South African Avocado Growers' Association Yearbook 1993. 16:20-21

THE CYTOKININ COMPLEX AS RELATED TO SMALL FRUIT IN 'HASS' AVOCADO

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SUMMARY

The 'Hass' avocado produces small fruit as the tree becomes older. The trait is more marked and accelerated when the trees are grown in warmer areas. Small fruits are a major problem for producers as the market can only absorb very small quantities. Recent results have shown that young fruits dipped in synthetic urea cytokinins develop into larger fruit when compared to untreated fruit. The possibility that endogenous cytokinin may regulate fruit size was therefore investigated. Young fruit from a warm and a cool production area were sampled and the cytokinin complex determined by combined HPLC isolation and immunoassay quantitation methods. Fruits from the warmer areas had both quantitative and qualitative differences in endogenous cytokinins when compared to fruits from the cooler area. In warmer areas it appears that climate interferes with cytokinin transport and/or synthesis and metabolism as endogenous concentration and complement are altered and reduced.

INTRODUCTION

The 'Hass' avocado has become one of the most important exported avocado cultivares, being preferred by both the North American and European consumer. One problem with 'Hass' is small fruit size; the problem being worse as the trees age or when produced under warmer environments. As the tree has a natural tendency to bear small fruit any further reduction in fruit size renders a large portion of the crop unmarketable.

Recent research using a urea cytokinin fruit dip shortly after fruit set increased 'Hass' fruit size by 28% (Könne, 1991). The possibility that endogenous cytokinins influence or regulate fruit size was therefore investigated.

MATERIALS AND METHODS

Avocado fruits cv Hass were from Westfalia Estate (hot climate and small fruit history) in the warm eastern Transvaal and Everdon Estate (cool climate and large fruit history) in the cool mistbelt region of Natal in South Africa. Fruit were harvested about 120 days after flowering with a mass of about 75 g. After harvest 1 kg bulk pooled fruit samples from each environment were sectioned into exocarp; meso- and endocarp; and seed

and testa components, freeze dried, milled and stored at -20 °C until analysed.

Two gram samples were extracted overnight in 20ml 90% menthanol at 4 °C with shaking. After centrifugation (20,000g for 10 min) the supernatant was decanted off and reduced to dryness in a centrifugal evaporator. The residue was dissolved in 2ml 10% methanol in 0.2N acetic acid (with the pH adjusted to 3.5 with triethylamine), filtered through a 0.45 urn disposable Millipore LCR filter and injected into the HPLC. Separations were achieved on *a* Waters gradient HPLC fitted with a 10 x 250 mm Zorbax ODS semiprep column and a UGK variable volume injector. The column was eluted with a gradient of 10% methanol in 0.2N acetic acid (with the pH adjusted to 3.5 with triethylamine) to 50% methanol over 70 minutes at a flow rate of 1.5 ml. min-1. The gradient was then held constant at 50% methanol for 10 min and then taken to 100% methanol over 10 min and then held at 100% methanol for a further 20 min. For the immunohistograms and cytokinin quantitation two min fractions were collected from 20 min to 80 min and dried in a Savant concentrator. Cytokinin determination by immunoassay was as described previously (Cutting, 1991).

RESULTS AND DISCUSSION

There were both quantitative and qualitative differences in the cytokinin complex in 'Hass' fruits from either warm or cooler production areas. Seed and testa concentrations of zeatin and dihydrozeatin type cytokinins were greater in fruit from cooler areas (Fig. 1). There were no differences in isopentenyl type cytokinins from either warm or cooler production areas (Fig. 2). Zeatin and dihydrozeatin concentrations in mesco-and exocarp were low and not significantly different.

A large proportion of the fruit from the warmer area had already shown signs of premature degradation at the sampling date (about 120 days after fruit set). In contrast there was almost no testa degradation in fruit from the cooler area. Other factors have been implicated in the small fruit problem and include respiration (Whiley, 1990), nutrition and irrigation (Lahav & Kalmar, 1977) and tree complexity (Lahav & Adato, 1985). However, once optimized management is applied, the most important physiological consideration appears to be testa health. The exact relationship between the cytokinins and testa health still needs to be determined, but there ia a relationship with cell division which continues throughout the life of the avocado fruit (Schroeder, 1953), and explains why "small fruit" respond to exogenous cytokinin application while "large fruit" are responsive and do not significantly increase in size.

The next step is to determine management systems to prolong testa life and influence cytokinin content to enhance fruit size "naturally".

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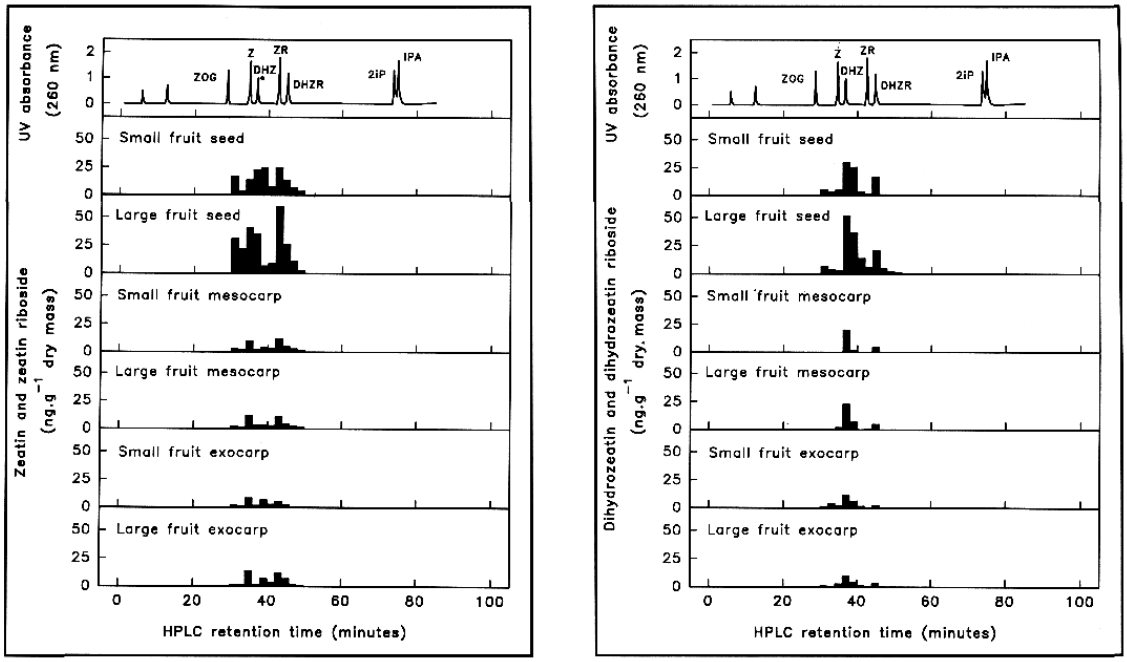

FIG. 1 HPLC immunohistograms of zeatin and diihydrooozeatin-type cytokinins in different parts of young "Hass" avocado fruit.

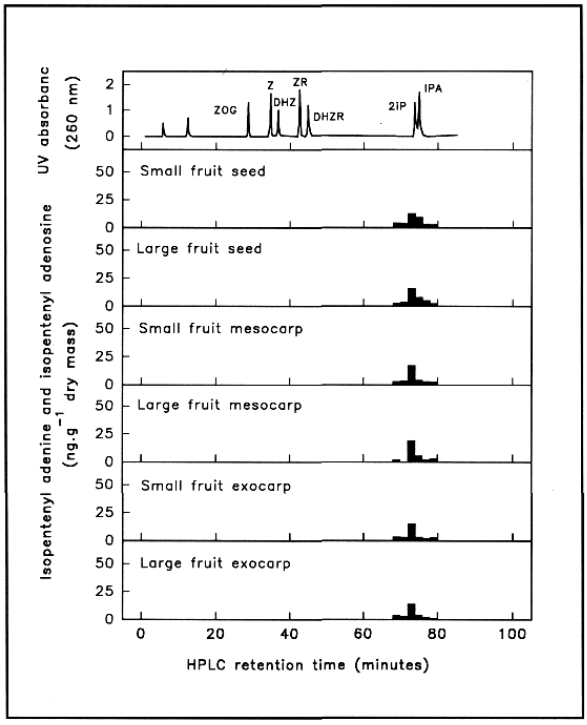

FIG. 2 HPLC immunohistograms of isopentenyl-type cytokinins in different parts of young 'Hass' avocado fruit.