CONTROLLED ATMOSPHERE DISINFESTATION OF FRESH SUPERSWEET SWEET CORN FOR EXPORT

ALAN CARPENTER

Crop & Food Research, Levin Research Centre, Private Bag 4005, Levin

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The use of controlled atmospheres (CA) to disinfest export produce so it can pass smoothly through quarantine barriers is becoming more widely acceptable internationally (Klag 1986; Carpenter and Potter 1993). CAs of various compositions will kill a wide variety of insects on a wide range of crops (Carpenter and Potter 1993).

Supersweet sweet corn is exported from New Zealand to Japan each southern summer. The volumes traded vary from year to year depending on exporter confidence, market demand and quality. Sweet corn may be infested by thrips and aphids as well as the more obvious caterpillars. Lack of pesticides for use close to harvest provides a problem in producing ears of the quality needed for export. This paper describes two experiments on the use of CA on the insect pests associated with supersweet sweet corn and discusses the implications of the data for the export industry.

Cobs of export maturity of "Marika" supersweet sweet corn were picked in Hawkes Bay (20.1.87 and 21.3.87), packed in polystyrene boxes, top-iced, returned to the Levin Research Centre, and held at 0-1°C overnight. Cobs were stored with their wrapper leaves on. The next day cobs were randomly assigned to three treatments: - air control (one replicate); 8% carbon dioxide + 8% oxygen + 84% nitrogen (two replicates); 8% carbon dioxide + 1% oxygen + 91% nitrogen (two replicates) (all at 0-1°C). There were 25 cobs per replicate. The gas mixtures were produced at 200 ml/min. from a manifold that mixed carbon dioxide, oxygen and nitrogen from cylinder supplies. After 20 days storage the corn cobs and wrapper leaves were assessed for insect numbers.

In the second experiment there were 20 cobs per replicate (the same treatments were used as in the first experiment). There were two replicates of each treatment. Ten cobs were removed from each treatment every 7 days up to 28 days. This experiment ran for 1 week longer than the first to try to get to the point where all insects were dead. Insects were assessed by inspecting each wrapper leaf as it was removed. Insect numbers were not assessed at the beginning of the experiment.

For both experiments the most common insect was the cereal aphid (*Rhopalosiphum padi*). There were an average of 14.7 aphids per cob (range 0-50, median 13). The two most common thrips were cereal thrips (*Limothrips cerealium*) and hairless flower thrips (*Pseudanaphothrips achaeus*). There was an average of one thrip per cob. There were also small numbers of an unidentified mealybug and a coccinellid beetle larvae. The mean number of wrapper leaves per cob in the experiment was 10.45 (range 7-19, median 10).

Most aphids were on the outer wrapper leaves and numbers left on the corn decreased rapidly with leaf position towards the cob. Thus the level of aphid infestation could be reduced by reducing the number of wrapper leaves left on the cob at shipment, but the key Japanese market requires they be left on.

In all three treatments of Experiment 1, all insects were dead at the end of twenty days storage with the exception of one live aphid at the base of a wrapper leaf in one replicate of the 8% carbon dioxide + 8% oxygen treatment. This gave a mortality of 99.8%.

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TABLE 1: Mean percent mortality of cereal aphids in controlled atmosphere storage.

Treatment	Days			
	7	14	21	28
Air	93.2	99.6	100	96.2
8% CO ₂ + 8% O ₂ *	97.3	99.8	92.2	84.6
8% CO ₂ + 1% O ₂ *	99.2	97.2	100	99.2

* balance nitrogen

Respiration rate of the corn was estimated three times in the first 15 days of the first experiment by measuring the change in gas concentration between the inlet and outlets of the storage containers. Using these data with the known weight of the cobs, the gas flow rate and the ideal gas equation, the production of CO₂ in mg/kg/hour could be estimated. Mean respiration was 28 mg/kg/h (range 25-32 mg/kg/h). A sea container with 10 tonnes of corn would produce 275 gm CO₂/h which is within the standard range of respiration rates of chilled produce. Hence supersweet sweet corn should provide no unusual problems in terms of controlled atmosphere generation and maintenance with existing technology if a controlled atmosphere composition that was insecticidal on thrips and aphids could be devised.

This research has shown that for the most common insects on supersweet sweet corn, cold storage is as effective as controlled atmospheres plus cold storage in reducing insect numbers. These results are similar to those of Lill and van der Mespel (1986) and Klaustermeyer *et al.* (1977) who showed that green peach aphid (*Myzus persicae*) survived combined cold storage and controlled atmosphere for up to 21 days.

For disinfestation during seafreight of supersweet sweet corn to Japan there is no advantage in using controlled atmospheres of the compositions evaluated here over standard cold storage. It did appear that the controlled atmosphere storage kept the wrapper leaves in good condition, reduced kernel dimpling and suppressed postharvest rots. The benefits of controlled atmospheres in maintaining quality have since been confirmed in other research (Brash *et al.* 1993). The variation in results between the two experiments shows the problem exporters face in dealing with natural variation in response of pest populations to quarantine treatments.

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