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Nitrogen Fertilization Strategies to Enhance the Rheological Parameters of Wheat for Biscuits.

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The wheat grain protein content (GPC) is certainly one of the key quality factors that can influence the end-use of wheat market classes throughout the world. Unlike improver or superior bread-making wheat, which require high levels of protein, a low grain protein (<10.5%) and flour strength (W) are desirable for the wheat for biscuit (Foca et al., 2007). With the cultivar, nitrogen fertilization is the main factor that affects storage proteins, also for this wheat quality category (Blandino et al., 2015). The aim of this study was to compare the effect of different N fertilization strategies on the quality requirements of common wheat intended for biscuits production in order to setup the Good Agricultural Practices (GAP) for this food chain.

Field experiment were carried out over 2 growing seasons and 4 sites, characterized by different pedo-climatic conditions in North West Italy. In each site the effect of N fertilization (10 treatments, related to the type of N fertilizer and the application timings) was evaluated on 2 wheat for biscuit cultivars, following a full factorial scheme with 4 replication. The same N rate (130 kg N ha^{-1}) was applied to all compared treatments. The following parameters have been recorder for both crops: ear density, flag leaf greenness (NDVI vegetative index), grain yield, test weight (TW), thousand kernel weight (TKW), GPC, gluten content, alveographic and Mixolab parameters (Chopin+ protocol).

By comparing different timings of N fertilization application at stem elongation stages, as ammonium nitrate, compared to the later N applications at 2nd and 3rd node stages, the distribution at 1 node stage resulted in a higher grain yield (+4%) lower GPC (-0.4% on dry weight basis) and lower value of flour strength (-12%), dough development time (-13%) and stability (-11%).

Taking in account the same N rate, the application of a slow release fertilizer applied only at tillering resulted in a significantly lower GPC (-0.5% on dry weight basis), dough strength (-17%), dough development time (-12%) and stability (-33%) compared to the split fertilization with ammonium nitrate, while no difference was observed for ear density and grain yield. By comparing different slow release mechanism, the best results in term of reducing W and dough stability have been obtained with the application of organ-mineral or double membrane fertilizers, compared to nitrification inhibitor systems. Among the comparison of split application at tillering and stem elongation stage, the use of urea instead of ammonium nitrate in the second fertilization time reduce GPC (-0.3%), W (-8%) and dough stability (-17%). Conversely the application of ammonium sulfate significantly increase GPC (+1.3%), W (+12%) and dough stability (+58%) compared to ammonium nitrate.

The data reported in the present study work clearly underline that in addition to the N rate, the fertilizer type and the adopted N fertilization strategy affect the GPC and the rheological parameters of grain for biscuits. In particular the recommended GAP consider the application of slow release fertilizers applied distributed at tillering, which gradually match the N crop uptake, reduce the risk of having an excessive GPC and flour strength in wheat for biscuits, without causing any grain yield loss. This strategy could help avoid the occurrence of high levels of N in the soil solution immediately after fertilization, which, with the split application of a quickly available N fertilizer, such as ammonium nitrate at the stem elongation stage, could be responsible for a rise in the protein concentration in wheat kernels and flour. This negative effect for GPC could be observed with the use of ammonium sulfate instead of ammonium nitrate or application timings later than second node stage.

Keywords: Triticum aestivum, high protein wheat, gluten, nitrogen fertilization, alveograph, Mixolab.