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STUDIES ON FRUIT GROWTH AND ORGANIC METABOLITES IN DEVELOPING KIWIFRUIT

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SUMMARY

The kiwifruit exhibited a characteristic double sigmoidal growth pattern, following rapid growth for 80 days (Stage-I), period of slow growth for 30 days (Stage-II) and period of enhanced growth for 75 days (Stage-III). The total and the reducing sugars increased throughout the period of fruit development gradually upto 170 days after full bloom (DAFB) and slowly thereafter. Titratable acidity was quite low during early stages of fruit growth and increased to reach peak value at 155 DAFB. Sugar acid ratio was quite high initially but declined gradually upto 90 DAFB and increased during maturity. The ascorbic acid content was quite low in the immature fruit and increased rapidly during Stage-II and gradually declined with the advancement of maturity.

***Key words*: *Actinidia deliciosa*, ascorbic acid, fruit growth, kiwifruit.**

INTRODUCTION

Kiwifruit or Chinese gooseberry (*Actinidia deliciosa)* is an important fruit introduction of recent times. It is a deciduous, dioecious and perennial vine and holds exceptional promise for cultivation in the low and mid hills of Himalayan region covering Jammu and Kashmir, Himachal Pradesh, Uttranchal and north-eastern states of India. It has been reported that kiwifruit takes about 160 days from pollination to weigh approximately 120 g (Beever and Hopkirk 1990). There are conflicting reports in the literature of the overall pattern of fruit development. Pratt and Reid (1974) reported a triple sigmoid curve for the cultivar Bruno, while, Hopping (1976) reported double sigmoid growth curve for Monty cultivar.

Biochemical constituents, their interaction and biochemical events taking place during critical stages of fruit development provide us an insight into that aspect of ontogeny, described as maturation and ripening. These also play a decisive role in determining the composition and quality of fruits at harvest. Sugars in free or as derivatives, play an important role in imparting attractive colour, flavour, appearance and texture to the fruit. Flavour is fundamentally the balance between sugars and acids. Kiwifruit is an excellent source of ascorbic acid with higher levels than that of apple and peaches (Thomas and Corden 1970). Therefore, the present investigations were carried out to study the pattern of fruit growth and changes in the levels of various metabolites in kiwifruit cultivar Allision.

MATERIALS AND METHODS

The present study was carried out in the kiwi orchard of University of Horticulture and Forestry, Nauni, Solan (H.P.) during 1995-96. The experiment was laid out in 10 years old vines planted at 6 x 4 m and trained on T-bar trellis with 5 wires running parallel to each other at a distance of 30 cm. Three vines of kiwifruit cv. Allison were selected for recording observations. Fruits were sampled at 15 days interval beginning 20 days after full bloom (DAFB) through the final harvest. The weight of a unit sample of fruit was taken on a top pan balance and

expressed as weight per fruit in grams. Sugars and titratable acidity were determined as per the standard methods of AOAC (AOAC 1970). Sugar acid ratio was determined by dividing the amount of total sugars by titratable acid. Quantitative estimation of ascorbic acid was done, using 2, 6 dichlorophenyl indophenol dye (AOAC 1970).

RESULTS AND DISCUSSION

Growth of kiwifruit as followed by the measurement of fresh weight at 15 days interval beginning 20 days after full bloom (DAFB) revealed a cyclic development characteristic to of a double sigmoidal pattern of growth (Fig. 1). The fruit registered a significant increase in fresh weight at fairly uniform rate till 80 DAFB when a slight inflection in growth curve was noticed (Stage-I). The fruit entered Stage-II, 90 DAFB, which lasted for 30 days. An abrupt change in the rate of increase was noticed from 110 to 185 DAFB, which marked the beginning of enhanced rapid growth of flesh and fruit weight (Stage-III). Rathore (1981) has also reported a cyclic pattern of fruit growth in four cultivars of kiwifruit under Shimla hills conditions of Himachal Pradesh. He has further reported that kiwifruit grows rapidly in the initial phase of about 7 weeks after fertilization and becomes slow for the next 5 weeks but continues to grow at a steady rate upto 31st week. Several other workers have also reported that the major increase in the fruit weight and volume occurs during initial 10 weeks after anthesis (Pratt and Reid 1974, Hopping 1976, Okuse and Ryugo 1981, Jao *et al.* 1990).

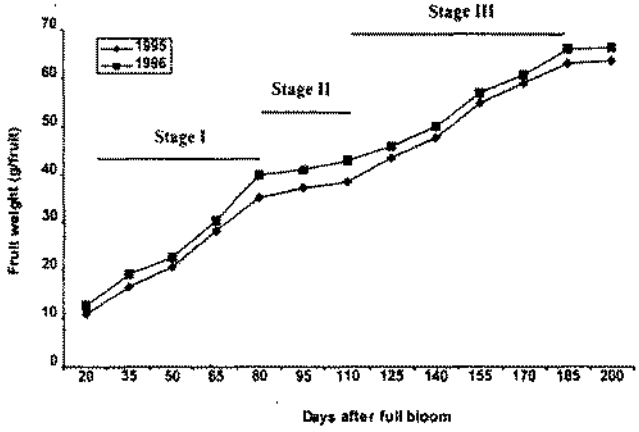

Fig. 1. Growth pattern of developing kiwifruit cv. Allison

Total and reducing sugars increased steadily throughout the period of growth and maturation (Fig. 2). Sugars more or less followed the pattern of fruit growth and bear a direct relationship with the fruit development. The most marked changes in developing fruit occur in carbohydrates, especially starch and sugars components. During the early developmental stage of kiwifruit, photosynthates are translocated from leaves to the developing fruits, where these accumulate as starch. Starch content declines during later stages of growth. Concurrently, there is a marked rise in total sugars of the fruit due to major increase in glucose, fructose and sucrose (Reid *et al.* 1982). A regular increase in the levels of sugars may also be attributed to the translocation of photosynthates from the leaves to young fruits which are partly used for the synthesis of pectic substances and other cell wall constituents and partly converted to the usual storage product, the starch (Whiting 1970).

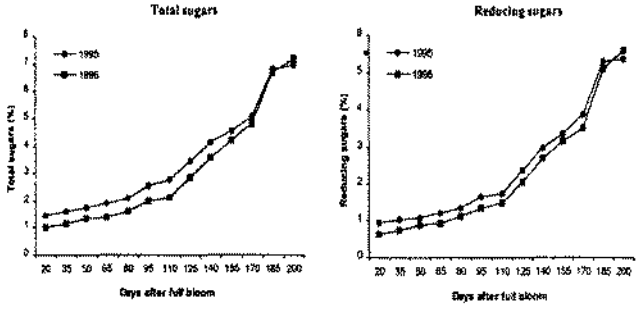

Fig. 2. Changes in total and reducing sugars (%) of developing kiwifruit cv. Allison

Higher sugar acid ratio during initial stages of fruit growth may be attributed to the lower levels of organic acids, which increased during later stages. The abrupt rather sharp increase in sugar acid ratio towards maturity and thereafter may be due to the rapid increase in sugars and decrease in the levels of organic acids (Fig. 3). The titratable or free acid content of kiwifruit increased during the initial period of fruit growth, reached highest value at 155 DAFB and declined thereafter at a uniform rate as the fruit neared maturity. Organic acids are metabolised by kiwifruit during the ripening process resulting in decrease in total acidity (Heatherbell *et al.* 1980, Widleman and Luh 1981, Matsumoto *et al.* 1983).

Ascorbic acid content also exhibited an upward trend commensurate with fruit growth till 155 DAFB and thereafter, a gradual declining trend ensued as fruit

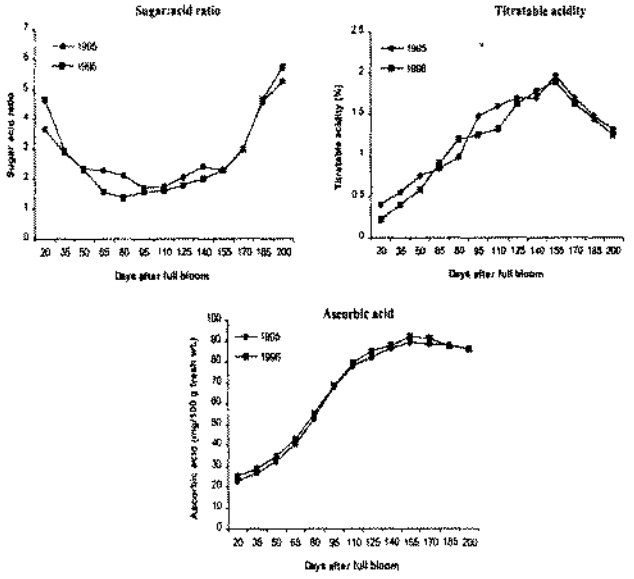

Fig. 3. Changes in sugar acid ratio, titratable acids and ascorbic acid contents of developing kiwifruit cv. Allison

progressed through the maturity. Kiwifruit contains a significant concentration of ascorbic acid, although there is disagreement in the literature on changes in pattern of ascorbic acid accumulation during development and the final concentration reached in ripe fruit. The results of present investigation are in conformity with Okuse and Ryugo (1981). The higher ascorbic acid levels during early stages has been attributed to the adequate supply of hexose sugar via photosynthate activity in peach (Sharma 1984) while, a decrease in ascorbic acid contents during maturity might be correlated to its role as a terminal oxidase in competition with the cytochrome oxidase in electron transport system (Mapson 1970).

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