



# Long-term fertilization effects on processing quality of wheat grain in the North China Plain



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## ABSTRACT

A 28-year fertilization experiment was carried out in the wheat–maize rotation region of North China. The effects of different sources of organic manure and inorganic fertilizers on grain processing quality were studied in winter wheat (*Triticum aestivum* L.). The results showed that wheat protein contents and processing quality were significantly improved with both organic manure and inorganic fertilizer treatments after long-term fertilization. Various effects of long-term fertilization on different quality parameters were found, with the descending order of dough stability time, dough development time, sedimentation value, wet gluten, dry gluten, and water absorption rate. Grain protein content, dry gluten content, wet gluten content, sedimentation value, and water absorption rate were also significantly improved. The durations of dough development and stabilization were significantly improved, and bread volume and baking score were increased. Grain protein content and processing quality were generally improved for the long-term and continuous fertilization. However, there was no significant difference in wheat quality between T<sub>4</sub> (high amount of organic manure) and T<sub>5</sub> (high amount of inorganic fertilizer). The effect of optimal amounts of inorganic fertilizer was greater than that of organic manure treatments at base-line application levels.

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## 1. Introduction

The main purpose of agricultural production is to obtain high crop yields and good quality. Many studies revealed significant roles of fertilizer on crop production over the past several decades (Roberts, 2009). However, as yields increase, the quality of crop products often decline. Therefore, research has focused on improving crop yield while resolving the problems causing poor quality (Abad et al., 2004; Fang and Meng, 2013; Zhao et al., 2006).

Wheat is one of staple food crops in the world and its quality becomes more valued over time. Commercial value is determined by the processing quality of flour. Dough appearance, structure, smoothness, taste, elasticity and odor are highly related to the processing quality of wheat flour. With continuous improvement in

human living standards domestic consumption of bakery products gradually increases. Thus, the comprehensive quality parameters of wheat flour, baking quality of dough, and processing technologies determining the quality of bakery products must also be improved. In addition to the influence of genetic factors and ecological conditions wheat quality is significantly influenced by cultivation measures, especially fertilization regimes (Zhao et al., 2007). Therefore, fertilization has become a basis for modern agricultural production. It is the major source of crop nutrients that take part in the metabolism of crops and is therefore closely associated with crop yield and quality (Gu et al., 2004). Many studies on the effects of fertilization on yield and quality have been reported, but most are based on short-term fertilization in winter wheat (Hussain et al., 2002; Jan et al., 2002; Li et al., 2014). Although the effects of long-term fertilization on crop quality were reported, the results were inconsistent (Cai and Hao, 2013; Gu et al., 2004; Luis et al., 2001; Mäder et al., 2007) (Fig. 1).

The Rothamsted Institute in England is a famous agricultural research center and it is also the oldest long-term experimental station in the world. Many important results on agricultural research from long-term experiments have been obtained, particularly in agronomy, soils, plant nutrition, ecology and environmental science (Fan et al., 2008; Harpole and Tilman, 2007; Jenkinson et al.,

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