INDIAN JOURNAL OF ARID HORTICULTURE
2011, Vol. 6 (1-2) : 35-37

Morphological variability of *bael* varieties under rainfed conditions of hot semi-arid environment of western India

A.K. Singh*, Sanjay Singh, R. S. Singh and H. K. Joshi
Central Horticultural Experiment Station, (CIAH) Vejalpur, (Godhra) Gujarat

Abstract

Bael is an indigenous hardy fruit tree, its fruits are very rich source of riboflavin (Vitamin B_2) with high nutraceutical and medicinal value. Every part of *bael* tree is used in one way or the other. During recent years, its importance has been highlighted in north India but, adequate attempts have not been made for its exploitation in Western India. A study keeping this fact in view was carried out to evaluate the *bael* genotypes for their growth behaviour and floral traits at Experimental Farm of Central Horticultural Experiment Station (CIAH), Vejalpur, Panchmahals, Gujarat during the years 2008 and 2010. Among the varieties evaluated for growth characters, plant height was recorded in CISH B-1, while plant spread, root stock and stem girth were recorded maximum in the variety NB-7. All the varieties exhibited significant difference with respect tofor most of the growth characters. Studies on floral biology revealed that the flower bud emergence started from 20th April and continued up to 23rd June, while anthesis initiated from 12th May and completed by last week of June. Bud length and width varied from 10.00 to13.00 mm and 7.00 to 9.50 mm while length and width of flower size ranged between 12.00 to 19.00 mm and 24.00 to 35.00 mm, respectively among the evaluated varieties. Number of petals in different varieties varied from 4 to 6 but majority of flowers showed only four petals. Stamen length varied from 7.00 mm (NB-7) to 9.00 mm (CISH B-2), whereas ovary length was recorded maximum in the genotype Pant Aparna (8.00 mm). Stigma length was recorded highest (3.50 mm) in the four varieties namely CISH B-2, Pant Aparna, NB-7 and NB-16, among the evaluated genotypes of *bael*. Pollen viability was observed more than 94 per cent in almost all the varieties.

Key words: *Bael*, varieties, variability, morphology, flower

Introduction

Bael (*Aegle marmelos* Correa) occupies an important place among the indigenous fruit of India not only because of its religious significance but also due to its high medicinal, nutritive values and ability to grow under harsh agro-climatic conditions. It is considered to be one of the richest sources of riboflavin and known to provide lots of minerals and vitamins to diet (Barthakur and Arnolds, 1989). Because of its hardy nature, *bael* can be grown successfully in wider range of habitats of arid, semi-arid to mesophytic conditions (Arya, 1986). Its cultivation can be done successfully in even alkaline and stony soils having pH range 5-10 (Jauhari and Singh, 1971; Ram and Singh, 2003; Srivastava and Singh, 2000; Pal and Mishra, 2005). In western India, a wide range of varieties of naturally grown trees is available contributing to wide genetic diversity in their morphology. In order to initiate any crop improvement programme, it would be imperative to generate information regarding growth and flowering behaviour as identification of suitable varieties has become necessary for promoting its productivity, production and quality of the produce under semi-arid tropics of western India. Keeping these points in view, attempts were made to evaluate the *bael* varieties for their growth pattern and floral biology under semi-arid ecosystem of western India.

Materials and Methods

An investigation was carried out on newly established block of *bael* genotypes collected from different institutes/universities and elite genotypes selected from diversity rich areas of country, which were planted at distance of 10 m x10 m in square system. The experiment was carried out using twelve varieties *viz.*, CISH B-1, CISH B-2, NB-5, NB-7, NB-9, NB16, NB-17, Pant Aparna, Pant Sujata, Pant Urvashi, Pant Shivani and Goma Yashi and studied for growth and flowering behaviour under semi-arid ecosystem. The experiment was led out in randomized block design with four replication considering two trees per unit. Annual extension of growth was recorded and data of both the year were pooled and subjected to statistical analysis. The period between emergence of first and last flower was considered as duration of flowering. The opening of 70-80% flowering was indicative of the tree in full bloom stage (peak period). Twelve shoots were randomly selected from four directions on each tree were tagged and detail observation was recorded on floral traits. The pollen viability percentage was carried out using 1% acetocarmin stain test (Johansen, 1940). Pollen that stained deeply and appearing normal and symmetrical was considered being viable.

*Corresponding author's email- aksbicar@gmail.com

Results and Discussion

The results of various observations for growth behaviour are presented in Table-1. A perusal of data collected from various varieties grown in semi-arid ecosystem of Gujarat revealed that the different genotypes varied widely in growth and flowering attributes. Results of the study on growth characters revealed that the different genotypes showed significant differences in their growth behavior under semi arid ecosystem of western India (Table 1). Plant height (53.50 cm) was recorded significantly maximum in the CISH B-1, while rootstock girth (5.00 cm), scion girth (3.40 cm) and plant spread (E-W-48.95 and N-S-43.40 cm) were recorded maximum in NB-7 whereas these parameters were recorded minimum in Goma Yashi (plant height-13.00 cm, rootstock girth-3.55cm, scion girth-2.42, E-W-34.95 and N-S- 34.40 cm). These findings are in consonance with results on *bael* as reported by Singh *et. al.* (2006a) and Singh ((1989).

Terminal and lateral leaf size was recorded maximum in NB-7. The terminal and lateral leaf length was recorded lowest in NB-9, while terminal and lateral leaf breadth was recorded lowest in Goma Yashi. As regards to floral characters, the earliest flower bud emergence took place in CISH B-1 (20 April), whereas it took maximum time in case of Pant Urvashi (8 May), where the flower bud emergence continued up to June. The earliest flowering was recorded in CISH B-1(12 May) and Goma Yashi (12 May) and it continued up to 24th June. The longest duration of flowering was recorded in NB-9, whereas the shortest duration of the same was observed in the variety Goma Yashi (Table-2). Similar trends with respect to bud and flower emergence were reported by Singh and Singh (2006) in *bael* and also in other crops like mango (Hoda *et. al.* 2003), *litchi, mahua* and *jamun* (Singh and Singh, 2005a). There were marked variations in flower size and bud size in most of the genotypes (Table-2). Variety CISH B-2 revealed maximum flower length (18.00mm) while width was the maximum in NB-7 (35.00 mm), whereas minimum flower length and width were recorded in Goma Yashi. Equal bud length and width (13.00 mm and 9.50 mm) was recorded in CISH B-2 and NB-7. The range of petal length and width was recorded in between11.00 to 19.00 mm and 7.00 to 10.00, respectively. Petal length (19.00mm) was recorded highest in NB-7 while petal width was the maximum with Pant Aparna. These results on *bael* are in agreement with findings by other workers also (Singh and Singh, 2006; Singh and Mishra, 2004). Mean values of floral traits showed wide range of variations *i.e.* pedicel length (4.00-10.50 mm) and width (2.00-2.50 mm), stamen length (6.75-9.00 mm), filament length (2.75-5.00 mm) and width (0.40-0.80 mm), anther length (3.50-4.00) and width (0.50-0.80 mm), ovary length (4.00 to 6.50 mm), width (3.00-5.00 mm), style length (1.00-1.50 mm) and width (1.50-2.50 mm), stigma length (2.00-3.50 mm), and stigma width (2.00-3.00 mm). Among the evaluated varieties, pedicel length was recorded maximum in NB-5, whereas petal width was 2.50 mm in NB-5, NB-7, NB-16, Pant Sujata and Pant Urvashi. Singh and Mishra (2004) and Singh *et. al.* (2006) evaluated different varieties of *bael* for growth and flowering behavior and recorded the variability in the floral traits in *bael* under conditions of north and western India, respectively. Variation in soil and genetic makeup might have caused the variability in the different genotypes. Earlier Das *et. al.* (2004) in case of litchi, Hoda *et. al.* (2003) and Singh (2002) in mango, Kausal *et. al.* (2001) in plum, McArtney *et. al.* (2001), McLaughlin *et. al.* (1991) in Apple, Singh and Singh (2006) in grapefruit and Singh *et. al.* (2004) in tamarind also observed the existence of such variation under different agro-climatic conditions. Similar trends in the variability in the underutilized fruits like, *khirni, jamun*, have also been reported by Singh *et. al.* (2006), Singh and Singh (2005) under semi-arid tropics of western India, respectively. Pollen viability was recorded more than 94 per cent in all the varieties. Pollen diameter ranged from 41.25-45.00 micron maximum being in NB-7 and Goma Yashi. More or less similar findings with respect to pollen viability have been reported in the various under exploited fruits including by Singh and Singh (2005) in *mahua*, Suranyi (1991) in apricot, Sharma and Bist (2003) in pomegranate, Thimmaraju *et. al.* (1997), Usha and Singh (1994) and Singh *et. al.*(2006) in tamarind. Thus, the present study corroborates their findings.

References

Arya, H. C. 1986. Clonal multiplication of tree species in the Thar Desert through tissue culture. *Forest Ecology and Management*, 16:201-208.

Barthakur, N. N. and Arnold, N. P. 1989. Certain organic and inorganic constituents in *bael* (*Aegle marmelos* Correa) fruits. *Trop. Agric.*, 3 (11): 10-14

Das, B., Nath, V. and Dey, P. 2004. Investigations on flushing and panicle emergence in litchi under sub-humid sub-tropical plateau region of eastern India. *Indian Journal of Horticulture*, 61: 1-5.

Hoda, M. N., Singh, S. and Singh, J. 2003. Evaluation of ecological groups of mango (*Mangifera indica* L) cultivars for flowering and fruiting under Bihar conditions. *Indian J. Agric. Sci.*, 73: 101-5.

Johansen, D. A. 1940. Plant micro technique. Mc Graw Hill Company, New York.

Jauhari, O. S. and Singh, R. D. 1971. *Bael*: valuable fruits. *Indian J. Hort.*, 948-53.

Kaushal, R. Parmar, R, Sharma, S.D. and Bist, H.S. 2004. Floral morphological and flowering studies in some plum and apricot cultivars. *Indian J. Hort.*, 61: 276-77.

McArtney, S. J., Hoover, E.M., Hirst, P.M. and Brooking, I. R. 2001. Seasonal variation in the onset and duration of flower development in Rayal Gala apple buds, *Journal of Horticultural Science and Biotechnology*, 76: 536-40.

McLaughlin, J. W. and Greene, D. W. 1991 a. Fruit and hormones influence flowering of apple. I. Effect of cultivar, *Journal of American Society for Horticultural Science*, 116: 446-9.

Pal, M. and Mishra, K. K. 2005. Effect of pollen on fruit set, fruit drop and final retention in self and cross-pollination in *bael* (*Aegle marmelos* Correa). *Indian J. Agric. Sci.*, 12: 800-4.

Ram, D. and Singh, I. S. 2000. Physio-chemical studies on *bael* (*Aegle marmelos* Correa) fruits. *Prog. Hort.*, 35 (2): 199-201.

Ray, P. K., Rani, R. and Singh, S. K. 2002. Sex ratio and fruit set pattern in 10 litchi cultivars. *Prog. Hort.*, 34: 17-21.

Sharma, Nirmal and Bist, H. S. 2003. Studies on pollen characters and pollination behaviour of pomegranate (*Punica granatum* L) cultivars under mid hills of Himachal Pradesh. *Haryana J. Hort. Sci.*, 32:11-140.

Singh, A.K. and Singh, S. 2005.Effect of urea and zinc on growth, yield and quality of grape fruit. *Annals of Agricultural Research*, 26 (4): 571-574.

Singh, R. D. 1989. Studies on *bael* (*Aegle marmelos* Correa) morphology of flower, anthesis, dehiscence and receptivity of stigma. *Prog. Hort*, 32: 15-24.

Singh, A.K., Singh Sanjay, Bagle, B.G. and Dhandar, D.G. 2006. Growth behaviuor of *bael* genotypes under semi-arid tropics of western India. National Symposium on Underutilized Horticultural Crops on 8th and 9th June at IIHR, Bangalore, pp-41.

Singh, A.K., Singh Sanjay, Apparao, V.V., D.T. Mesh ram, Bagle, B.G. and Dhandar, D.G. 2006a. Studies on floral biology of *bael* (*Aegle marmelos* Correa) under semi-arid ecosystem. National Symposium on Production, Utilization and export of underutilized Fruits with Commercial Potentialities, 22-24 November 2006,B.C.K.V.pp-31.

Singh, Sanjay, Singh, A. K., Bagle, B.G. and Dhandar, D.G. 2006. Reproductive biology of mahua (*Bassia latifolia*). National Symposium on Under-utilized Horticultural Crops on 8th and 9th June at IIHR, Bangalore, pp-60.

Singh, Sanjay, Singh, A.K., Joshi, H.K. Bagle, B.G. and Dhandar, D.G. 2006a. Genetic diversity in khirni (*Monilkara hexandra*) under sem-arid system of western India. National Symposium on Production, Utilization and Export of Underutilized Fruits with Commercial Potentialities, 22-24 November 2006, B.C.K.V. Kalyani. P.P-10.

Singh, S. 2002. Evaluation of mango genotypes for their flowering, fruiting and fruit quality attributes. *Prog. Hort.*, 34:240-243.

Singh, S.and Singh, A. K. 2005. Studies on genetic diversity in Mahua (*Bassia latifolia*) under semi arid ecosystem of Gujarat. *Indian J. Agric. Sci.*, 75: 519-23.

Singh, S. and Singh, A. K. 2005a. Genetic variability in Jamun (*Syzygium cumini*) in Gujarat. *Progressive Horticulture*, 37: 44-48.

Singh, S., Singh, A. K. and Appa Rao, V. V. 2004. Genetic divergence in tamarind under semi arid conditions of Gujarat. First Indian Horticulture congress, 6-9 November 2004 at IARI, Pusa, New Delhi pp-28.

Singh, S., Singh, A. K. and Appa Rao, V. V. 2006. Genetic diversity in chironji (*Buchanania lanzan*) under semi arid ecosystem of Gujarat. *Indian J. Agric. Sci.*, 76 (11): 659-8.

Singh, S., Singh, A. K. and Apparao, V. V. 2006. Performance of tamarind (*Tamarindus indica* L) under semi-arid condition of Gujarat. *The Hort. J.*, 1: 20-23.

Singh, S. K., Bist, L. D. and Patel, V. B. 2004. Flowering and flower biology in low chill pear cultivars. *Indian J. Hort.*, 61: 94 -96.

Sigh, V. P. and Mishra, K. K. 2004. Estimation of variability parameters for floral traits and yield in *bael* (*Aegle marmelos* Correa). *Prog. Hort.*, 2:253-58.

Srivastava, K. K. and Singh, H. K. 2000. Floral biology of *bael* (*Aegle marmelos*) cultivars. *Indian J. Agric. Sci.*, 70: 797-798.

Suranyi, D. 1991. Floral morphological characteristic of Hungarian apricot varieties. *Acta Horticulture*, 293: 303-310.

Thimmaraju, K. R., Narayana Reddy M. A., Swamy, N. and Sulladmath U. V. 1997. Studies on floral biology of tamarind (*Tamarindus indica* L). *Mysore J. Agric. Sci.* 11: 293-298.

Usha, K. and Singh, B. 1994. Selection of tamarind tree types for higher yield. *Crop Improvement*, 23: 199-202.