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CHANGES IN THE ENDOGENOUS PHYTOHORMONES IN LEMON FRUIT DURING GROWTH AND DEVELOPMENT

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SUMMARY

Studies on the endogenous level of plant growth hormones in the fruit of Baramasi lemon during growth and development were undertaken at Punjab Agricultural University, Ludhiana. Lemon fruit showed a single sigmoid curve and the fruit takes about 90 days to reach maturity from fruit set (April 15). Growth of the lemon fruit was initially slow which increased rapidly and then gradually following a lag period. Activity of IAA and gibberellin like substances was more in the pulp than that of peel. A month after fruit set their activity was low which increased gradually during fruit development and declined thereafter towards maturity. The pattern of fruit growth closely resembled that of IAA and gibberllin like substance's activity which indicate that these substances are contributing to cell enlargement. Activity of zeatin was higher in the initial stages of fruit gorwth which declined as maturity advanced. Activity of ABA was more in the peel than in pulp. Initially it was high which decreased along with development, as maturity advanced and then increased to a high level at maturity.

Key words: *ABA, fruit, GA, IAA, lemon, phytohormone, pulp, peel, zeatin.*

INTRODUCTION

Information on the growth behaviour of lemon fruit is very limited. The endogenous plant growth substances play an important role in the growth and development of the fruits. The developing fruits are dependent on the continuous supply of various phytohormones which regulate their development. Although some information about the endogenous plant growth hormones is available in few citrus fruits (Erner *et al.*, 1976, Garcia-Papi and Garcia-Martinez, 1984, Dhillon, 1986, Murti, 1989), information on lemon is not available. The present study is an attempt to elucidate the changes in the endogenous plant growth hormones associated with growth and development of lemon fruit.

MATERIALS AND METHODS

A considerable number of fruits of lemon cv. Baramasi were labelled immediately after fruit set (15th April). Fruits samples were collected at 30, 60, 75 and 90 days after fruit set (DAFS). These samples were collected in 80% methanol and kept in deepfreezer and utilized for the estimation of IAA, gibberllin like substances, zeatin and ABA. Fruit sample was macerated and extracted in 80% chilled methanol for 48 hours and volume was made three times and filtered. After filteration residue was discarded and filtrate (methanol) was evaporated by rotary flash evaporator at 35°C to water phase and filtered. The pH of water phase was adjusted to 8.6 with 1% NaOH and partitioned three times with ethyl acetate (fraction I).

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Fraction I was evaporated to dryness and dissolved in 80% methanol. Again it was evaporated to water phase and the pH was adjusted to 2.8 with 1% HCl and partitioned three times with ethyl acetate. The pH of water phase was again adjusted to 5.5 with 1% NaOH and partitioned three times with water saturated n-butanol. Then the water phase was discarded and n-butanol fraction was reduced to 10 ml volume and used for the analysis of Zeatin by GLC (Shindy and Smith, 1975). The pH of water phase (Fraction II) was adjusted to 2.8 with 1% HCl and partitioning was done three times with ethyl acetate. Water phase was discarded and ethyl acetate fraction was reduced to 10 ml volume and analysed for IAA, gibberellin like substances and ABA by GLC (Shindy and Smith, 1975 and Slominski *et al.*, 1979). For derivatization the fractions were dried in vials and dissolved in 0.2 ml pyridine solution. The silylation was done by using N, O-bis-(trimethylsilyl) acetamide (BSA) to obtain TMS derivatives. The vials were immediately capped and allowed to stand for one hour before GLC analysis (Davis *et al.*, 1968).

The Gas Chromatograph fitted with dual glass column and flame ionization detector Nucon Micro Process Control 5765 was used to separate the plant growth hormones. For quantification, the respective areas of individual peaks were measured and calculated as ng/g fresh weight.

RESULTS AND DISCUSSION

The fruit of lemon matured in about 90 days after fruit set. The growth pattern of lemon fruit (diameter) followed a single sigmoid curve (Fig. 1) The diameter of the fruit increased with the advancement of maturity (Fig. 1). Initially the growth of the fruit was slow upto 30 days after fruit set, which increased thereafter upto 60 days and slowed down again when the fruit reaches maturity. The slow increase in the initial stage and then a faster increase could be attributed to the cell division in the initial stages and cell enlargement in the later stage. Similar observations have been reported by Hittalmani *et al.*, (1977) in Tahiti lime, Josan *et al.*, (1987) in Wilking mandarin and Murti (1989) in Acid lime.

It is evident from the Fig 2 that IAA content of the pulp was higher than that of peel. Initially there was an increase in IAA content in both peel and pulp upto 60 days

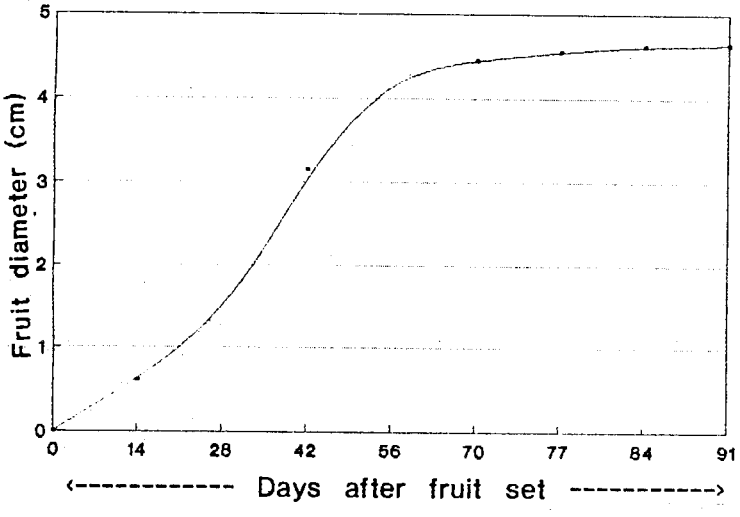

Fig. 1. Growth Curve of lemon fruit

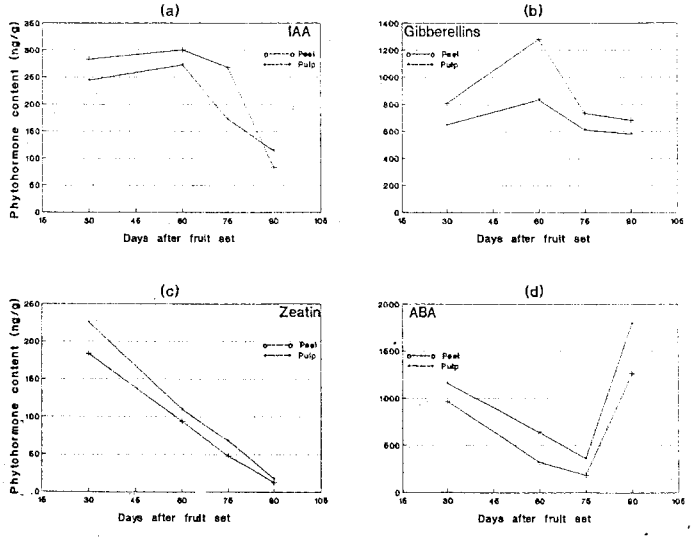

Fig. 2 : Seasonal changes in phytohormones in lemon fruit

after fruit set (DAFS) which declined as the fruit matures, though at harvest the level of IAA was less in the pulp than the peel. Takahashti *et al.*, (1975) have reported higher auxin level in the beginning which decreased later on in the fruits of Satsuma. Higher level of IAA in the fruit in the initial stage is suspected to be responsible for the faster development.

The activity of gibberllin like substnaces was higher in the pulp than that of peel of the fruit. It increased upto 60 DAFS, with a decline thereafter upto maturity (Fig 2). The higher activity of gibberellin like substances in the initial stages coincides with the faster growth period of fruit during the same period. Gibberellin level increased during the cell enlargement stage. The fruit approaching maturity had less GA_3 like activity than the youngest fruit (Goldschmidt, 1976). Dhillon *et al.*, (1986) also observed that gibberellin like substancs in the kinnow fruit showed positive correlation with the fruit growth which decreased as the fruit maturity advanced. Similar findings have been reported in Satsuma mandarin by Kuraoka *et al.* (1977). As the gibberellins are known to play an active role in cell elongation, the rise in gibberellins may be contributing to the rapid growth of the fruit through its effect on cell enlargement.

It was observed that the activity of zeatin was higher in the peel and pulp of the fruit in the initial stages of fruit growth which decreased rapidy along with the advancement of fruit development (Fig 2). High zeatin activity in the fruit coincides with the cell division in the first phase of fruit growth. Murti (1989) also recorded high activity of cytokinin in the fruit 60 days after fruit set which decreased rapidly during active growth period and Goldschmidt (1976) reported that fruit reaching maturity had low cytokinin activity.

Higher level of ABA was recorded during first phase of fruit growth i.e. 30 DAFS which decreased upto 60 DAFS and again rise at the time of fruit maturity (Fig 2). Kuraoka *et al.*, (1977) recorded the similar results that during fruit growth the ABA content of Satsuma peel increased gradually and then rapidly during fruit maturation. Goldshmidt (1976), Dhillon (1986) and Harris and Duggar (1986) also reported the similar results in various citrus fruits.

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