CARBON DIOXIDE FUMIGATION OF THRIPS (*Thrips tabaci* Lind.) IN EXPORT ONIONS

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Quarantine regulations for horticultural exports demand that produce be free from all live insects. This along with increasing consumer resistance to pesticide use, is ensuring that alternative pest control methods are being sought. Onion thrips (*Thrips tabaci* Lind.) pose a major threat to the export of New Zealand onions. There is customer resistance to the use of pesticides by growers, and to the use of fumigants by exporters. The number of fumigants available for post-harvest disinfestation is small. Alternatives such as elevated carbon dioxide controlled atmospheres are being evaluated. The aim of this work was to evaluate the effect of differing carbon dioxide concentrations on the mortality of both larval and adult onion thrips in export onions.

A replicated gas delivery system using certified gas mixtures from pressurised gas cylinders (BOC Gases) was designed to deliver various CO_2 concentrations in a constant supply to thrips-infested onions in sealable plastic bags. Six carbon dioxide treatments, 0% (air control), 15%, 30%, 45%, 60% (all in balance air) and 100%; were applied for 6, 12, 24, 48, and 72 h. Gas rates delivered to the plastic bags ranged from 70-200 ml/min. Treatments were held at 20^{o}C during the studies. CO_2 concentrations were measured regularly during the experiment. Onions were sub-sampled from each treatment and thrips mortality was assessed.

Complete mortality of onion thrips was achieved using CO_2 concentrations at and above 30% after thrips have been exposed for 24 h or more at 20°C. Our studies indicate that onion thrips are tolerant to CO_2 concentrations up to 100% for at least 12 h, and to lower levels of CO_2 (15%) for up to 72 h exposure.

Our system ensured that the thrips-infested onions were continuously exposed to the CO_2 concentration being delivered. In practice, when large volumes of onions will need to be disinfested, a system is required to ensure that all onions are fully exposed to the carbon dioxide. To be effective, the elevated CO_2 atmosphere must be maintained until all of the insects die. The required exposure time is dependant on the percentage of CO_2, and possibly the temperature at which the treatment is carried out.

Ultimately, the success with using CO_2 as a fumigant will depend on the initial concentration being achieved by maintaining a system that avoids leakage of the gas, that displaces air volume, and allows for CO_2 absorption by the onions. It must also be able to be effectively purged or recycled once the treatment has been completed. As these factors will vary between facilities, a set dosage per tonne of produce may only be a rough guide to the required treatment time. Higher concentrations and longer exposure times may be needed if the treatment is to be effective.

Each fruit and vegetable seems to have different levels of tolerance to CO_2. We don't know how tolerant onions are to high CO_2 exposure and therefore CAs must be designed carefully to protect both taste and quality. Using very high CO_2 concentration ensures that the onions are not exposed for an extended period. We have yet to determine the effects of carbon dioxide on onion quality.

The experimental temperature of 20^{o}C simulated a setting close to what would be expected when fumigation of onions occurs in industry i.e. at ambient store temperature. Changes in temperature often have variable effects on the toxicity of modified atmospheres. Temperatures lower or higher than what was evaluated may influence thrips mortality. Further research would be needed to ensure that the toxicity of the control atmosphere meets statistical quarantine requirements (e.g., Probit 9.)