available today for wheat and barley, is based on three key essential steps described below and illustrated in fig. 3:

- Singulation: Grains are fed through one top inlet that evenly distributes the kernels to the sorting units (up to 8 sorting units per equipment). Individual kernels are then accurately positioned in individual channels and controlled all the way towards the detections and ejection points.
- Detection: The inner quality of each individual kernel is assessed by analysis of the signal from NIR light shining through it (NIR in transmission mode).
- Ejection: The data is processed, and individual kernels are sorted into one of two quality fractions (e.g. high and low protein), either by passing through the machine or by being individually ejected with compressed air into a second sorting fraction.

Fig. 2 Barley kernel ejection

Optimizing grain supply through protein segregation

In some regions, especially in emerging markets, where malting barley has not been historically produced, a large portion of domestic production can fall short of malting requirements. This can be due to protein level not being in line with required specifications. Malt producers, thus, depend on imported and remotely sourced malting barley to compensate for the shortage and fulfill the needs for their production. Yet, due to the quality variation within each rejected batch of grain, there is a portion that could still comply with the malting requirements. When we sort kernels individually there is potential to take that portion back, saving value while raising the overall quality and process efficiency. Indeed, when assessing the quality kernel by kernel, based on protein level for instance, a minimum of 20 % in each batch can often be classified as higher grade. And, if we look at barley that fall just outside of specifications, as much as 70 % could be recovered and used for malting if individual grain sorting is applied to the batch.

Fig. 4 presents the data of a typical sample of malting barley sorted with the BoMill technology. The material was initially out of specifications for malting due its high protein level 12,8 %. If we target a maximum of 12 % protein content, this technology allows recovery of minimum 48 % of the batch.

Based on the same sample, if one targets a level of 11 % protein content, well within the malting specifications, about 30 % can still be recovered.

In some regions, a typical barley supply looks like scenario A in fig. 5. To fulfill the needs of malt production, part of the sup-

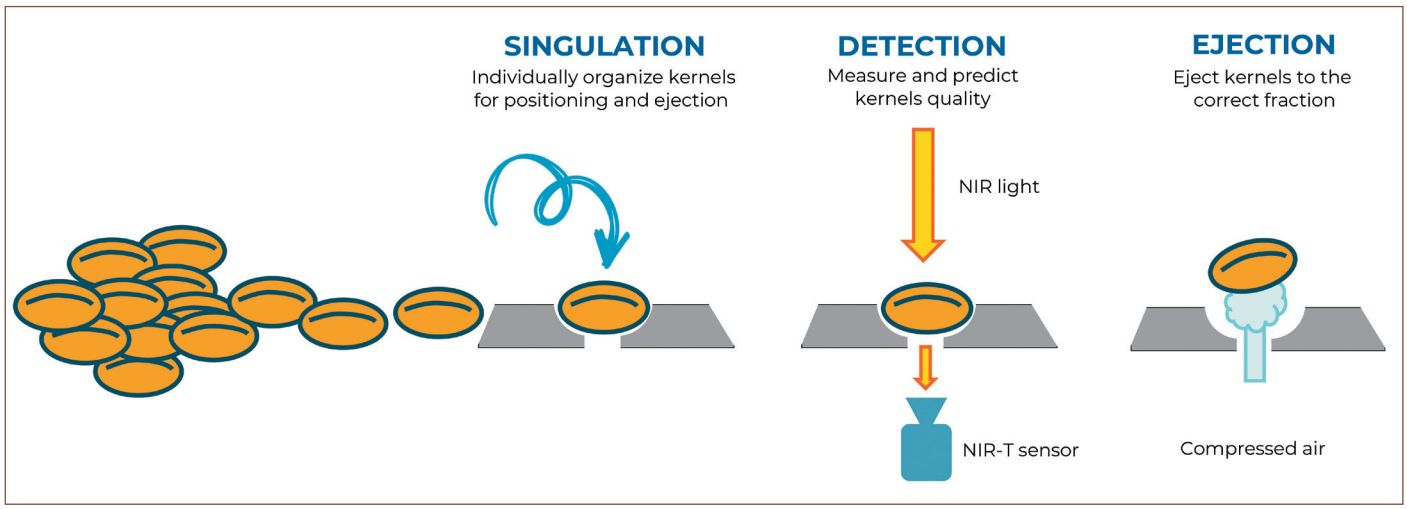

Fig. 3 Key sorting steps

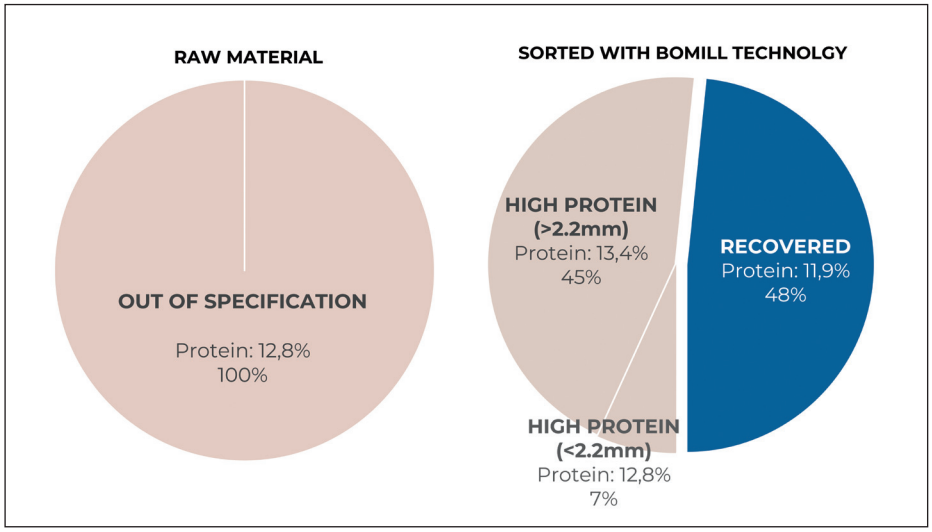

Fig. 4 Malting barley segregation based on protein content

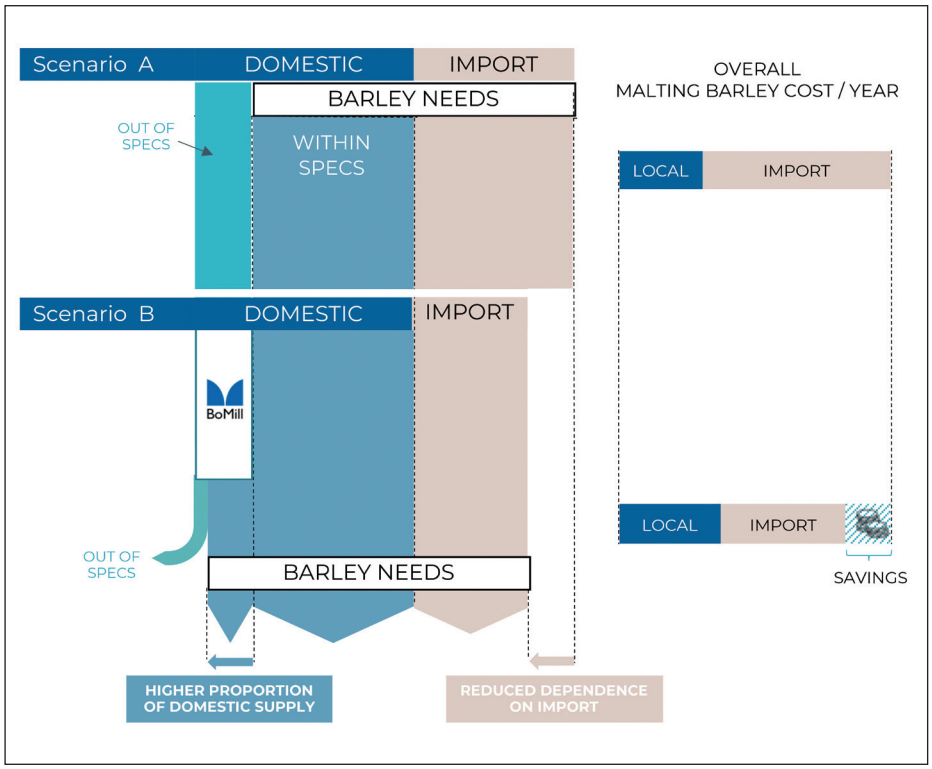

Fig. 5 Impact of sorting technology on malting barley supply: Scenario A (without sorting)/ Scenario B (with BoMill InSight™)

ply comes from the portion of locally grown barley that is within specifications, and the rest is imported. The remaining portion of barley locally grown and out of specifications may be downgraded as feed and is rejected. But if we apply individual grain sorting on this material, the relation could change to scenario B. By applying the BoMill sorting technology on the portion of malting barley that is out of specifications, it is possible to increase the proportion of domestic supply while reducing dependance on imported materials. This has the effect of reducing raw material and transport costs, lowering dependence on external markets while improving the resilience against volatile global market conditions.

Utilizing more of the domestic production is also more sustainable both in terms of transport emissions and better relationships with local contracted farmers. The latter point can actually be crucial in markets where barley competes with other crops, that can be more lucrative for the farmers. With a long-term approach, malt producers need to be able to accept as much as possible what is produced by contracted farmers, even when unexpected growing conditions have altered crops' malting quality. This helps strengthen a lasting relationship, bringing more assurance to the farmers that their commitment to barley production is supported by the value chain.

Reducing waste and increasing food safety

Fusarium head blight (FHB) is a fungal disease in grain, causing reduction in yield, grade and end-use quality. It produces mycotoxins such as deoxynivalenol (DON) in grain crops that can affect human and animal health if they enter the food chain, but also known to impact the risk of beer gushing.

Transfer of infected seeds in other fields and specific weather patterns facilitate the development of fungal diseases in certain regions. Due to high occurrence of Fusarium and other weather-related crop downgrades, malt producers must often contract greater acreage (more than 30 %) to compensate for the volume of malting barley that has a risk to be downgraded to feed.

Using single kernel sorting technology, it is possible to remove the fraction of grains which is the most highly affected by Fusarium. This makes it possible for grain handlers to save a portion of grain batches that were initially downgraded, while improving food safety and reducing waste (fig. 6). Ultimately it can also help optimize the level of acreage contracted.

Fig. 6 shows an example of a typical malting barley sample, sorted with BoMill technology. In this case, a sample of commercial material, provided by a grain handler, has a DON level of 1117 ppb, but the malting plant requires 750 ppb. The technology makes it possible to recover nearly 80 % of the batch with DON concentration well below the required level.

Summary and outlook

Climate conditions will continue to cause fluctuations in quality and price of grain. In parallel, malt producers need ways to increase production while minimizing their environmental impact. With protein segregation and removal of Fusarium infected grains, BoMill single kernel sorting

approach, based on NIR-T, already offers solutions to reduce waste and support domestic production, thus helping to further optimize the malting barley supply in a sustainable way.

And the technology offers more potential for the future of the malting and brewing industry. The beneficial effects of using more homogenous raw materials in the malting and brewing process also need to be explored. There are already indications that this could support quality assurance and improve process efficiency and reliability. A consistent and uniform quality of raw materials makes processing and malt performance easier to predict. Each grade of malting barley can be processed in the most optimal way, and malting parameters can be adapted even more effectively to produce better malt and, in the end, better beer. ■

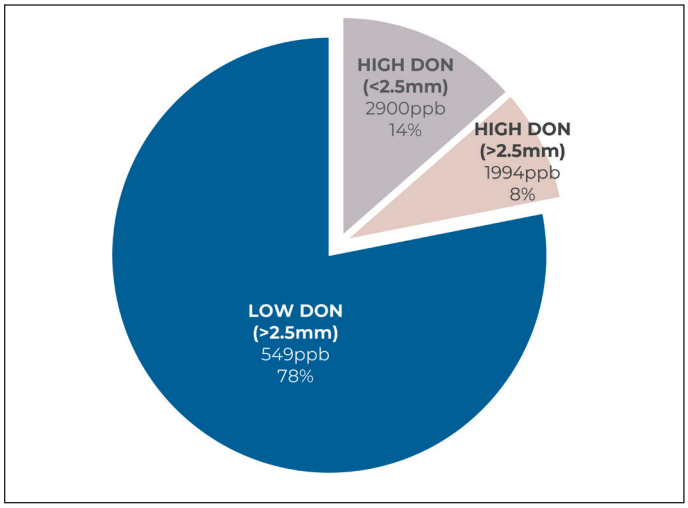

Fig. 6
Malting barley segregation based on DON level