# FIELD TRIAL OF CARBONYL SULFIDE FUMIGATION OF HAY IN 40FT SHIPPING CONTAINERS

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The fumigation of bales of oaten hay for export poses a challenge to successful fumigation. They are very highly compressed, each measuring 500mm x 460mm x 360mm and weighing 64kg. Traditionally, shipping containers packed with these bales have been fumigated with methyl bromide to meet the phytosanitary requirements of importing countries. Alternatives currently available (phosphine and carbon dioxide) require long exposure times (7 days and 15 days respectively) and are recommended only if the ambient temperature exceeds 15°C. Carbonyl sulfide (COS) offers a faster alternative to either of these fumigants. Insect mortality studies indicate that a dose of 60 $gm^{-3}$ COS for 48 hours will kill more that 99% of the hardest to kill life stage of *Sitophilus* species at temperatures above 17°C (Weller and Morton, 2001). Below 17°C a longer exposure time is required to achieve the same level of kill given the same concentration, for instance, at 10°C a 4 day exposure of 60 $gm^{-3}$ would be needed.

In a field trial, 60 $gm^{-3}$ COS (calculated on the empty vessel) was applied to oaten hay in a 40ft shipping container (76.4$m^{-3}$) with an 8 second pressure halving time (empty). Penetration of gas into the bales and diffusion out of the bales during airing was assessed by measuring gas concentrations both in the shipping container and within a series of bales. Mixed age cultures of *Sitophilus oryzae* were inserted into the several palletised bales as bio-indicators of the success/failure of the fumigation

The headspace concentration in the container 24 hours after the commencement of fumigation was 41.3 ± 0.6 g $m^{-3}$ and at 48 hours was 34.9 ± 4.8 g $m^{-3}$ while the concentration of gas in the bales was 42.1 ± 2.1g $m^{-3}$ and at 48 hours was 37.1 ± 2.0 g $m^{-3}$. The lowest concentrations were recorded at the front of the container (i.e. by the doors), indicating gas leakage or intake of air in that area. While the target of a 48-hour fumigation at 60 g $m^{-3}$ was not achieved in this trial, the dose attained was sufficient to kill all test insects. The temperature in the container was 30°C at the commencement of fumigation, assuming a maximum of 5 °C variation in temperature in the hay inside the container during the fumigation and the dose achieved exceeded that needed to kill 99% of *S. oryzae* eggs (in the temperature range of 25 – 30°C the required dose is 30 g $m^{-3}$ for 48 hours, (Weller and Morton, 2001)).

The loss of gas from the headspace can be attributed to both sorption and leakage of gas from the container. Assuming the rate of loss through sorption in the container to be the same as that observed in previous laboratory studies, the concentration in the container

would have fallen to 53 g $m^{-3}$ over the 48 hours. The remaining loss of concentration is assumed to be due to leakage of gas and the intake of air.

While the level of gas tightness of the container used in this trial is acceptable for methyl bromide fumigation of hay at the application rate of 64 g $m^{-3}$ (Anon, 2000) the low final concentration of COS highlights the need to improve the gas tightness of containers or to fumigate under tarpaulins to reduce gas loss.

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