DISTRIBUTION OF CARBONYL SULFIDE IN WHEAT FUMIGATED IN A FARM BIN

Y. L. Ren, D. Mahon and J. E. van S. Graver*. CSIRO Entomology, Stored Grain Research Laboratory, Canberra ACT 2601, Australia.

The work reported here is part of the CSIRO Stored Grain Research Laboratory's program to develop a data package to register carbonyl sulfide (COS) for use in Australia. A commercial-scale fumigation treatment was undertaken to disinfest 500 tonnes of feed wheat.

The objectives of this trial were to monitor COS levels in the grain to ensure, that at outloading:

- The in-bin concentration of COS was at or below the 10 ppm Australian experimental TLV for this fumigant.
- Residues of COS in the treated grain complied with the current 0.2 mg/kg Australian experimental MRL for COS in wheat (Food Standards Australia New Zealand 2003) .

The wheat was stored in a sealed 670 m^3 bolted steel, flat bottomed, farm bin equipped with a recirculatory system providing one air change per day.

The fumigation was done at a rate of 25 g m^{-3} COS using a 4 day exposure period in accordance with the proposed Australian label dosage rates (Weller and van S. Graver in these proceedings). The gas was injected, with nitrogen (11% COS in N_2), into the recirculatory system, upstream of the fan.

Carbonyl sulfide concentrations in the bin were sampled 1, 3, and 5 m below the grain surface from:

- four points 0.5 m from the silo wall; 1, 3, and 5 m below the grain surface.
- at the centre of the grain bulk; 1, 3 and 5m below the grain surface.
- one point located 0.1-0.2m above bottom of the silo.
- one point in the centre of the headspace.

Gas samples were drawn from each sampling point regularly during the exposure and aeration periods. Fumigant concentrations were determined on-site using a Varian 3300 equipped with TSD.

After dosing, penetration of COS into the grain bulk was rapid and the 25 g m^{-3} target concentration was achieved three hours after application. Nine hours later the concentration of COS had equilibrated at 23 (±2) gm^{-3} throughout the bin (Figure 1). This rapid distribution and equilibration may be attributed, in part, to the large volume of nitrogen (11/89) used to carry the COS into the bin.

Carbonyl sulfide concentrations during post-fumigation aeration of the bin were monitored (Figure 2). Despite the low flow rate of the fan fitted to the bin (1 air change/day after 5 days, the concentration of COS in most of the grain had declined below the 10 ppm TLV (ren 2001). These results are consistent with those obtained in previous commercial-scale trials with barley, oats and canola (Ren et al. 2003, Desmarchelier et al. 1998).

On outturn the concentration of COS in the wheat had fallen to natural levels (Ren 2001).

References

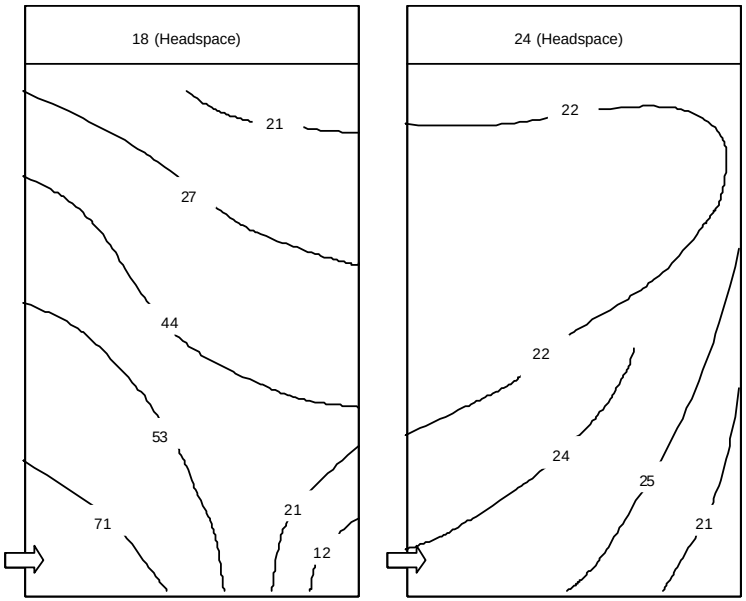
Desmarchelier, J. M., Allen, S. E., Ren, Y. L., Moss, R. and Vu, L. T. (1998). Commercial-scale trials on the application of ethyl formate, carbonyl sulfide and carbon disulfide to wheat. CSIRO Entomology, Technical Report No. 75.

Food Standards Australia New Zealand - food standards code: (Accessed 31 August 2003). http://www.foodstandards.gov.au/foodstandardscode/

Ren, Y. L., Desmarchelier, J., M. Le, T. Vu and Weller, G. L. (2003). Commercial-scale Trials on Application of Carbonyl Sulfide (COS) to Barley, Oats and Canola. CSIRO Entomology, Technical Report No. 91.

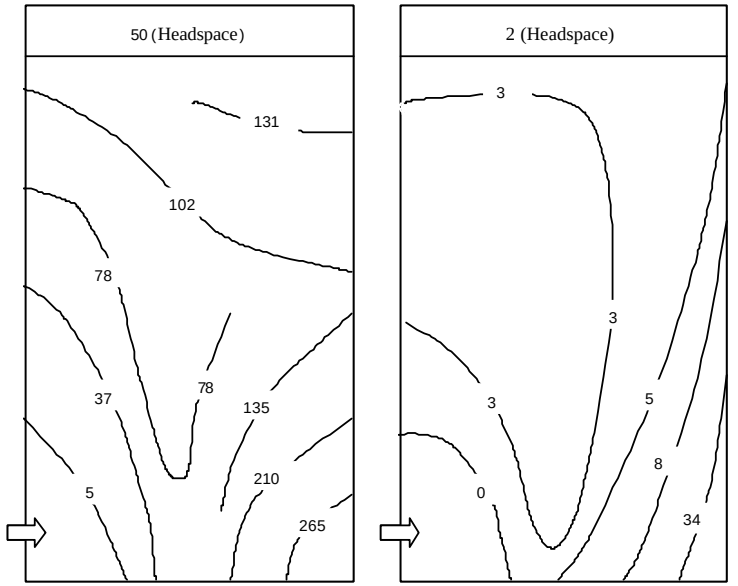
Ren, Y. L. and Desmarchelier, J. M. (2001). Natural occurrence of carbonyl sulfide and ethyl formate in grains. In: Donahaye, E. j., Navarro, S. and Leesch, J. G. Eds. Proceedings of the International Conference on Controlled Atmosphere and Fumigation in Stored Products. Fresno, CA, 29 October-3 November, 2000, Executive Printing Services, Clovis CA, 639-649. ISBN 0-9718024-0-8.

Weller, G. L. and. van S. Graver, J. E. Carbonyl sulfide for disinfestation of export hay: an update. In these proceedings.



3 hours after application 9 hours after application

Figure 1. Distribution of COS (**g m^{-3}**) in silo containing wheat (500 t) at different times during exposure period with recirculation fan providing 1 air change / day.



After 1 day of aeration After 5 days of aeration

Figure 2. Distribution of COS (**ppm**) in silo containing wheat (500 t) at different times during aeration phase with fan providing 1 air change /day.