CONFIDENTIAL

HIGH STRESS CONTROLLED ATMOSPHERES FOR ASPARAGUS DISINFESTATION

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Partially funded by the New Zealand Asparagus Council

SUMMARY

The range of controlled atmospheres tested indicated that short term disinfestation of asparagus prior to air freighting to northern hemisphere markets is feasible without adverse effects on asparagus quality.

RECOMMENDED ACTION

(1) That the possibility of an exporter funding the commercialisation of this project be investigated.

The use of high CO_2 for shorter periods and the effects on spear quality needs to be evaluated.

(2) A copy of this report be forwarded to Ruth O'Brien and Bill Neill, as representatives of NZAC, with a strong request that it be kept confidential whilst the commercial value of the results are investigated.

HIGH STRESS C.A. FOR ASPARAGUS DISINFESTATION

Introduction

High stress C.A. mixes were first used for asparagus disinfestation by Carpenter & Lill (1987) after it had been found that standard C.A. mixes gave insect suppression compatible with the time span of sea freight to northern hemisphere markets but not compatible with the shorter time span of air freight. It was found that high stress C.A. mixes gave good insect suppression in about one week (Carpenter & Lill 1987).

For the 1987 season the use of high stress C.A. was further evaluated and a taste panel was also used to test the acceptability of the product after storage as it had been generally believed that CO_2 levels higher than 10% were potentially phytotoxic to asparagus stored for more than a short time (Lipton 1965) although the exact nature of the phytotoxicity was not defined.

Methods

Asparagus were placed five to a one litre Agee jar. A minimum of 10 thrips and 10 green peach aphids were added to each jar and the jar was then covered with paper tissue which was secured with a rubber band. The jars were then placed in air tight containers and a constant supply of the appropriate atmosphere was supplied, humidified, at 200 ml/min in a flow through system.

Insect survival was assessed by removing all the bracts and assessing whether insects found were alive or dead.

Experiment 1: Insect survival was assessed at 2, 4, 6 and 8 days storage. Each treatment was replicated 4 times. The atmospheres were air, 10%CO_2-2%O_2, 20%CO_2-2%O_2, 30%-2%O_2.

Experiment 2: Insect survival assessed after 8 days. Each treatment was replicated 3 times. The atmospheres used were air, 20%CO_2-2%O_2, 40%CO_2-2%O_2 and 60%CO_2-2%O_2. A sub sample was held at 20°C for another day and then assessed for off flavours and acceptability after cooking on a hedonic scale of 9 points from extremely like to extremely dislike. There were 20 tasters and the 60%CO_2-2%O_2 was not tasted.

A further lot of 10 spears per treatment was weighed at harvest then reweighed after storage. All experiments were carried out at 0°C.

Results

The results of experiment one in which the time series mortality of thrips and aphids was examined is shown in Figure 1. Thrips control was very good after 8 days in all the atmospheres except air. At 30%CO% thrips mortality was 100% after only 4 days. At 20%CO_2 thrips mortality was high after 4 days, although not as good as for the higher CO_2 level. The 10% CO_2 level was rather less effective again. Both 10 and 20% CO_2 treatments had slight dips in effectiveness between 4 and 6 days.

Aphid control was much poorer. It was acceptably high at 20 and 30%CO_2 after 8 days. 30%CO_2 had a quite high level of control after 4 days and a good level after 6 days.

In Figure 2 insect mortality after 8 days in a higher range of CO_2 concentrations is shown. At all levels of CO_2 other than air, insect mortality was high. Spear weight did not change as a function of CO_2 level (Table 1).

The taste panel compared spears stored in air, 20%CO_2 and 40%CO_2

for both flavour and appearance. From the panel's comments the air stored spears were more acceptable than either of the elevated CO_2 treatments. This did not show as a statistically valid result. Appearance of the spears stored in 20 and 40% CO_2 was less acceptable than those stored in air (P 0.01).

Discussion

As has been shown previously (Lill & van der Mespel 1986; Carpenter & Lill 1987), aphids are less easily killed than are thrips by controlled atmospheres. There is no doubt that the levels of insect mortality found after 4 days storage in high levels of CO_2 have application to the disinfestation of air freighted asparagus as the relatively short holding time needed of 4-6 days is compatible with the maintenance of product quality.

A commercial shipment would not have the extreme levels of infestation used here and the likelihood of live insects being found after 4 days would be correspondingly reduced.

The taste panel information is less easy to relate to practical exporting. All asparagus has a major decline in acceptability in the first week of storage (King, Henderson & Lill 1987) which makes quantification of the difference in acceptability between the air stored spears and the spears stored in 40% CO_2 difficult.

The lack of variation in weight change between treatments indicates that no undue dehydration occurred as a result of the elevated CO_2 levels.

Conclusion

These experiments have confirmed the 1987 finding that the use of high stress C.A. has a role in predispatch disinfestation of asparagus that is to be air freighted to northern markets. The time series change in flavour of spears stored at high CO_2 levels needs to be evaluated and then, after a CO_2 level has been selected, a semi commercial shipment should be arranged through an exporter. This project should be evaluated for commercialisation now so that the freight forwarding aspects can be carried out in conjunction with and at the expense of an exporter.

Acknowledgements

The NZ Asparagus Council made a contribution to the costs of these projects. Dr R.E. Lill provided advice and encouragement in times of stress. Kate Henderson and Dr. G. King carried out the taste panel for me. Adrienne Stocker provided welcome technical assistance.

References

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Lill, R.E. & van der Mespel, G.J. 1986. The effect of controlled atmosphere storage of asparagus on survival of insect passengers. Proceedings of the 39th NZ Weed and Pest Control Conference: 211-214.

Lipton, W.J. 1968. Post-harvest response of asparagus spears to high carbon dioxide and low oxygen atmospheres. Proceedings of the American Society for Horticultural Science 86: 347-356.

TABLE 1: Change in mean spear weight over 8 days storage in various atmospheres.

Atmosphere	Mean weight (±s.e) Initial	Final
Air	20.2 (±7.2)	20.3 (±7.4)
20% CO_2, 2% O_2	16.9 (±6.2)	16.8 (±6.2)
40% CO_2, 2% O_2	19.96 (±7.9)	19.86 (±7.6)
60% CO_2, 2% O_2	18.5 (±8.5)	18.3 (±8.6)

FIGURE 1: Time series mortality of thrips and aphids held in various atmospheres.

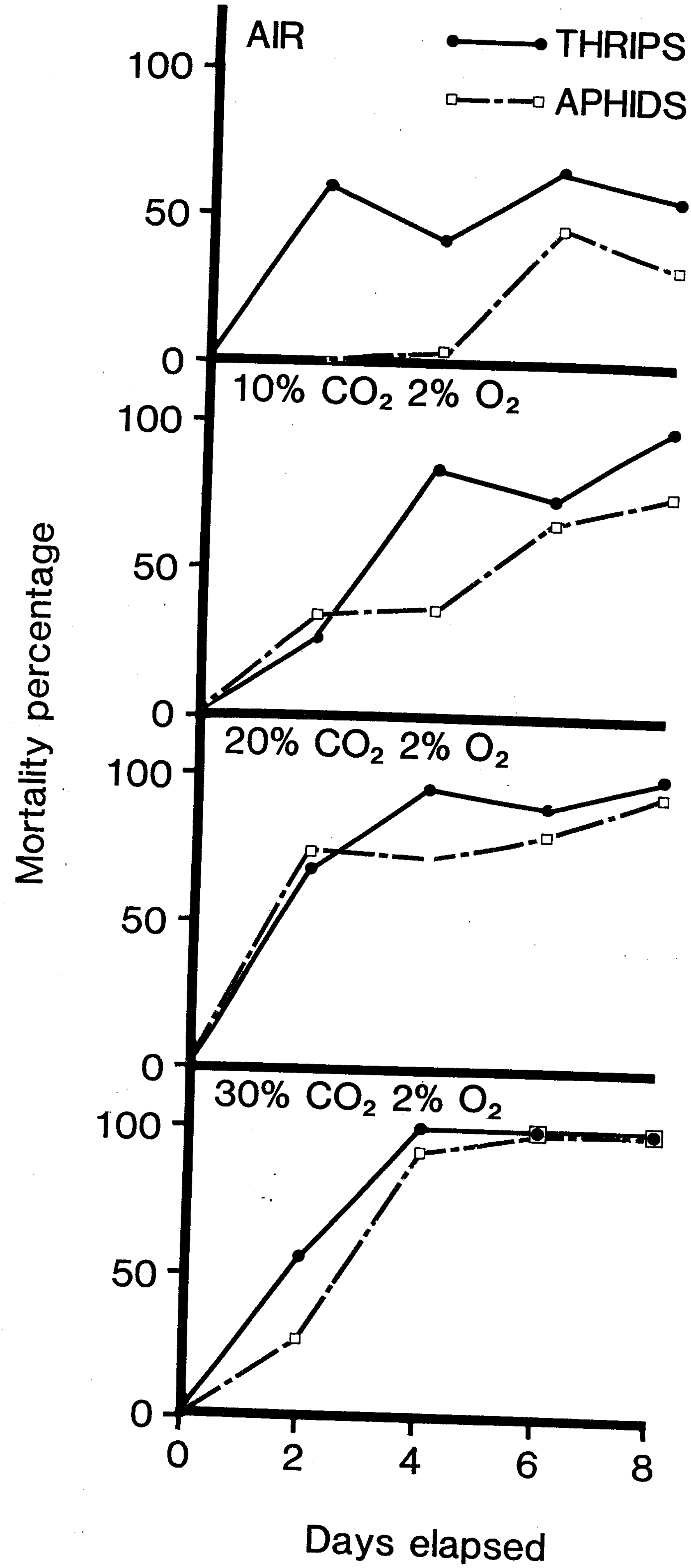
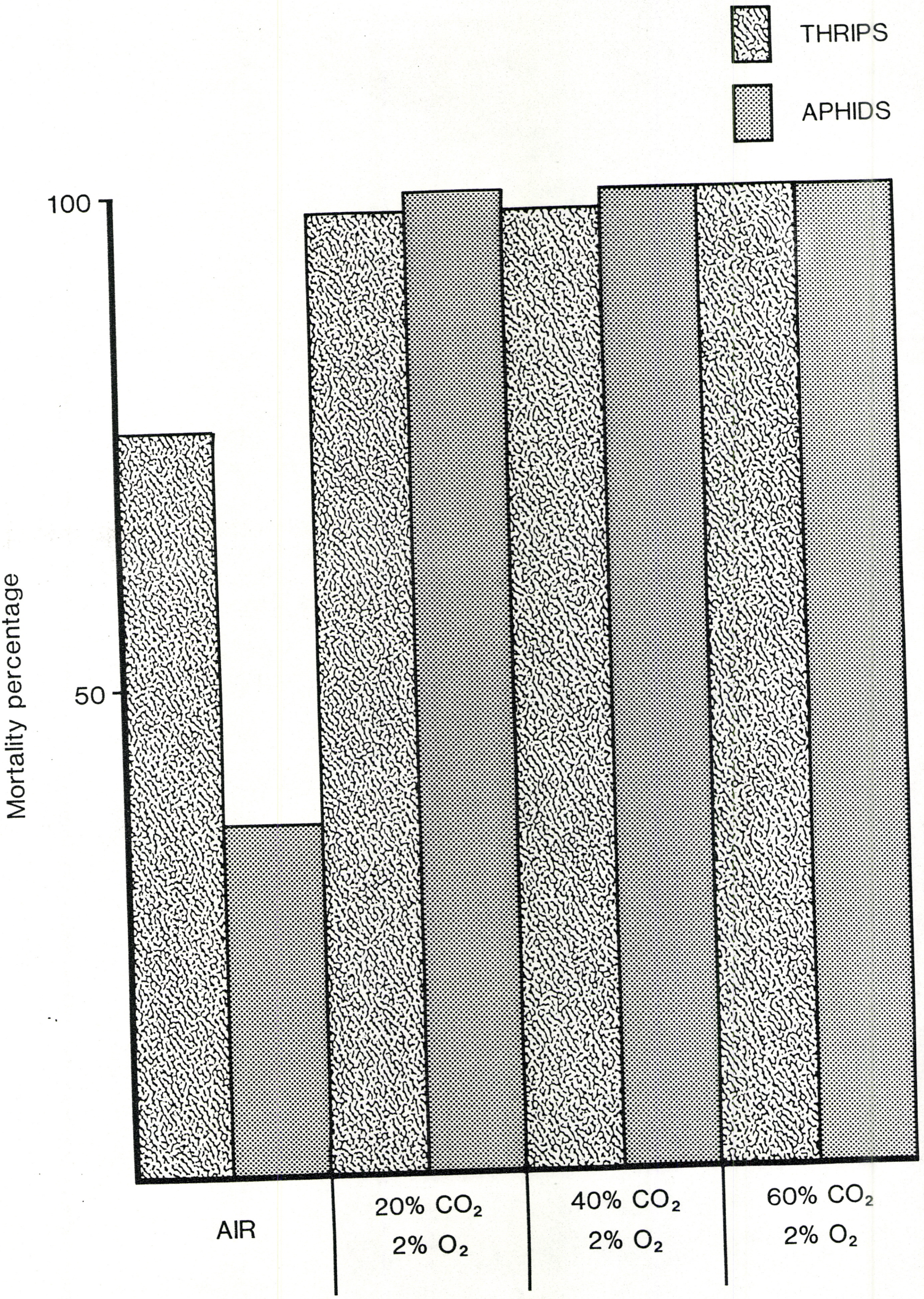

AIR
THRIPS
APHIDS
10% CO2 2% O2
20% CO2 2% O2
30% CO2 2% O2
Mortality percentage
100
50
0
0
2
4
6
8
Days elapsed

FIGURE 2: Mortality of thrips and aphids held in various atmospheres for 8 days.


THRIPS
APHIDS
100
50
Mortality percentage
AIR
20% CO₂ 2% O₂
40% CO₂ 2% O₂
60% CO₂ 2% O₂

Costs

Atmospheres	$1,375
Asparagus	$ 27
Insect supply	$1,390
Science time	$7,500
Taste Panel	$ 350
Sub total	10,842
Less NZAC contribution	$1,000
Toal cost to MAFTech	$9,842

Commercialisation

Asparagus 200 kg @ $2/kg	$ 400
Packaging etc	$ 75
Atmospheres	$ 400
Science time	$7,500
Air fares (Japan)	$2,000
Internal accommodation etc	$2,700
Total	$11,075
Commercial costs/Legal/ Directors etc	$ 4,500
Total	$15,575