IMPROVING THE QUALITY OF SOFT WHEAT WITH SULPHUR

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BACKGROUND: SOFT WHEAT, ASPARAGINE, AND SULPHUR FERTILISER

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Soft wheat is used to make products such as biscuits, cakes, and breakfast cereals and is used to produce over **half a million tons** of flour every year in the UK.

Many products made with soft wheat contain **acrylamide**: a potentially harmful processing contaminant that forms during high temperature processing.

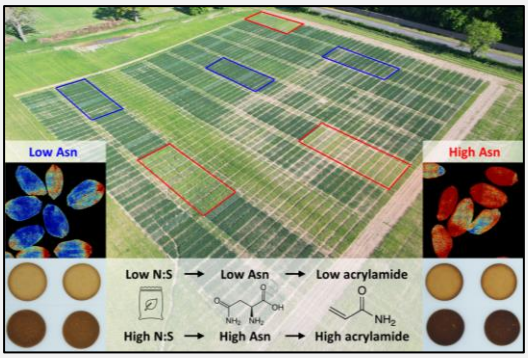

Figure 1. Graphical depiction of our analyses.

Asparagine is a naturally occurring amino acid and is the key precursor to acrylamide in wheat-based food products (**Figure 1**).

Applying **sulphur (S)** helps to reduce grain asparagine content (**Figure 1**), but the relationship between sulphur and asparagine has not been fully explored.

GENE DELETIONS AND SULPHUR

The deletion of the asparagine synthetase gene *TaASN-B2* (**Figure 2**) is associated with a significant reduction (13 – 33%) in free asparagine; but only when sulphur is sufficient in the soil or applied through fertilisers.

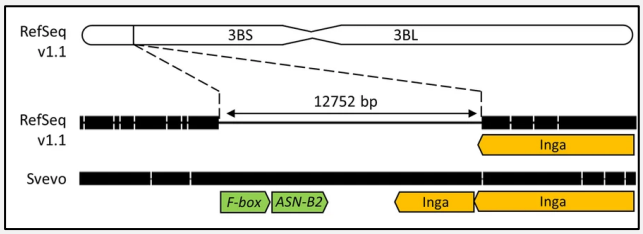

Figure 2. Genomic location of the *TaASN-B2* deletion in the reference genome (Chinese Spring) and durum wheat Svevo. A retrotransposon (Inga) is shown directly adjacent to the deletion.

DETECTING SULPHUR DEFICIENCY

Sulphur deficiency causes a yellowing of the wheat canopy (**Figure 1**), so we investigated whether multispectral reflectance measurements from the field could predict grain asparagine content.

Grain asparagine content could be predicted with an accuracy of 71% (and yield with an accuracy over 80%) when using this data in a Partial Least Squares Regression (PLSR) model (**Figure 3**).

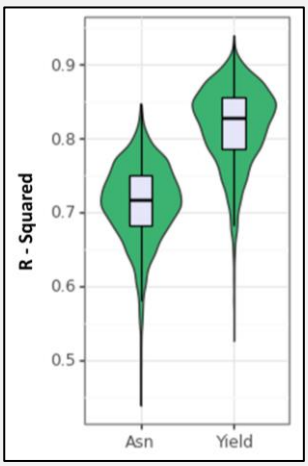

Figure 3. Accuracy of predictive PLSR models (measured by five-fold cross validation) built for asparagine (Asn) and yield.

TESTING NPK AND S APPLICATION RATES

Our analysis found that a N:S application ratio of 10 to 1 (kg/ha) was sufficient to prevent large increases in asparagine (**Figure 4**), whereas P or K did not impact grain asparagine content when S was present.

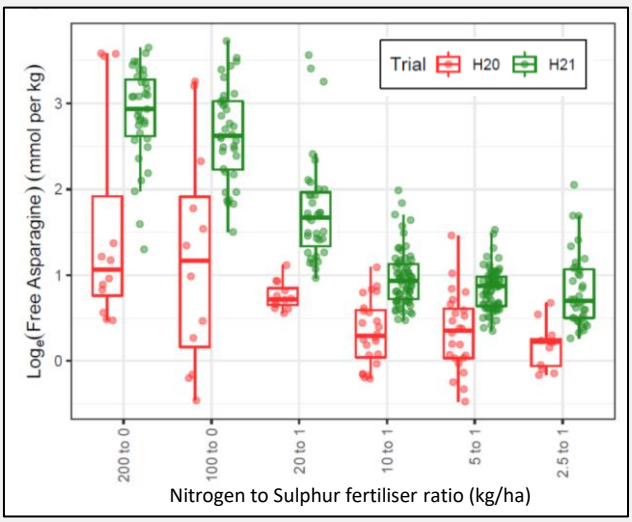

Figure 4. Impact of the N:S ratio on grain asparagine content.

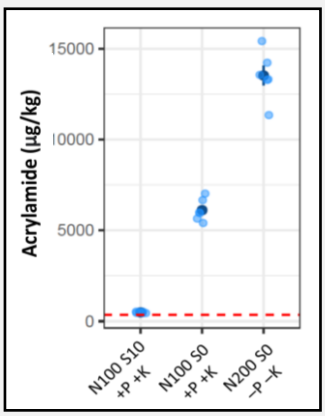

Figure 5. Biscuit acrylamide content separated by fertiliser treatment.

Acrylamide levels in biscuits were significantly impacted by fertiliser treatment (**Figure 5**).

Conclusions:
Sulphur fertilisers are essential to prevent large increases in grain asparagine content and their application can enable additional reductions to be made through genetic variants.

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