Post-harvest insect pests: fumigation on co2

Science, Geography

ASSIGN BUSTER

Post-harvest insect pests can cause serious losses during product storage, reducing the quantity and/or quality of the stored products (Evans, 1987). Fumigants, which must be toxic in the gaseous stale, have been used for many years for the control of these insects (Moffitt and Burditt, 1989; Taylor, 1994). At least 16 chemicals have been registered as fumigants, but because of concern for human safety, methyl bromide and phosphine are the primary fumigants currently being used commercially for stored products (Bond, 1984; Evans, 1987; Taylor, 1994). In spite of the diverse biological activities of methyl bromide in agriculture, use of this ozone-depleting chemical is scheduled to be phased out in the United States by 2005 under the Montreal Protocol. Several alternatives for methyl bromide are being considered, including carbon dioxide (from compressed gas or a solid formulation) (White and Jayas, 1993), mixtures of contact insecticides and insect growth regulators, reduction of the oxygen content by using nitrogen and other gases, and storage temperature control (Donahaye et al., 1985; Moffitt and Burditt, 1989). Dichlorvos is a potent chemical insecticide known for many years for its broad spectrum activity and high efficacy, but is classed as a Class C human carcinogen.

Additional problems with controlling post-harvest insects include residues of applied chen~icals on grain (Jessup and Sloggett, 1993), phytotoxicity to the grain, and the development of resistant strains of insect pests. There are several reports on resistance to organic chemicals applied against the red flour beetle Tribolium castuneum (Herbst) (Zettler and Cuperus, 1990; Zettler, 1991; Donahaye et al., 1992). Halliday et al. (1988) reported that 50% of field strains of T. castaneum in the southern United States were resistant to dichlorvos, and cross-resistance existed between dichlorvos and pirimiphos-methyl. Therefore, additional fumigants and control measures are required and have been studied by some researchers (Jilani et al., 1988; Talukder and Howse, 1993; Watters et al., 1983)

Under aerobic conditions, insects survive by producing energy through respiration. When the insect are exposed to an environment deficient of oxygen (O2), they can produce energy for short periods by glyculysis, but death will occur if the a O2-deficient environment is maintained . Insects also die when exposed to elevated levels of carbon dioxide (CO2) because CO2 bas insecticidal action (Banks 1979). Controlling insects by altering the concentrations of atmospheric gases inside the storage environment is known as modified atmosphere storage of grain. Thus, lethal environments can be created without the addition of synthetic chemicals.

Modified atmosphere -rage of grain is not a new concept. It is believed that the ancient Egyptians made use of this idea to protect their stored grain from insects. Lee (1960) reports that a flint sickle was found at the bottom of an ancient pit dong the Nile river. It is believed that grain was stored in these underground phs because kernels of barley and an ancient wheat a called ‘ Emmer” have been discovered inside these pits. Respiration by the grain depletes the O2 supply inside an airtight structure such as an underground pit. With a depleted O2 supply, death of the insects occurs.

Recently, modified atmosphere storage of grain bas received renewed attention around the world. The Australia have successfully fumigated grain in Luge, central storage facility (Banks et al. 1980; Ripp 1984). Their greatest obstacle was that extensive sealing had to be done to the storage structures so that they would be able to maintain efficiently the modified atmosphere. The cost of extensive sealing of these storage structure was high. In western Canada, grain is typically stored in small storage structures on individual farms and framers are responsible for ensuring the quality of their stored grain. For modified atmosphere fumigation to gain widespread acceptance in Canada, the cost of sealing a storage structure must be reduced so that it is feasible for an individual farmer.

Fumigation of insects by exposure to elevated Levels of CO2 is more appropriate for Canadian conditions than exposure to reduced levels of O2 because the environment does not have to be controlled as precisely. Use of CO2, therefore, reduces the cost of a modified atmosphere fumigation. Trial fumigations using dry ice as the source of CO2 were conducted. The CO2 environment inside the storage structure was created by ducting gaseous CO2 into the head space and allowing air to escape from the bottom of the storage structure. Observed peak CO2 concentrations were similar for fumigations of 10 days and 4 days duration , but mortality of caged adults Cryptolestes ferrugineus (Stephens) was higher following the 10 days exposures.