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SUMMARY OF A REPORT ON AN INVESTIGATION INTO PHYSIOLOGICAL DISORDERS OF AVOCADOS

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Dr LJ van Lelyveld has been studying physiological disorders in avocados for many years. Apart from his work on the effects of root rot on tree physiology, he takes a keen interest in post-harvest fruit disorders. During his visit to the UK in 1983 he made an in depth study of the fruit disorders. Some of his results are summarized here*. — Ed*

Avocado post-harvest fruit disorders

Fuerte avocados which are exported by sea and air from the Republic of South Africa to the United Kingdom are often subjected to serious physiological and pathological disorders which make them unacceptable for marketing. This investigation was initiated in order to get a better understanding of the physiological and biochemical nature of the most serious of the disorders.

During the period of this investigation, 6 April to 5 July, 1983, two disorders were investigated viz mesocarp discoloration and pulp spot, of which the former was by far the most serious economically, whereas the latter only affected fruit from one farm on two occasions. In this report details are given of the nature and extent of the particular consignments investigated.

The biochemical analyses revealed that the two major factors involved in the browning reaction viz the Polyphenol oxidase (PPO) enzyme activity and phenolic substrate concentration, were both significantly higher in both mesocarp discolouration and pulp spot-affected fruit. These two factors are both essential in the determination of the development and extent of the browning reaction. It has also been found by other research workers that PPO and the phenolic substrate concentration are higher in the Fuerte cultivar than in other cultivars, which will explain why Fuerte is more susceptible to these disorders. We have discovered in this investigation that the higher PPO activity in mesco-carp discolouration-affected fruit was as a result of the release of latent and/or bound PPO. It has been found, that in other crops, this release could be caused by stress factors. We have proved to our satisfaction in this investigation that cold storage or "chilling" injury could be ruled out as a cause, although the same symptoms have been described by other investigators to be a result of "chilling" injury. We suggest and show that these symptoms are more likely to have been caused through "suffocation" of the fruit during storage, and that some form of check on the ventilation and hence respiration of the fruit be carried out in the future.

The increase in total phenols as a result of mesocarp discolouration and also pulp spot

affected both disorders. The fact that we found the phenylalanine ammonia-lyase (PAL) enzyme activity in ripe avocado fruit to be unaffected by both disorders, suggests that the phenolic substrates may already have been affected and increased by stress under field conditions such as water relations and *Phytophthora* root rot. The extent of the increase in phenolic substrates may eventually determine the extent of the development of the disorder symptoms.

We have shown that the PPO enzyme in avocado fruit can be separated on Sephacryl S-300 into at least six forms which vary qualitatively and quantitatively in unaffected and affected fruit. Furthermore, some of these forms also reveal specific activity towards certain specific phenolic substrates found in avocado fruit. From these results it appears that epicatechin, catechin and chlorogenic acid may be the most likely substrates for the avocado PPO enzyme. Proanthocyanidin was also increased in mesocarp discolouration-affected fruit and its possible association with catechin accumulation may be investigated in future. Indications were also found that cinnamic acid derivatives are higher in both mesocarp discolouration and pulp spot-affected fruit and it will be of Interest to establish at what time, that is, preor post-harvest, this increase takes place.

Pulp spot was found in significant percentage and severity from one farm only, on two occasions. This fact, as well as that no latent or bound PPO could be found in the mesocarp of unaffected fruit, indicates that the "trigger" for the development of pulp spot in the vascular system must have been different to that of mesocarp discolouration. This is supported by the fact that mesocarp discolouration only develops in the mesocarp whereas pulp spot is localized only in the vascular tissue and it was only in very rare instances that both were found in the same fruit. The "injury" was therefore, caused at two different sites by different circumstances. Furthermore, the same container, or even carton may contain pulp spot affected fruit as well as healthy fruit whereas with meso-carp-disco-louration 100% of the fruit is usually affected.

Peroxidase activity was also higher in mesocarp discolouration-affected fruit compared with healthy fruit. Apart from the possibility that stress ethylene evolution may have some association with this increase there does not seem to be any likely explanation.

Avocado cell suspension cultures and *Phytophthora cinnamomi:*

Callus cultures and cell suspension cultures from avocado cuttings have now been grown successfully by us. This has placed us in a position to start a preliminary study on the effect of cell wall phytotoxins from *Phytophthora cinnamomi* on avocado cell suspension cultures.

Phenylalanine ammonia-lyase (PAL) activity in avocado cell suspension cultures was increased after 4 and 8 hours after treatment with *P cinnamomi* cell wall extracts after which it dropped at 24 hours. The significance of this response may be found in the lignin synthesis as a resistance response to infection.

Polyphenol oxidase (PPO) activity was also increased up to 8 hours after treatment with a drop in activity after 24 hours. The significance of this response cannot be accounted for at this stage.

Peroxidase (POD) activity was increased 4 hours after treatment with a slight drop at 8

hours and a further major increase at 24 hours. This response may be important and will have to be further investigated in view of the results found earlier in leaves of trees affected with root rot *(P cinnamomi).* The participation of POD in lignin synthesis, and its effect on resistance is a further possibility that will have to be investigated.

The TLC separation of 80% methanol extracted substances from cells revealed one substance which was present in untreated cells but was quantitatively increased with increasing time of incubation with extracts from *P cinnamomi* cell walls. With the short time available it was not possible to establish whether this substance was fungitoxic.