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Rootstock Effect on Growth and Fruit Quality of Sweet Orange var Valencia Late

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ABSTRACT

Effect of citrus rootstock Rough lemon (*C. limon* Linn. Burn *Citrus jemberi*) on plant growth and fruit quality of sweet orange varieties like Pera, Pine apple, Jaffa, Washington novel, Hamlin, Valencia late, Sathgudi and Blood red malta evaluated at All India Coordinated Research Project on Tropical Fruits (Citrus), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola 2012-13. Budded plants of Valencia late orange on rootstock were grown in medium, well drained and maintained free from weeds and the physical and chemical properties of soil are as suitable. Results showed that rootstock had significant effect on growth and development as well as fruit quality of Valencia late. Highest Plant height (4.42 m), Plant mean spread (4.17 m) and Plant volume (40.31m^3) was recorded on Rough lemon rootstock. Rootstock types had significant effect on highest number of fruits per plant (232.76), number of kg per plant (32.75) as well as fruit quality like highest juice percentage (53.15), TSS (12.56 brix), Acidity (1.01%) and Ascorbic acid (57.86 mg/100 ml juice) were budded on rough lemon rootstock.

Keywords Citrus, Rough lemon, Root stock, Valencia late, Number of fruits.

INTRODUCTION

Rootstock type has important role in quantity and quality of growth and development and crop production in citrus and rootstock not only plays vital roles in improving the resistance to biotic and abiotic stresses of the plants by (Hippler *et al.* 2016), (Hussain *et al*. 2018), but also affects the size of canopy, fruit yield and quality (Emmanouilidou and Kyriacou 2017). Citrus rootstocks differ in compatibility to kinds of soils, manner of root dispersion and affiliation to micorhyza. This object leads to difference in leaf mineral elements concentration or leaf of budded cultivars on them and finally affect vegetative growth and fruit quantity and quality. 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). 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). In a budded tree, rootstock type

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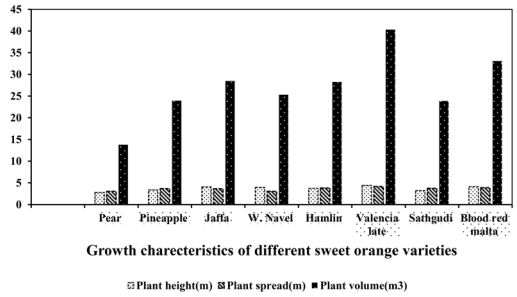

Fig. 1. Growth performance of different sweet orange varieties.

affects many scion properties such as plant height, plant spread and plant volume. Highest number of fruits per plant, number of kg per plant as well as fruit quality like highest juice percentage, TSS, Acidity and Ascorbic acid observed in Valencia late. Valencia orange is the most important late ripening sweet orange in the world, which has good compatibility with warm region. This cultivar is commercial and its fruit has good marketable and fruit permanency on tree is excellent. Somewhat is resistant to cold and drought and in due to proper compatibility. Attentive to budding propagation and using of different rootstocks for this cultivar and non-existence of sufficient information on interaction between it and rootstock type, aim of this investigation was the effect of rootstock type on growth and fruit quality of Valencia orange in Akola condition.

Table 1. Growth characteristics and yield of different sweet orange varieties.

Variety	Plant height (m)	Plant spread (m)	Plant volume (m^3)	No. of fruit/ plant	Fruit yield (kg/ plant)
Pear	2.81	3.06	13.81	62.83	10.09
Pineapple	3.37	3.68	23.95	76.40	12.73
Jaffa	4.07	3.65	28.47	131.72	16.47
W. Navel	3.94	3.05	25.32	163.61	20.19
Hamlin	3.74	3.80	28.25	145.15	20.98
Valencia late	4.42	4.17	40.31	232.76	32.75
Sathgudi	3.23	3.76	23.88	220.00	29.32
Blood red malta	4.15	3.90	33.07	186.85	23.35
SEm (±)	0.17	0.08	0.77	4.38	0.93
CD at 5%	0.54	0.24	2.32	13.24	2.83

MATERIALS AND METHODS

Eight sweet orange varieties viz. Pera, Pineapple, Jaffa, Washington navel, Hamlin, Valencia late, Sathgudi and Blood red malta were selected for study. The studies were conducted at All India Coordinated Research Project on Tropical Fruits (Citrus), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola 2012-13. All the trees were of same age (12 years) raised on Rough Lemon (*C. limon* Linn. Burn). Experiment was laid out in RBD with three replications. The plants were protected against attack of insects, pests and diseases. Considering maturity time, fruits of different varieties were harvested at different times. Physico-chemical analysis of fruit of these varieties was carried out in the laboratory. All plants were given the standard cultural practices. The plants were watered by Drip system. NPK @ 1500-750- 500 g along with 60 kg FYM per plant were applied during study period. Nitrogen was applied in three split doses i.e. before flowering, at pea stage and during August, 2012-13. The height of the plant was measured in meters from ground level to tip of the plant by marked bamboo. The spread of tree was recorded by measuring maximum spread in North-South and East-West directions in meters with the help of marked bamboo calculated mean spread of plant in Ambia. The plant volume of selected plants was computing using formula suggest-

Table 2. Bio-Chemical composition of different varieties of sweet orange.

Variety	Juice percentage (%)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/ 100 ml juice)
Pera	25.34	8.20	1.07	51.81
Pineapple	21.42	9.00	0.96	46.61
Jaffa	37.00	9.37	0.72	51.10
W. Navel	36.48	9.65	0.62	51.36
Hamlin	42.58	10.26	0.61	53.02
Valencia late	53.13	12.10	1.01	57.86
Sathgudi	38.67	11.10	0.51	51.50
Blood red malta	35.23	9.66	0.84	54.04
SE (m)	0.60	0.29	0.06	1.48
CD at 5%	1.83	0.88	0.20	4.46

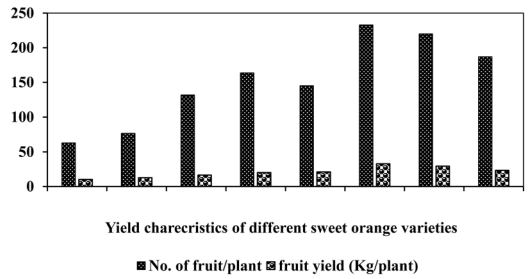

Fig. 2. Yield performance of different sweet orange varieties.

ed (Roose *et al*. 1986) and recorded in cubic meter
Plant volume (V) = $4/6 \times \pi \times h \times r^2$
Where,
H = height of plant,

$$R = \frac{\text{Sum of E-W and S-N direction (m)}}{4}$$

E-W = East-West, N-S= North -South

The TSS was measured by digital refractometer and the percentage of acidity was determined by an anhydrous citric acid by nitrogen the dilute juice against 0.1N sodium hydroxide by using phenolphthalein indicator.

Formula : 1 ml of 0.1 N NaOH = 0.0064 g of citric acid was employed.

Ascorbic acid present in fruit from each treatment was estimated in milligrams of ascorbic acid /100 ml of fruit juice. One ml of fruit juice taken and blended with 3 percent meta phosphoric acid (HPO_3) and volume was made to 100 ml with HPO_3.The contents after shaking well were filtered with What man No.1 filter paper. Ten ml of the filtrate was titrated against dye solution of 2,6-dichlorophenol till light color persisted for at least 15 seconds. The titration values were put the following formula to calculate ascorbic acid content.

$$\text{Vitamin C (mg/100 g)} = \frac{e \times d \times b}{c \times a} \times 100$$

$$\text{Dye factor (d)} = \frac{0.5}{\text{Average burette reading for Standardization of dye solution.}}$$

Where,
a = weight of sample
b = volume made with meta phosphoric acid
c = volume of aliquot taken for estimation
d = dye factor
e = average burette reading for sample.

RESULTS AND DISCUSSION

Maximum height (4.42 m) was attained by Valencia late (Table 1 and Fig. 1) while Pera attained the lowest height (2.81 m). The highest spreading variety Valencia late (4.17 m) whereas the least spreading variety was Pera (3.06 m) variety. Maximum plant volume was observed in variety Valencia late (40.31 m^3) followed by Blood red malta (33.07 m) whereas the variety Pera recorded the minimum tree volume (13.81 m^3). This may due to the formation of bottleneck type bud union configuration, which might have restricted the movement of nutrient to the scion and rather accumulation of higher amount of food material through photosynthesis in the stock and also these differences may be different potential of each variety. Zheng *et al.* (2010) reported that Carrizo and trifoliate orange (Rich 16-6) demonstrated significant effects on growth of tree, fruit yield and quality of Hamlin sweet orange (*C. sinensis*) and Gaona-Ponce *et al.* (2018) found that the xylem vessels with greater area, lower density, greater fiber length and xylem radiuses contributed to the vigorous growth of Tahiti lime on Sour orange and Volkamer rootstocks. Significantly maximum number of fruits per plant (Fig. 2) was recorded in variety Valencia late (232.76) which at par with variety Sathgudi (120). The minimum no. of fruits per plant was recorded for variety Pera (62.83). While the minimum fruit yield per tree was found in variety Pera (10.09 kg/plant). The probable reason for obtaining higher yield in Valencia late variety is that due to more fruit set percentage and by adapting good cultural and management practices along with highest photosynthesis assimilates and storage food

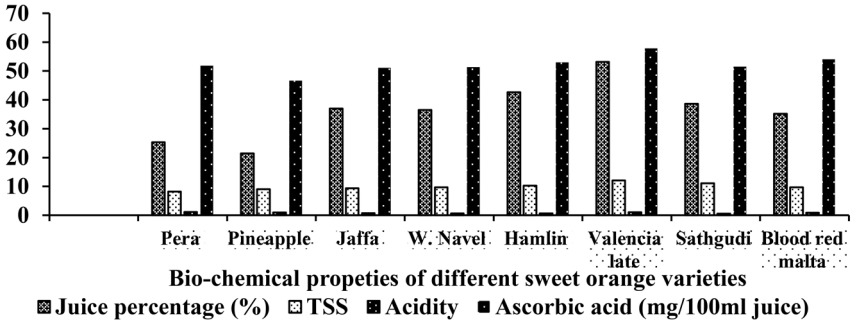

Fig. 3. Fruit quality parameters of different sweet orange varieties.

material leads to maximum fruit yield per plant. Cantuarias-Aviles *et al.* (2011) also reported that the cumulative yield of Folha Murcha sweet orange on dwarfing trifoliate Flying Dragon was significantly lower than that on both Swingle citrumelo and Carrizo citrange, but the yield efficiency was much higher.

Valencia late showed maximum juice percentage (53.13) followed by Hamlin (42.58), Sathgudi (38.67) and jaffa (37.00). The results further showed (Table 2 and Fig. 3) that maximum TSS (12.1°Brix) was also recorded in Valencia Late while Sathgudi, Hamlin and Blood Red malta showed the average TSS of 11.10, 10.26 and 9.66, respectively. Minimum TSS (8.2 °Brix) was recorded in Pera. Maximum acidity (1.07 %) was recorded in Pera against minimum in Sathgudi (0.51%). Liu *et al.* (2016) also suggested that the content of both TSS and sugar on trifoliate orange was higher than those on Canton lemon rootstock, and the activities of sucrose synthase was also higher. In citrus fruits, the acidity increases during development reaching levels below optimal for enzymatic activity Significant variation was observed in ascorbic acid content of sweet orange fruit of different varieties. Significantly maximum ascorbic acid (57.86 mg/100 ml) was found in variety Valencia late which at par with variety Blood red malta (54.04 mg/100 ml). The minimum ascorbic acid content was recorded in variety Pineapple (46.61 mg/100 ml). The increase in ascorbic acid was associated with rapid increase in total sugar as the fruit synthesizes ascorbic acid from hexose sugar precursors. The respiration rate decreased with increasing maturity of fruit. Chun *et al.* (2010) compared the fruit quality of Jincheng sweet orange on 11 different rootstocks and found that Sunchusha mandarin (*C. reticulata*), Carrizo citrange and C35 (*C. sinensis*×*P. trifoliata*) were the best rootstocks.

REFERENCES

Cantuarias-Aviles T, de Filho FAAM, Stuchi ES, da Silva SR, Espinoza-Nunez E (2011) Horticultural performance of 'Folha Murcha' sweet orange onto twelve rootstocks. *Scientia Hortic* 129 : 259—265.

Chun CP, Peng L Z, Lei T, Tang HT, Cai L, Jiang CL, Ling LL (2010) Effects of rootstocks on fruit quality of 'Jincheng' sweet orange. *Acta Hortic Sinica* 37 : 991—996.

Emmanouilidou MG, Kyriacou MC (2017) Rootstock-modulated yield performance, fruit maturation and phyto-chemical quality of 'Lane Late' and 'Delta'sweet orange. *Sci Hortic* 225 : 112—121.

Gaona-Ponce M, Almaguer-Vargas G, Barrientos-Priego AF (2018) Relationship of rootstock xylem anatomy with the initial growth of 'Tahiti' lime (Citrus. latifolia Tanaka ex Q. Jiménez). Revista Chapingo Serie Ciencias Forestales y del Ambiente 24 : 359—370.

Hippler FWR, Cipriano DO, Boaretto RM, Quaggio JA, Gaziola SA, Azevedo RA, Mattos Jr D (2016) Citrus rootstocks regulate the nutritional status and antioxidant system of trees under copper stress. *Environ Experim Bot* 130 : 42—52.

Hussain S, Khalid M F, Saqib M, Ahmad S, Zafar W, Rao MJ, Morillon R, Anjum MA (2018) Drought tolerance in citrus rootstocks is associated with better antioxidant defense mechanism. *Acta Physiologiae Plantarum* 40 : 135.

Kumar S, Awasthi OP, Dubey A K, Sharma RM (2017) Effect of different rootstocks on growth, leaf sclerophylly and chlorophyll fractions of Kinnow mandarin. *Ind J Hort* 74 (4) : 505—509.

Liu Z, Hong LW, Li J, Chen JZ, Luo XY, Qin Y (2016) Effects of different rootstocks on fruit quality of 'Shatangju' mandarin. *Guangdong Agricult Sci* 43 : 39—44.

Roose ML, Cole DA, Atkin D, Kuper RS (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 TH, 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.

Zheng YQ, Deng L, He SL, Zhou ZQ, Yi SL, Mao SS, Zhao XY (2010) Effects of seven rootstocks on tree growth, yield and fruit quality of 'Hamlin' sweet orange in South China. *Acta Hortic Sinica* 37 : 532—538.