FIELD TRIALS ON BIOGENERATED V-HF SYSTEMS TO CONTROL THE LARGE NARCISSUS FLY

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To develop a methyl bromide (MB) alternative control treatment based on vacuum, hermetic storage, or CO_2 enriched controlled atmosphere against the large narcissus fly (*Merodon eques*) investigations were carried out by Rindner et al. (2003). The large narcissus fly *Merodon eques* is a quarantine insect species that attacks narcissus bulbs as well as bulbs of other geophytes. Fumigation with methyl bromide (MB) is the only gaseous rapid treatment available for handling infested bulbs. However, the most recent international resolution under terms of the Montreal Protocol, ending the use and production of methyl bromide as well as the phytotoxic effects of MB required further studies to find alternative fumigation methods. According to Rindner et al., (2003) LT_{99} values for *Merodon eques* maggot infested bulbs at 50 mm Hg absolute pressure, at hermetic conditions (for the bio-generation of modified atmospheres) and at 90% CO_2 were 24, 34, and 24 h, respectively. Respiration of the bulbs, under hermetic conditions, depleted the O_2 concentration to 0.1% and increased the CO_2 to 21% within 24 h at 30ºC. The bio-generation of modified atmospheres under hermetic conditions did not adversely affect the germination levels of the bulbs. Based on these findings, Finkelman et al, (2002), reported on results of three semi-commercial experiments conducted in Israel. In these experiments, the effectiveness to control the large narcissus fly under hermetic conditions in a prototype of the newly developed V-HF (vacuum hermetic fumigation) system was demonstrated. The objective of the current work was to obtain additional information on the application of the bio-generation of modified atmospheres to control the narcissus flies as a quarantine alternative treatment to MB.

Materials and methods

A specially constructed V-HF module of 5.5 m long, 2.6 m wide and 2.4 m high was used to accommodate 10 pallets containing the bulbs. The V-HF module consisted of two sections; the upper section that was destined to cover 1.4 m from the top and the bottom section that had a wall of 1 m high. The bulbs were loaded over the bottom section of the module on their original shipping pallets using a forklift. Then, the top and the bottom sections were zipped together to obtain a sealed structure. Each pallet consisted of 920 kg of narcissus bulbs stored in 40 crates stacked in 8 rows. In each trial, 10 pallets of the commodity were arranged inside the V-HF module. At start of the trial, a slight vacuum of 100 Pa was applied to adhere the V-HF liner to the crates, thus minimizing the free space within the V-HF system. Before each trial, paper bags containing *Merodon eques* maggot infested 50 bulbs were placed on top and bottom, inside the V-HF module. At the end of the trials bioassays were checked for mortality of the maggots. Data loggers to measure temperature and air relative humidity were also placed in each trial on top and bottom of inside the V-HF module.

Results and discussion

The desired modified atmosphere was obtained taking advantage of the respiration of the narcissus bulbs. The hermetic seal of the V-HF system resulted in a rapid O_2 depletion. In eight trials carried out, the O_2 concentration was decreased to levels of 0.1% within 36 h, while the CO_2 concentration increased up to 21%. During the narcissus bulbs harvest season (July 2003) the natural temperature of the bulbs fluctuated between 24º and 32ºC. Since temperatures lower than the set temperatures of 30ºC were observed at the lower layers of the pallets, there was a risk for survival of larvae. Therefore, artificial heating of the bulbs to reach 30ºC was assayed. An air circulation fan was added to assist distribution of heated air from the top of the pallets to the lower layers. The demonstration quarantine application was carried in the packinghouse of a narcissus bulbs grower. Although, according to our laboratory work an exposure time of 34 h was needed to obtain 99% mortality of the pest, the system was kept sealed for additional 48 h after the O_2 concentration level reached 0.1%, to ensure the successes of the treatment in the V-HF system. Infested narcissus bulbs were examined after each trial revealed no live larvae at the end of the eight treatment trials.

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