



Effect of rootstocks on growth, yield and fruit quality attributes of sweet orange (*Citrus sinensis*) cv. Sathgudi

Sanjay Singh, A. K. Singh, D. S. Mishra and V. V. Appa Rao
Central Horticultural Experiment Station (ICAR-CIAH), Vejalpur-389340, Godhra, Gujarat
(Received : 22.07.2018, Accepted : 21.09.2018)

Abstract

The plant growth, yield and fruit quality attributes of 'Sathgudi' sweet orange (*Citrus sinensis* (L.) Osbeck) on four rootstocks were evaluated under semi-arid conditions of central Gujarat at Central Horticultural Experiment Station (ICAR-CIAH, Bikaner), Godhra during the year 2016-2017 and 2017-2018. Results showed that various rootstocks had significant effect on growth, yield, fruit weight and quality of Sathgudi sweet orange. The highest plant height (1.50 m), root stock girth (17.20 cm), scion girth (16.30 cm), plant spread (1.40 m & 1.35 m) and tree volume (1.48 m³) were observed with Rangpur lime rootstock closely followed by rough lemon. The fruit weight and yield were also affected by different rootstocks. Trees on 'Carrizzo' citrange had lower fruit weight and yield than those budded on to the other rootstocks. Significantly, the maximum fruit weight (170.20 g), yield (8.5 kg/plant), juice percent (42.12 %), TSS (12.0 °Brix), TSS and acid ratio (8.95), total sugar (5.70%) and vitamin C (58.90 mg/100g) were found in Sathgudi trees budded on to Rangpur lime.

Key words: Orange, rootstock, growth, yield, quality

Introduction

Sweet orange cv. Sathgudi is successfully cultivated in the semi-arid tracts of the Indian subcontinent. It is popular amongst growers in semi-arid regions of country owing to its higher yield potential and consumer's preference. India's citrus production has reached to approximately 12.75 mt in 2017 from an area of 1.06 mha out of which sweet orange contribution in production is 3.48 mt from an area of 0.209 mha. (Anon., 2017). Various kinds of rootstocks used in citrus production played substantial role in the development of the citrus industry in the world (Yildiz *et al.*, 2013). Rootstock is used beneficially for solving both limiting and restricting factors of citrus production (soil, climate and pests, etc.) and conditioning the market demands on productivity, short juvenility period and high-fruit quality. Further, factors like cultivar characteristics, rootstocks employed, growing conditions orchard management, type of flowers and the fruit drops can affect citrus cultivars yield and quality attributes (Demirkeser *et al.*, 2003, Parameshwar *et al.*, 2018). The use of particular type of rootstock can influence different aspects of tree growth and development, including yield, fruit quality and tolerance to stress caused by biotic and abiotic factors (Filho *et al.*, 2007). The main rootstock in India for citrus production is rough lemon or Jatti khatti (*Citrus jambhiri* Lush.) which can be considered as an ideal rootstock for all set of agro-climatic conditions (Kumar *et al.*, 2017). It is now well known fact that the genotypic differences of rootstocks may modify growth, yield and fruit quality attributes. The present study was aimed to assess the effect of different rootstocks on sweet orange cv. Sathgudi tree growth, yield and quality under

semi-arid conditions of central Gujarat.

Materials and Methods

The present work was carried out during 2016-2017 and 2017-2018 at Central Horticultural Experiment Station (ICAR-CIAH), Vejalpur, Godhra. Plant materials for the experiment consisted of sweet orange cultivar budded on four rootstocks, viz., rough lemon (*Citrus jambhiri* Lush.), Rangpur lime (*Citrus limonia* [L.] Osb.), Carrizo citrange (*Citrus sinensis* [L.] Osb. × *Poncirus trifoliata* [L.] Raf.) and Cleopatra mandarin (*Citrus reshni* Hort. ex Tan.). The budded plants were planted during the year 2012. The experiment was laid out in Randomized Block Design with 4 treatments and 5 replications. Plant growth in terms of plant height (m), root stock girth (cm), scion girth (cm), plant spread (m) and tree volume (m³) were recorded. Plant height was determined by measuring the distance from the ground to the top of the plant with the help of measuring tape. Plant spread in North-South and East-West directions was recorded with the help of measuring tape and tree volume (V) was determined as per formula suggested by Roose *et al.*, (1986) and recorded in cubic meter. Scion girth was taken at fixed height 10 cm above the graft union and root stock girth at 10 cm below the graft union. The positions were marked with paint for taking observations. All plants were given the uniform cultural practices. The data on fruit yield (kg/tree) and physico-chemical characters were recorded using standard procedures. From each treatment, fruits were randomly selected from all the directions for recording the data and brought to the laboratory of Central Horticultural Experiment Station,

Vejalpur, Panchmahal (Godhra), Gujarat. TSS of fruits was measured with the help of hand refractrometer while titratable acidity, ascorbic acid, and total sugars were determined by AOAC (1990) methods. The data were statistically analyzed as per method of Gomez and Gomez (1984).

Results and discussion

Different rootstocks significantly influenced the various growth parameters of Sathgudi sweet orange (Table 1). Sathgudi on Rangpur lime rootstock produced vigorous plant with the maximum plant height (1.50 m), root stock girth (17.20 cm), scion girth (16.30 cm) plant spread in E-W (1.40 m) and N-S directions (1.35 m) and tree volume (1.48 m³) followed by rough lemon (1.35 m, 16.32 cm, 15.60 cm, E-W 1.30 m, N-S 1.28 m and 1.18 m³) for these parameters. The minimum plant height (1.10 m), root stock girth (14.20 cm), scion girth (14.0 cm) plant spread in E-W (1.13 m) and N-S directions (1.0 m) and tree volume (0.65 m³) were recorded on Cleopatra mandarin rootstock. The findings of the present study clearly demonstrated the differential growth response of the rootstocks on the scion variety which might be due to the inherent genetic potential of the rootstocks. Results of the study showed that Rangpur lime followed by rough lemon showed its superiority in terms of plant height, spread tree volume of Sathgudi sweet orange over other rootstocks, thus indicating their well adapted nature to soil conditions with efficient root system that might have resulted in higher accumulation of nutrients (Kumar *et al.*, 2017). Variation in growth parameters of sweet orange due to use of various rootstocks have also been reported earlier by Yildiz *et al.* (2013) and Ghosh *et al.* (2012).

Significantly, the maximum fruit weight (170.20 g), fruit yield (8.5 kg/plant) and juice content (42.12 %) were observed with Rangpur lime rootstock followed by Rough lemon (160.50 g, 7.20 kg/plant and 38.0 % respectively). While the minimum fruit weight (152.10 g), yield per tree (5.20 kg) and juice content (36.0 %) were found with Cleopatra mandarin (Table 2). Degree of yield expression of a scion cultivar, budded on specific rootstock is considered as one of the indicators for rootstock-scion combination for a particular agro-climatic condition. Higher yield along with other yield attributing characters of sweet orange on Rangpur lime rootstock was reported by Mustafa and Reddy (1990) under Bangalore and Ghosh *et al.* (2012) under West Bengal conditions. Grace *et al.* (2005) recorded maximum weight, size and Juice percentage in Sathgudi sweet orange fruits on Rangpur lime rootstock in Tirupati (Andhra Pradesh) conditions. Further, fruit chemical quality characters were also significantly affected by various rootstocks used (Table 2). In respect of chemical quality parameters of fruit, significant improvements have been observed in TSS (12.0 °Brix), TSS acid ratio (8.95), total sugar (5.70%) and vitamin C (58.90 mg/100g) in Sathgudi trees budded on to Rangpur lime while the minimum TSS (11.0 °Brix), acidity (1.44 %), TSS acid ratio (7.63), total sugar (5.10%) and vitamin C (48.10 mg/100g) were recorded in Sathgudi orange on Cleopatra mandarin. These results are in agreement with Ghosh *et al.* (2012) and Grace *et al.* (2005).

In conclusion, Rangpur lime may be adopted as Rootstock for sweet orange cv. Sathgudi under the semi arid conditions of central Gujarat to increase yield with improved fruit quality attributes.

Table 1. Effect of rootstocks on growth, yield and fruit quality attributes of sweet orange cv. Sathgudi

Treatments	Plant height (m)	Root sock girth (cm)	Scion girth (cm)	Plant spread		Tree volume (m ³)
				E-W (m)	N-S (m)	
Rangpur lime	1.50	17.20	16.30	1.40	1.35	1.48
Rough lemon	1.35	16.32	15.60	1.30	1.28	1.18
Cleopatra mandarin	1.20	16.00	15.50	1.15	1.10	0.80
Carizzo Citrange	1.10	14.20	14.00	1.13	1.00	0.65
CD(P=0.05)	0.11	0.09	0.10	0.12	0.11	0.27

Table 2. Effect of rootstocks on fruit yield and fruit quality attributes of sweet orange cv. Sathgudi

Treatments	Yield (kg/plant)	Fruit weight (g)	Juice (%)	TSS (°Brix)	Acidity (%)	TSS and acid ratio	Total sugar (%)	Vitamin C (mg/100g)
Rangpur lime	8.50	170.20	42.12	12.00	1.34	8.95	5.70	58.90
Rough lemon	7.20	160.50	38.00	11.20	1.42	7.88	5.50	51.20
Cleopatra mandarin	6.20	155.15	37.12	11.10	1.43	7.76	5.40	50.12
Carizzo Citrange	5.20	152.10	36.00	11.00	1.44	7.63	5.10	48.10
CD(P=0.05)	0.98	2.31	1.11	0.13	0.03	0.07	0.12	0.48

References

- Anonymous. 2017. Horticultural Statistics at a Glance 2017. Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India, Krishi Bhavan, New Delhi. pp. 15.
- AOAC. 1990. Official methods of analysis. 17th edn. Association of Official Analytical Chemists, Washington DC, USA.
- Demirkeser, T. H., Eti, S. and Kaplankiran, M. 2003. The effects of GA₃ and BA treatments on fruit set and quality on Nova mandarin in Turkish with an English summary (p. 181-184 IV National Symposium on Horticulture) Tr (Antalya Turkey. 8-12 September. Akdeniz University Antalya, Turkey.
- Filho, F.A.A.M., Espinoza-Núñez, E., Stuchi, E.S. and Ortega, E.M.M. 2007. Plant growth, yield, and fruit quality of 'Fallglo' and 'Sunburst' mandarins on four rootstocks. *Sci. Hortic.*, 114:45-49.
- Ghosh, S.N., Bera, B. and Roy, S. 2012. Effect of rootstocks on performance of mosambi sweet orange under irrigated condition in laterite soil of west Bengal. *India. J. Crop & Weed*, 8(2):50-52.
- Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedure for Agricultural Research, 2nd edn., John Wiley and Sons Inc., New York.
- Grace, K., Ranganayakulu, J. C. and Seshadri, K.V. 2005. Effect of rootstocks on the fruit quality of, Sathgudi sweet orange grown on different rootstock. *Ind. J. Hort.*, 62:300-302.
- Kumar, S., Awasthi, O.P., Dubey, A.K. and Sharma, R.M. 2017. Effect of different rootstocks on growth, leaf sclerophylly and chlorophyll fractions of Kinnow mandarin. *Indian J. Hort.*, 74(4):505-509.
- Mustafa, M.M. and Reddy, B.M.C. 1990. Effect of rootstocks on growth, yield and quality of mosambi sweet orange. *Crop Res.*, 3:234-240.
- Parameshwar, P., Joshi, P.S. and Nagre, P.K. 2018. Effect of Rootstock on Plant Growth and Fruit Quality of Sweet Orange (*Citrus sinensis* var. Valencia late). *Int.J.Curr.Microbiol. App. Sci.*, 7(4): 1685-1689.
- Roose, M.L., Cole, D.A., Atkin, D. and Kuper, R.S. 1986. Yield and tree size of four citrus cultivars on 21 root stocks in California. *J. Amer. Soc. Hort. Sci.*, 114: 135-140.
- Yildiz, E., Demirkeser, T.H. and Kaplankiran, M. 2013. Growth, yield, and fruit quality of 'Rhode Red Valencia' and 'Valencia Late' sweet oranges grown on three rootstocks in eastern Mediterranean. *Chilean J. Agric. Res.*, 73(2):142-146.