CAF2020 Abstract No. A-2-7-20

Buenavista RME, Casada ME, Siliveru K (2021) Determination of phosphine sorption isotherm in hard red winter wheat. Page 72. In: Jayas DS, Jian F (eds) Proceedings of the 11th International Conference on Controlled Atmosphere and Fumigation in Stored Products (CAF2020), CAF Permanent Committee Secretariat, Winnipeg, Canada.

Determination of phosphine sorption isotherm in hard red winter wheat

Rañia Marie E. Buenavista[1*], Mark E. Casada[2], Kaliramesh Siliveru[1]

[1]Department of Grain Science and Industry, Kansas State University, Manhattan, KS 66506, USA.
[2]United States Department of Agriculture, Agricultural Research Service, Stored Product Insect and Engineering Research Unit (SPIERU), 1515 College Ave., Manhattan, KS 66502, USA.
*Corresponding author's email: rebuenavista@ksu.edu

ABSTRACT

With the growing population of phosphine-resistant stored grain insect pests, the sustainability of phosphine as an effective fumigant has been put at risk. Research studies are still insufficient to explain inconsistent phosphine concentrations in the grain bin during treatments. Limited data were gathered about sorption of phosphine into wheat kernels during fumigation. To fully account for this phenomenon in fumigation modeling studies, it is necessary to determine the sorption behavior of phosphine within the grain mass in response to varying environmental conditions and phosphine dose. The objective of this study was to characterize the phosphine sorption isotherm in wheat as affected by phosphine dose and temperature. Phosphine sorption isotherms in Hard Red Winter Wheat that has not been fumigated before were determined at 15°C, 25°C, and 35°C under a relative humidity level of 65%. Seven dosage levels (300, 600, 900, 1200, 1500, 1800, and 2100 ppm) were injected in separate airtight glass fumigation chambers with one-half wheat filling ratio. Phosphine headspace concentration was monitored at 2 h intervals for the first 8 h and once every 24 h until it approached equilibrium using a gas chromatograph equipped with a flame photometric detector set to phosphorus mode. The plot of sorbed phosphine concentration versus headspace phosphine concentration was fitted to various sorption isotherm models. Langmuir, Freundlich, and Redlich-Peterson sorption isotherm models were fitted to the sorption experimental data. Rate of phosphine sorption increased with an increase in temperature and decreased with time. Total sorbed phosphine at equilibrium is significant in determining the rate and maximum quantity of phosphine uptake in wheat. Phosphine sorption isotherm model for wheat kernels is useful in estimating the quantity of phosphine residue that needs to desorb from wheat kernels at given temperature and applied concentration.

Keywords: Phosphine sorption, Sorption isotherm, Sorption equilibrium, Wheat