Storage protein quality, metabolite composition, and baking quality of winter wheat as affected by late sulfur fertilization

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Baking quality of wheat is influenced by gluten proteins that are predominantly determined by the genetic background of the wheat cultivars. However, their quantity and quality can be changed by N and S fertilization. Late N fertilization is already known to enhance protein concentration in mature wheat grain and therefore benefits baking quality. Sulfur fertilization at sowing increases S-rich storage proteins such as γ-gliadins and low molecular weight (LMW)-glutenin subunits and further influence baking quality, since disulfid-bridges in storage proteins are primarily important for an adequate starch-gluten-network.

The objective of this thesis was to determine whether a late S fertilization concomitantly with a late N fertilization further benefits storage protein composition resulting in changed baking quality parameters. Pot experiments with two winter wheat cultivars, Batis and Türkis, differing in baking quality but not in protein concentration in wheat grain, were conducted. Increasing S fertilization levels with 0 g S, 0.1 g S, 0.2 g S at sowing and one late S fertilization level with 0.1 g S at sowing + 0.1 g S at ear emergence was applied.

When applying a late S fertilization, sulfate is predominantly transported to the flag leaf and assimilated to glutathione, instead of direct transport to the developing ear. In mature wheat grain a late S fertilization does not change protein or S concentrations but storage protein composition and thus protein quality. Changes in protein composition were found in both, mature and milk ripe grain. As a result late S fertilization influenced protein composition as well in early stages of development. By proteome analysis it was possible to identify starch-granule bound starch synthase (GBSS I) and high molecular weight (HMW)-glutenin subunits such as 1Dx7 and 1Dy9 to be synthesized in higher amounts after a late S fertilization than compared to high S fertilization at sowing (0.2 g S) in mature wheat grain. These results were shown for both cultivars, Batis and Türkis. The combination of HMW glutenin subunits 1Dx7+1Dy9 is known to be beneficial for baking quality.

Due to limited material resulting from pot experiments a standardized micro-scale baking test with wholemeal flour instead of fine flour was conducted for the first time. A late S fertilization increased loaf volume in both cultivars in one year but not in a second year of experiments.
However, late S fertilization was never shown to influence protein composition and baking quality in a negative way and so far functions as an alternative to S fertilization at sowing. Thus, late S fertilization is a fertilization technique that prevents S deficiency in late stages of wheat growth and further enables equal amounts of S and protein compared to an S application only at sowing with an increased protein quality.