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# Changes in physico-chemical composition of pomegranate fruits during growth and development under arid ecosystem

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**Abstract**

The fruits of pomegranate variety "Mridula" showed double sigmoid pattern of growth and development. The length, diameter, volume and weight of fruit indicated two phases of growth: a rapid phase until 30-90 days after anthesis and there after a gradual phase until harvest. With the advancement of the fruit maturity, the percentage of the arils and aril rind ratio increases, whereas, percentage of rind and its thickness decreased continuously throughout the growth period of the fruit. Total soluble solids, TSS: acidity ratio, reducing and non reducing sugars and ascorbic acid content of the fruits increased with advancement of fruit maturity, whereas acidity after little increase in the beginning, gradually decreased with growth and development. For best dessert quality and profitable marketing fruits of pomegranate var. 'Mridula" under arid ecosystem can be harvested 120-150 days after anthesis.

**Key Words:** *pomegranate, fruit growth, development, composition, maturity*

## Introduction

Pomegranate (*Punica granatum* L.) belongs to family punicaceae and is thought to be indigenous to the region of Iran where it was first cultivated in 2999 BC, however, it spread to the Mediterranean countries at a very early dates (Hayes, 1957). The fruit is one of the favorites of tropical and sub tropical regions. Because of its versatile adaptability, hardy nature, low maintenance cost, steady and high yields, its cultivation has spread to semi arid and arid regions and there is still further scope for its expansion (Dhandhar and Singh 2002). Pomegranate requires a long hot summer for fruit to mature, however, it can withstand low temperatures in winter. It is drought and salt tolerant plant. Under arid and semi arid ecosystem pomegranate flowers from late April until mid May, whereas, maturity and ripening extends from mid September to November depending upon the cultivars (Patil and Karale, 1990). In the epidermis of pomegranate seeds, the cells are relatively very elongated in the radial direction and are rod shaped (Fahn, 1975) and form edible parts termed as aril. Fruit growth is typically described as a single or double sigmoid curve reflecting organ flesh weight and other measures of growth (e.g. dry weight, diameter, or length) and may give different growth curves (Commbe, 1976) which varies with different ecozones and *bahars* (flowering and fruiting period). In the recent times export of pomegranate from India for world market has increased. But every year cracking, bruising, sun scald and variation in fruit size at harvest time render reasonable quantity of fruits unmarketable. Therefore, some growers prefer to harvest larger fruits soon and allow others to grow more to obtain bigger size. In order to maximize yield and get uniform size of fruits, it is necessary to know the phases of growth that are susceptible to environmental and physiological manipulation. Except some data on physical and chemical attributes at maturity and ripening (Ben-Arie *et. al.*, 1984; Al-Maiman and Ahmad, 2002), there is little information on the physiology of growth and development of the pomegranate fruits. Moreover, significant physiological changes associated with growth and development of pomegranate fruits may occur earlier and different cultivars may behave differently in different ecosystems. In view of the tremendous scope and importance of pomegranate fruits, present investigation was conducted to study in detail its growth and development under arid ecosystem.

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## Materials and methods

For the present study pomegranate fruits of cultivar "Mridula" were obtained from mature trees (8 years old) from Central Institute of Post Harvest Engineering and Technology, Research orchard Abohar, Punjab during advanced *mrig bahar* (May-September) 2005-07.The trees were spaced 5 x 3 meters and received routine cultural care suitable for commercial fruit production including summer and winter pruning requirement of *bahar* (Singh and Kingsly, 2007). The flowers were tagged at anthesis stage for selecting fruits of uniform maturity to study the different stages of growth and development. Ten fruits were selected randomly at 30 days of interval and the observations were recorded accordingly. The observations on physical parameters like length , weight, and volume of fruit, color of rind and aril, percentage of rind and aril, aril rind ratio, percentage of juice and number of arils in 100 gram weight and rind thickness were recorded periodically. TSS was measured using hand refractometer and titrable acidity of juice was determined by titration method (AOAC, 2000). Ascorbic acid was determined according to methods given by Rangana 1986. Colour of arils at different stages was calculate using plants lab mini scan XP plus colorimeter indicating 'L' (Luminance ) and 'a' (red/green ).

**Results and discussion**

The data in respect of length, diameter, weight and volume of fruit indicated two phases of growth (Fig. 1 &2): a rapid phase until 30-90 days after anthesis and there after a gradual phase until harvest, thus giving a double sigmoid for fruit growth curve. These findings are in agreement to *Ben-Arie et. al., (1984)* and Mirdehgan and Rahemi (2006), Fond *et. al.*, (1979), Shulman (1984) who also reported sigmoid growth patterns in pomegranate fruits. Percentage of aril and aril rind ratio increased with growth; however, increase was rapid from 30-60 days and gradual there after till maturity, whereas, percentage of rind and its thickness decreased continuously with growth and the decrease in percentage of rind was recorded gradual there after (Fig. 3, 4, 5). Similar results have been reported by Khodade *et. al.*, (1990). Juice content of fruits during growth and development increased rapidly up to 120 days and after that there was gradual increased up to 150 days of anthesis (Fig. 6). Juice content of fruit increased while percentage of aril decreased with advancement of maturity of fruit. Malhotra *et. al.*, (1983) and Shulman (1984) also reported same trend. Similar results were also reported by Khodade (1990).

Number of arils per 100 gram fruit decreased rapidly from 30th day of anthesis to 150 days of anthesis (Fig. 7). The data showed that the juice content of the seeds increased with advancement of maturity of fruit. Malhotra (1983) and Shulman (1984) reported similar results in pomegranate.

Data on changes in chemical composition of the fruit during fruit growth which indicates total soluble solids, TSS: acidity ratio, reducing and non reducing sugars, ascorbic acid content of the fruit increased with advancement of maturity, while, the acidity increased slightly from 30-60 days and there after decreased rapidly continuously and rapidly and up to 150 days of anthesis (Fig 8,9,10,11).The increase in TSS:acid ratio in juice of pomegranate was with advancement of maturity was also given by Malhotra (1983) and Khodade (1990). The data on colour characteristics (Fig 12) of the arils indicates slight increase in "L" value from 30-60 days of anthesis and after that there was no significant change in increasing trend of this value, indicating no remarkable change in brightness of the arils. The "a" value indicating redness of the fruit which increased rapidly up to 120 days and there after the increasing trend was not significant. Hence it could be inferred for the study that under hot arid ecosystem during advanced mrig *bahar* the fruit of pomegranate var. 'Mridula" for best quality and profitability marketing may be harvested between 120 to 150 days after anathisis.

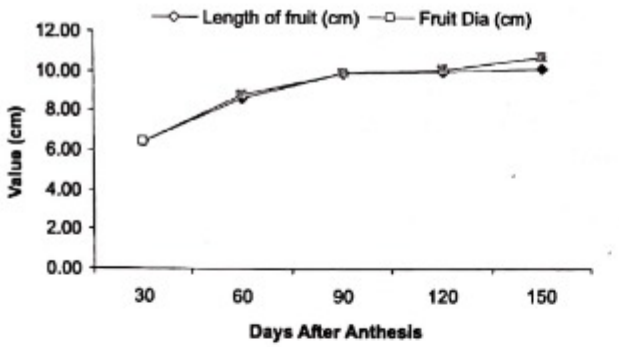


Fig. 1: Pomegranate fruit length and diameter during growth and development.

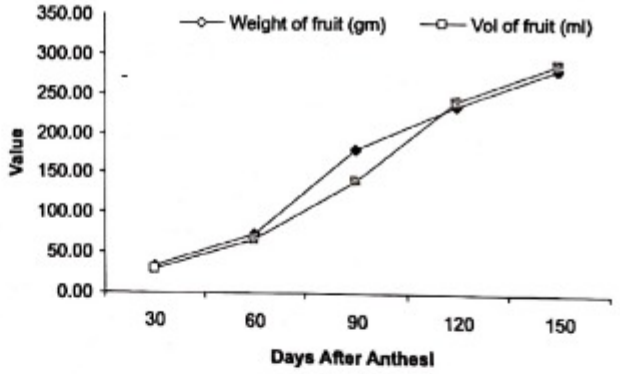


Fig. 2: Pomegranate fruit weight and volume during growth and development.

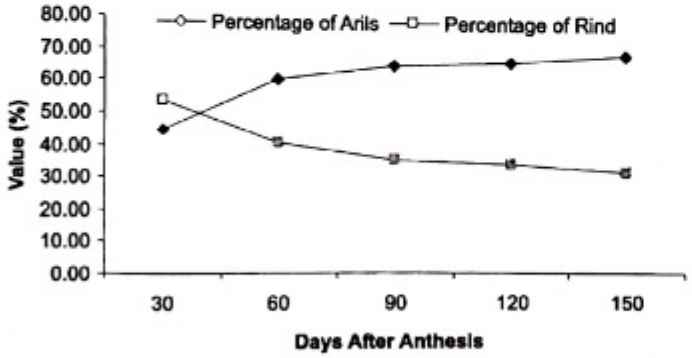


Fig. 3: Pomegranate fruit percentage of aril and rind during growth and development.

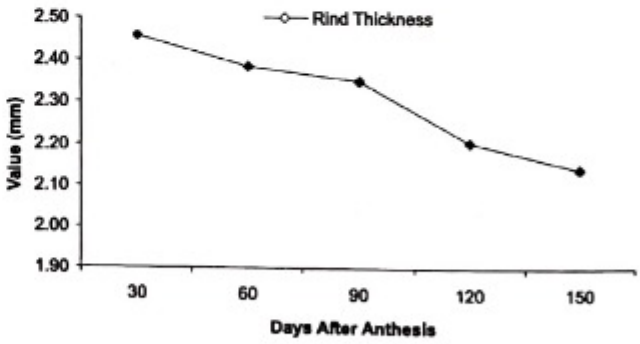


Fig. 4: Pomegranate fruit rind thickness during growth and development.

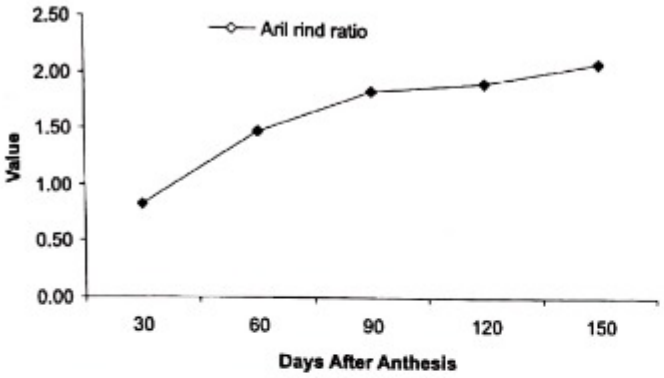


Fig. 5: Pomegranate fruit aril rind ratio during growth and development.

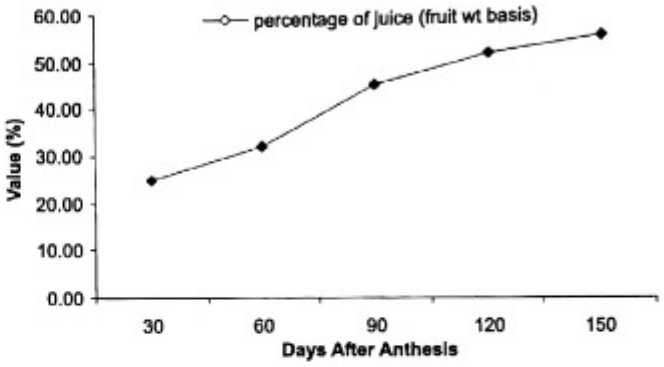


Fig. 6: Pomegranate fruit percentage of juice during growth and development.

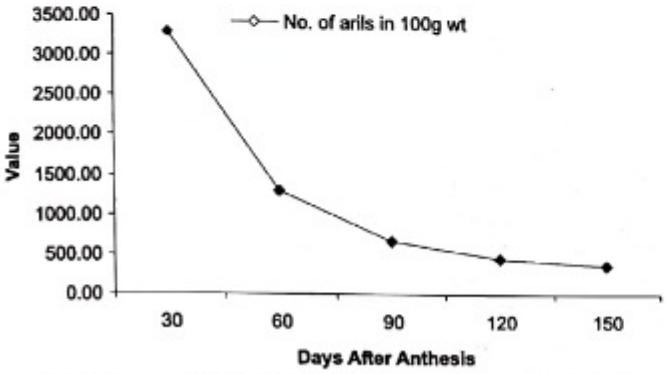


Fig. 7: Pomegranate fruit No of arils in 100g wt. during growth and development.

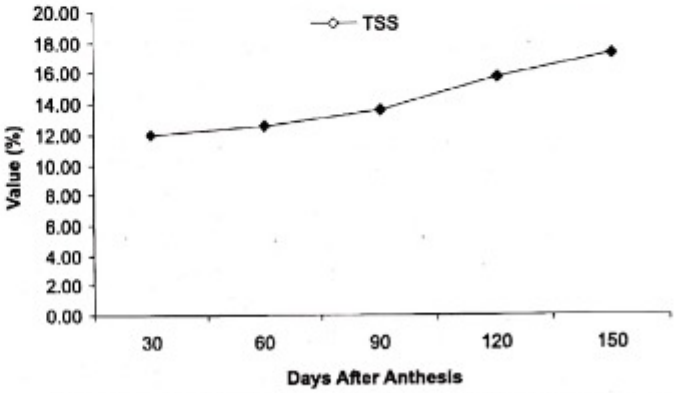


Fig. 8: Pomegranate fruit TSS (%) during growth and development.

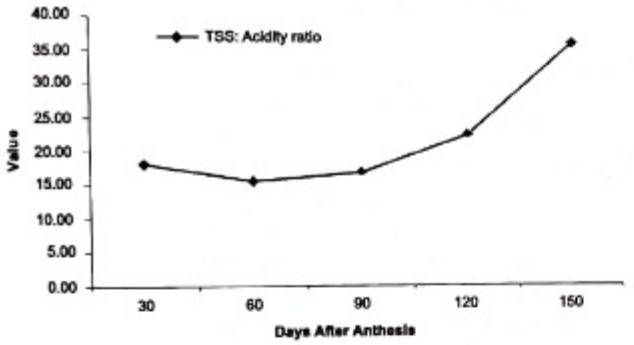


Fig. 9: Pomegranate fruit TSS: acid ratio during growth and development.

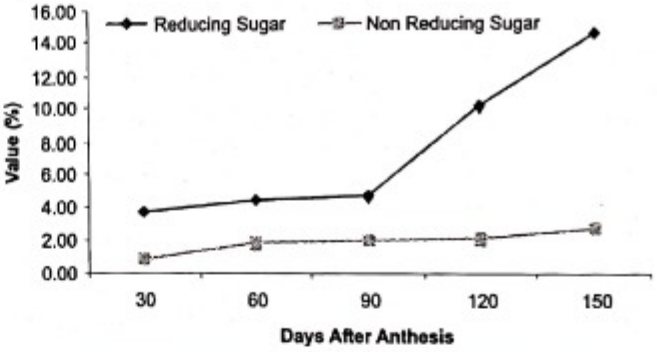


Fig. 10: Pomegranate fruit reducing sugar and non reducing sugar during growth and development.

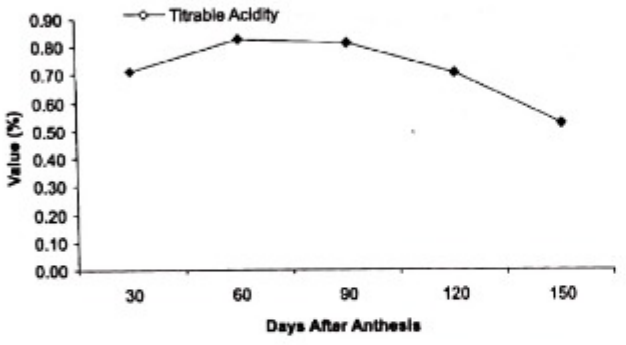


Fig. 11: Pomegranate fruit Titrable acidity during growth and development.

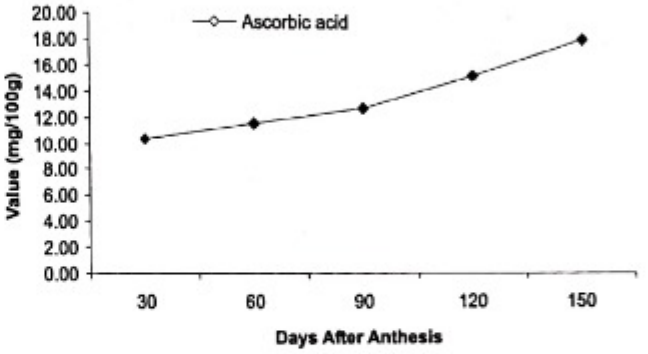


Fig. 12: Pomegranate fruit Vitamin C during growth and development.

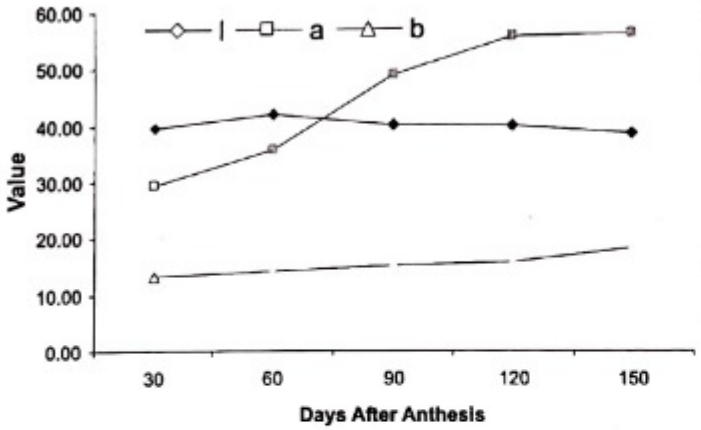


Fig. 13: Pomegranate aril colour during growth and development.

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