

Title A systemic approach to qualitative changes in the stored-wheat ecosystem: Prediction of deterioration risks in unsafe storage conditions in relation to relative humidity level, infestation by *Sitophilus oryzae* (L.), and wheat variety

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Abstract

A multidimensional laboratory trial was carried out to identify the primary causes of changes in quality traits in the stored-grain ecosystem to reveal critical storage condition boundaries that may endanger grain quality retention. Qualitative criteria were followed on grain batches from 3 wheat varieties which were stored for 160 d at temperature of 22–23 °C, at two different relative humidities, and with or without infestation by the rice weevil *Sitophilus oryzae*, to build a multivariate data matrix. The interactions between biotic deteriorative factors and qualitative trait changes were explored through a principal component analysis (PCA). From the Pearson's product moment correlation matrix, it was observed that the variables that correlated significantly with insect and fungal species dynamics were: moisture content, hL mass, seed viability, and fat acidity of extracted whole flour. Four factors explained the major part of the variance: storage duration, moisture content, hidden insect infestation density, and fungal contamination level. The rate of increase of the insect population was significantly different between varieties. PCA revealed that the significant difference in qualitative deterioration pattern observed between the three varieties was not related to their hardness but rather to a different relationship between the grain and relative humidity. Germination rate was the first quality factor to decline during the storage period. The technological properties of flour extracted from each variety were not affected before insect population density exceeded 1000 adult insects per kg. The rate of qualitative changes induced by the biotic deterioration factors was processed into a "biodeterioration susceptibility index" (BSI) according to the safe storage time assessed in the present study. This index may be used in IPM approaches to predict the susceptibility of a particular wheat variety to insect and fungal damage during long-term storage.