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AVOCADOS IN ISRAEL

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OPSOMMING

'n Kort oorsig oor die manier waarop navorsing in Israel gedoen word en verslae oor navorslng projekte, 'n onderhoud met 'n spesialis in beheerde atmosfeer berging en algemene indrukke aangaande avokado verbouing word bespreek. Die effek van waks op opberging en raklewe van Fuerte avokados word toegelig met proef resultate. Gevolgtrekkings word bespreek van 'n verlengde opbergings eksperiment waar verskillende chemikalie en toedraai materiale getoets is vir die bewaring van vrugkwaliteit.

SUMMARY

A brief account of the way research is done in Israel is followed by reports on research protects, an interview with a CA specialist and general observations on avocado growing. The effect of waxing on storage and shelf life of Fuerte avocados is discussed. Results are presented of very long storage periods using different chemicals and wrappers to improve avocado quality.

INTRODUCTION

The South African Avocado Industry has a long history of physiological and pathological post-harvest diseases in export fruit. This problem is not confined to South Africa alone but it is aggravated by the very long storage period necessary for transporting avocados to Europe.

Israel is renowned for outstanding agricultural research at the Volcani Institute, therefore, when I received an Israeli scholarship bursary I decided to join the Division of Fruit and Vegetable Storage to study avocado storage problems. During the 9 months stay in Israel I completed a research project on avocado waxing and participated in an extended storage experiment. Visits to scientists, research institutes and different types of farming enterprises, all involved in avocado culture, occupied the rest of my time.

Before I present the results of my research projects and investigations, a brief account of the way research is done in Israel may explain why the Volcani Institute has risen to such prominence in agricultural research world-wide.

1. Research is done on contract Government supplies the basic amenities, buildings,

equipment and a core of well trained staff.

2. Government, industries, companies and crop grower groups contract researchers to solve problems within a stated time and budget.
3. The state employed scientists negotiate for grants that include the cost of hiring assistants and to buy equipment necessary for the projects
4. At the end of a grant period a report is submitted and one or more publications appear in international journals. Interim publications abound Hired technical assistants may use projects for M.Sc. or Ph.D thesis purposes and non-graduate assistants benefit from being included as co-authors.
5. Because of the numerous publications scientists become well known with the result that they can maintain a permanent staff of highly trained assistants and equip their laboratories with the best and up to date equipment.
6. A government aided fund enables contributing scientists, technicians and assistants to visit research institutes all over the world to gain experience. This is in addition to scholarship or fellowship grants which are regularly provided.
7 Donations and imported specialists are important sources of income and expertise. Exchange of information and staff with the adjacent Weitzman Institute of Science and the Faculty of Agriculture of the Hebrew University of Jerusalem contribute greatly in propagating the most up to date knowledge and techniques within the Volcani Institute and all over the world.
8. The Division of Fruit and Vegetable Storage is the largest of its kind in the world. Their approach to storage problems is biochemical-plant-physiological but they also do screening of fungicides, insecticides, waxes, fumigants and compounds designed to improve storage ability of spoilable produce. Scientists work on different crops in different seasons, for example, avocados in winter and tomatoes and mangoes in summer.

The Israeli system seems to promote greater productivity and communication in agricultural research, compared to other systems. The results speak for themselves.

Results of the work that I completed in Israel will be published later, therefore, I shall only report briefly on a number of research projects and discussions with a specialist in controlled atmosphere (CA) storage.

WAXING TRIAL.

In Israel commercial waxing is confined to the Fuerte variety, for cosmetic purposes only. The effect of an artificial wax on the storage and shelf life of Fuerte avocados was studied in the 1980-81 season. A follow-up experiment was carried out by myself to confirm the previous results for fruit of a different season. The experiment was modified to include monitoring of the internal atmospheres of waxed and non-waxed fruit during storage and softening. Internal ethylene, CO_2 and O_2 were monitored. All that I have to say about the composition of the internal atmosphere of avocados at this stage is that it basically follows the same pattern as that detected on the outside of the

fruit in an enclosed atmosphere

Avocados were sealed in glass jars for an hour at a constant temperature. Gas samples were withdrawn at the end of the time with syringes and analyzed for C_2H_4 + CO_2 content. The glass jars were opened until the next sampling period. When the evolution of ethylene reaches a peak the softening of an avocado cannot be delayed or prevented anymore. A peak in the ethylene production curve is taken as the day on which the fruit is physiologically "ripe" although it actually' softens within two days after the ethylene peak occurs. The ethylene peak is an unbiased measure of the ripening time of an avocado.

At 20°C the waxed avocados exhibited more spread in the ripening times (ethyiene peaks) than non-waxed fruit. It should be noted that one waxed avocado ripened earlier than the control and two later while two ripened within the same period as control (fig. 1 a + b). Spread of ripening times of control was from 6 to 7 days while waxed fruit ripened in 5 to 8 days.

After storage at 5°C for 14 days waxed and non-waxed avocados were softened at 20°C. The spread of ripening times in control is the same as without cold storage (2-3 days) but the overall ripening time is reduced by about half. However, waxed fruit also have the same spread in ripening times as without cold storage but the spread was more even (fig. 1c + d).

The results suggest that waxing emphasizes maturity differences at picking time which manifests itself in differential ripening times. Since waxing encourages softening both earlier and later than control, waxing can become a liability. A more positive aspect of waxing is that it reduces moisture loss considerably (fig.2). Moisture loss may have bearing on fruit quality because dehydration of cells affects the metabolism of cells.

EXTENDED STORAGE

Yoram Fuchs and Uri Yanko experimented with various chemical treatments and wrappings to extend avocado storage and shelf life. The treatments were:

1. Dipping in 3 different anti-oxidants.
2. Sealing in plastic bags, normal and high-density polyethylene.
3. Impregnation with $CaCl_2$ under vacuum.

Samples of all the treatments were stored for 3, 5 and 7 weeks at 5°C and then softened at 20°C. The best results were obtained with normal polyethylene bags, high-density polyethylene film and waxing, in that sequence of performance.

My part in the experiment was to analyze the Ca^{++} content of control and $CaCl_2$ treated fruit and relate that with chilling injury. The results were disappointing in that no reduction in chilling injury as reported by Chaplin and Scott (1980), was detected. A gradient of high to low Ca^{++} content from the stem end to stylar end was observed and this is substantiated by the results of Chaplin and Scott (1980) and Arye Sive (personal communication)-Furthermore, the $CaCl_2$ impregnated fruit did not show significantly higher Ca contents compared to control while brown lesions attributed to

the $CaCI_2$ were observed.

A third project that roused my interest is the fact that plants (and animals) originating in warm climates tend to have more saturated fatty acids in their lipids. This was correlated with a physical phase transition from flexible liquid crystalline to a solid gel. structure at 10° to 12°C below which injury occurred in sensitive species of tropical origin.

Because I was near the end of my stay In Israel this subject could not be pursued further than a preliminary literature survey. However, both Yorum Fuchs (pers. comm.) and Irwin Eaks (pers comm.) will study this phenomenon in avocados, and its implication for avocado storage, in the near future.

CONTROLLED ATMOSPHERE (CA) STORAGE

Arye Sive of the Cold Storage Research Laboratory (Israel Fruit Growers Association) Probably has the most experience in CA storage of avocados in Israel. Extensive experimentation on small scale and one experiment where about 40 tonnes of avocados were stored in a controlled environment have not yet yielded results that could lead to firm recommendations.

Statistical analyses of all his experiments showed that temperature plays the major role in storage of avocados. The reason for the great variation in avocado quality after storage in CA or just cold storage is related to differences in environmental and cultural conditions during different seasons. According to Arye Sive a lot more information is needed on the effects of environmental conditions and cultural practices on the physiological state of avocados at the time of picking before commercial CA of avocados will be economically feasible.

To cover the investment of CA installations such facilities need to be fully occupied 50% of the time. Transportation under CA storage gives 10 times more problems than any other complex storage and transportation system. With regards to fruit quality, the longer the storage under Ca the greater the advantage compared to other storage systems. The effects of low levels (1-2 ppm) of ethyiene Is inhibited by cold storage but high levels (> 10 ppm) of ethyiene have deleterious effects at 6°C. This means that ethyiene levels should also be controlled under any extended storage conditions. CA storage containers of any format must be gas-tight to function properly. A failure in this respect leads to poor results.

HORTICULTURE

Considerable effort Is spent on selecting better cultivars of avocados in Israel. As new varieties become available they are screened in all the climatic regions of Israel. The most promising new cultivar is the Sharville. Local varieties are also actively screened and an intensive breeding and selection programme is in operation.

Spacing, thinning and pruning trials were established a few years ago. These are, however, very long term experiments and results are not available yet. Other projects include Irrigation, fertilization and pollination trials. All aspects of avocado growing are

covered by the research programmes which shows the importance that the Israelis attach to the avocado as an export commodity.

CONCLUSION

Avocados in Israel receive a lot of scientific attention which can only contribute to Improve the quality of the export crop. Although the climatic and edaphic conditions in Israel differ considerably from that in South Africa, the same horticultural problems are encountered and the solutions are equally complex. Problems in storage have more common ground but solutions are equally elusive. The advantages of the Israeli avocado industry centres around the absence of *Phytophthora* in their orchards, their geographical location and climatic region.

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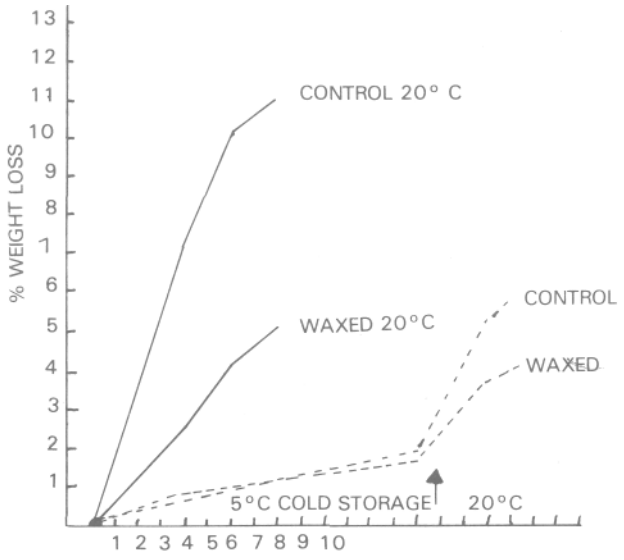

FIG. 2. MEAN WEIGHT LOSS OF CONTROL AND WAXED AVOCADOS STORED AT 5°C FOR 14 DAYS AND THEN RIPENED AT 20°C , AND ONLY RIPENED AT 20°C.

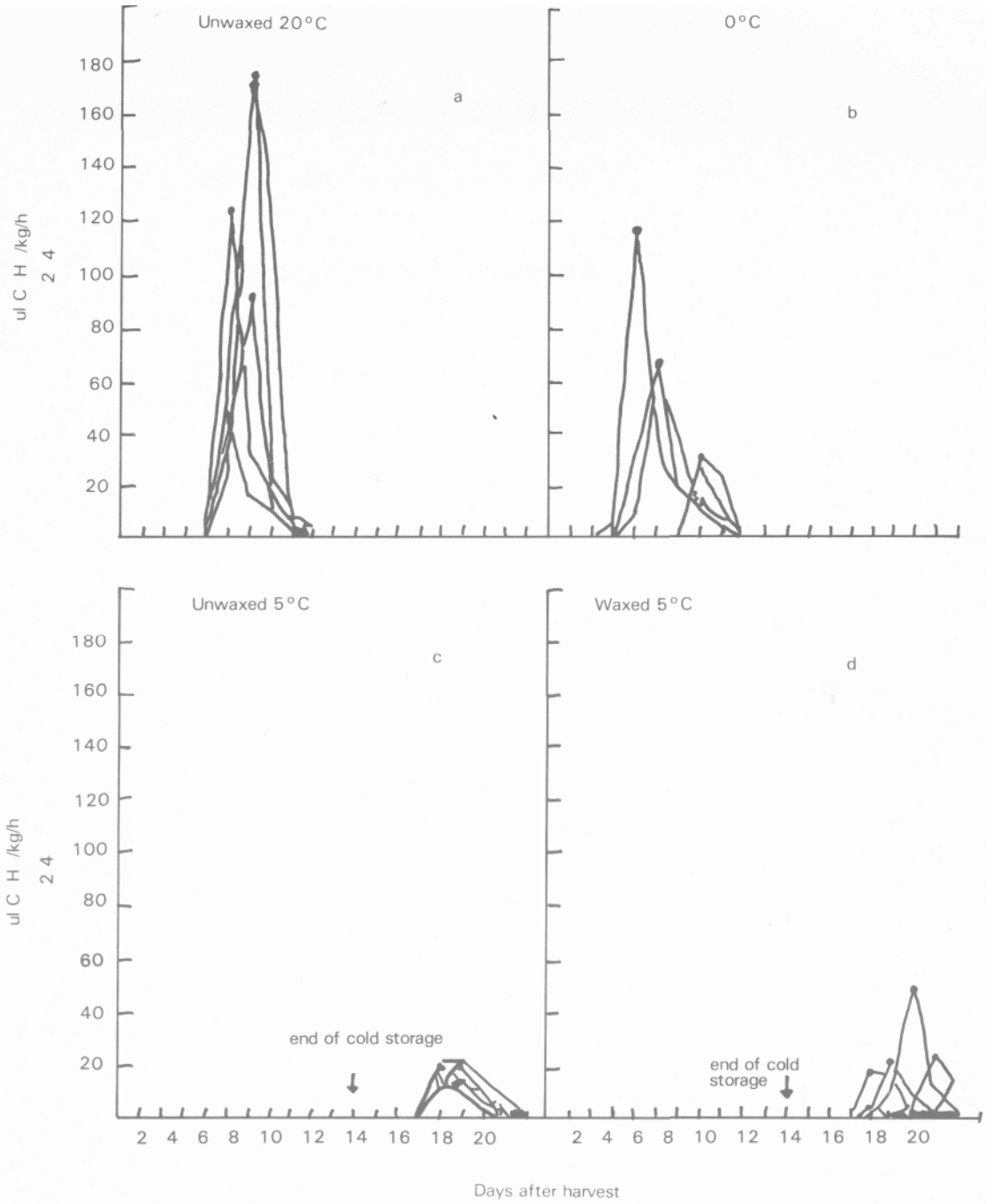

Fig. 1. Distribution of ethylene peaks (●) for control and waxed fruit softened at 20°C (a & b) and softened at 20°C and after 14 days at 5°C cold-storage (c & d).