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Management Effects on Quality of Organically Grown Winter Wheat

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The potential for improving wheat grain quality by management strategies involving crop rotation, catch crops, and organic manure was tested in organic long-term experiments in Denmark and Austria. Growing grass clover in a four-year rotation resulted in a higher wheat yield increase that could not be achieved by including leguminous catch crops in the rotation. Yield was also higher with a pre-crop of pea than of lucerne. The average protein concentration was 132 g kg^{-1} for grains from the Austrian experiments while the Danish grains held 85 g kg^{-1}. Protein was generally much less affected by the experimental conditions than grain yield. None of the tested management parameters affected grain protein concentrations in the Danish experiment. In the Austrian trial, a significant pre-crop × treatment interaction reflected a positive

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effect of the animal manure treatment on protein and dry gluten in wheat following pre-crop pea. Danish grains generally contained more soluble polymers of less interest for the baking process than the Austrian ones. The study emphasizes the challenges in improving the quality of organically grown wheat beyond what is predetermined by environmental growth conditions and cultivar. However, baking quality appeared better than could be expected from the quality parameters determined.

KEYWORDS bread, crop rotation, deoxynivalenol, flour, gluten, protein composition

INTRODUCTION

Since the beginning of the 1990s, organic farming has rapidly expanded in almost all European countries. At the end of 2006, 4% of the total farmed area in the European Union (EU) member states (EU-27) was under organic farming covering 6.8 million hectares and involving 180,000 farms (Willer et al. 2008). Within Europe, the countries with the largest market share of organic products are Austria, Denmark, and Switzerland at around 5% of the total market (Willer et al. 2008), and in this market the most important cereal is wheat (Schaack et al. 2008).

Organic farming faces a number of challenges relating to management and crop nutrition. Crop N uptake relies on N mineralized from applied animal manure, crop residues, and native soil organic matter. Scarcity of N may become critical in wheat production (L-Baeckström et al. 2004) where particular protein concentrations are considered essential for baking quality and, thus, commercial value (Baresel et al. 2008). Identification and development of farming systems that optimize the crop uptake and soil retention of N are, therefore, very relevant. An important practice for the last decades has been the use of catch crops alternating main crops in a rotation with the purpose of conserving N in the soil-plant system (Thomsen et al. 1993).

Biological N fixation (BNF) is one of the primary sources of N in organic farming and organically managed systems tend to incorporate forage legumes and catch crops more frequently than conventionally managed systems (Berry et al. 2002). The N supply through BNF will directly affect yields of legume crops, while other crops will benefit from BNF through N recycled in manure or through crop residues returned to the soil. Leguminous crops are essential in creating sustainable crop rotations and the ratio of leguminous to other crops in a rotation has a direct influence on the N nutritional status of the succeeding crops (David et al. 2005).

In organic dairy farming, symbiotic BNF in a grass clover mixture is often used to provide N to the whole cropping system (Berntsen et al. 2006).