Title Mathematical modelling of heat and moisture transfer of wheat stored in plastic bags (silobags)

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Abstract

A bidimensional finite element model that predicts temperature distribution and moisture migration of wheat stored in silobags due to seasonal variation of climatic conditions is described. The model includes grain respiration and calculates carbon dioxide and oxygen concentrations during storage as well as the associated dry matter loss. The model validation was carried out by comparing predicted with measured temperature and moisture content (MC) data. The temperature standard errors of the model validation were 1.94 °C at the bottom, 1.35 °C in the middle and 1.20 °C at the top layer. The model predicted moisture increase in the top grain layer during storage ranging from 1.0 to 1.5% w.b., while the measured increase ranged from 0.4 to 0.8% w.b. Predicted average CO_2 and O_2 concentrations were compared with measured data. For dry wheat (12.5% w.b.), after 100 days of storage, differences in concentrations were 1.8 and 0.6% points for CO_2 and O_2, respectively. For wet wheat (16.4% w.b.), the model predicted the total consumption of O_2 after five days while the observed O_2 data never dropped below 5%. The difference between the measured and predicted CO_2 concentration for the fifth day was 1.1%. For the range of MCs considered in this work, the change in CO_2 concentration during storage was satisfactorily predicted by use of White *et al.* (1982) estimation of CO_2 production rate, but prediction of O_2 concentration was poor for wet grain.