



## VEGETATIVE GROWTH AND FRUIT CHARACTER RESPONSE BY OLINDA ORANGE BUDDED WITH DIFFERENT TRIFOLIATE ROOTSTOCKS

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Received: February 16, 2016; Revised: April 20, 2016; Accepted: April 21, 2016

**Abstract-** Vegetative growth along with fruit characters of Olinda orange (*Citrus sinensis*) budded with three different trifoliate rootstocks were studied at Punjab Agricultural University's-Fruit Research Station, Jallowal. Tallest Olinda plants were recorded on C-32 citrange while Swingle citrumelo contributed for highest dwarfing effect. This rootstock also registered for lowest North-South and East-West spread among all the rootstocks under study. The stock circumference recorded in Rubidoux trifoliate was found to be highest while Swingle citrumelo registered lowest level of this parameter. Heaviest fruits among all the combinations were observed in plants budded on C-32 citrange, though its variation with the other two rootstocks was non-significant. Larger fruits in term of diameter and length were recorded in case of C-32 citrange, while smallest were in Swingle citrumelo. C-32 citrange rootstock also contributed for higher percent juice recovery. Swingle citrumelo contributed for highest TSS and lowest acidity in Olinda fruits but all the three rootstocks lacked significant variation in both these biochemical parameters.

**Keywords-** Olinda Valencia, Rootstock, Swingle citrumelo, C-32 citrange and Rubidoux trifoliate.

**Citation:** Chahal T.S., et al., (2016) Vegetative Growth and Fruit Character Response by Olinda Orange Budded with Different Trifoliate Rootstocks. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 24, pp.-1485-1487.

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### Introduction

Globally, citrus is grown at commercial level in more than 50 countries of sub-tropical and tropical regions with total production of 115.52 million tonnes. India is the fourth largest producer of citrus but its average productivity is just 9.69 tonnes/ha. Even with such a low productivity, area expansion has been recorded at an annual rate of 10.3% from 1992-93 to 2013-14 [1].

Citrus acreage in Punjab state is more than 50,000 hectares. Kinnow, a hybrid between King and Willow Leaf mandarin contributes to more than 90 percent of this area and production [2] and is thereby dominant fruit crop of the state. This mandarin cultivar is the choicest crop among the citrus growers of the region owing to the facts that it is a precocious bearer with high productivity. However, large plantation brought under this fruit crop is posing serious handling problems as its harvesting is confined to a limited period ranging from mid-January to mid-February. Therefore, market glut due to monopoly of Kinnow cultivation is a serious problem commonly faced by the fruit growers of the area and it engages attention of horticulturists to introduce and evaluate new citrus cultivars in the region. Therefore, studies were initiated to evaluate performance of Olinda Valencia, an exotic sweet orange cultivar introduced from USA in 2003.

An ideal citrus cultivar must have potential to adapt in different environmental circumstances, suitable plant canopy with high yielding and superior fruit production. Similarly, a suitable rootstock must be compatible to scion cultivar, have ability to acclimatize in different soil and climatic conditions and be tolerant to biotic and abiotic stresses. Performance of a scion cultivar highly dependent on the rootstock type, therefore its evaluation must be done on diverse stocks to workout appropriate stoic combination for the region. Adoption of rootstock recommendations of one part of the world in other part without their evaluation under local conditions is not advisable due to variation in climatic conditions and local cultural practices. Region specific studies of rootstocks help in selecting

appropriate stock for a particular cultivar under typical climatic and edaphic conditions. Keeping this in view, study was planned and carried out at Punjab Agricultural University's, Fruit Research Station, Jallowal to determine the horticultural adaptability and performance of sweet orange cultivar 'Olinda Valencia' on three different globally commercial rootstocks under North-Western Indian conditions.

### Materials and Methods

The study to evaluate performance of Olinda Valencia on three different rootstocks was conducted at Punjab Agricultural University, Fruit Research Station, Jallowal, Jalandhar (India) during 2014. The station is located under the central fruit zone of Punjab and represent typical sub-tropical climatic conditions with Latitude, 31° 29' 38" N and Longitude, 75° 37' 40" E. The region experiences mean highest temperature of 40.75°C and mean lowest temperature of 5.15°C with annual average rainfall of 701 mm [3].

Plants of sweet orange variety, Olinda Valencia budded on three different rootstocks, Swingle citrumelo, C-32 citrange and Rubydoux trifoliate were imported from USA in 2003 and plantation was done with row to row distance of 25 feet and plant to plant distance of 15 feet at Fruit Research Station, Jallowal.

These different stock-scion combinations were studied for vegetative growth and fruit quality characters. The data for different characters was recorded during the year 2014. Plant height was measured using collapsible PVC pole, calibrated in feet and inches. Tree spread was recorded in term of east-west and north-south canopy diameters. Scion and stock circumference were measured with the help of measuring tape, just above and below the bud union.

For studying physico-chemical parameters of the fruits, random samples of 20 fruits of same colour and uniform size were harvested at optimum maturity and were immediately subjected to analysis in the laboratory. Electronic balance was

used to work out fruit weight. Juice was extracted using citrus juice extractor and expressed in percentage (%). Total soluble solids were recorded using digital hand held Refractometer (Atago, Japan). The fruit acid content was determined by juice titration against sodium hydroxide (0.1 N) and indicator used was phenolphthalein. Data were analyzed statically through ANOVA and the variations between the averages were computed for impact at  $p < 0.05$  by LSD test through SAS (Statistical Analysis System) software type 9.3 (SAS Institute Inc., Cary, NC, USA) at 5% level of probability. Mean and standard errors of each sample were calculated for statistical comparison.

## Result and Discussion

**Vegetative growth characters:** The data regarding effect of rootstocks on plant height, given in [Table-1] reveals that plants of Olinda Valencia budded on C-32 citrange were tallest among all the combinations. They registered non-significant variation with Rubidoux trifoliate, which showed next best level of this parameter. Plants on both these rootstocks showed significantly higher height than those budded on Swingle citrumelo. [4] reported non-significant variation in height of Nova mandarin budded on different trifoliate rootstocks like Carrizo, Troyer and Yuma. Similar, results of these rootstocks for Clementine mandarin were also recorded by him in 2002 [5].

The data given in [Table-1] clearly shows that plants of Olinda Valencia recorded

highest east-west spread when budded on Rubidoux trifoliate. Plants on C-32 citrange registered next level for this parameter while Swingle citrumelo resulted into lowest spread in this direction. All the rootstocks registered significant variation with each other. Infinitesimal variation in north-south spread was observed between Olinda Valencia plants with C-32 citrange and Rubidoux trifoliate as rootstocks. Both these stocks induced significant effect on this parameter in comparison to Swingle citrumelo, which recorded lowest north-south spread. Studies by [4] discovered significant variation in canopy diameter of Nova mandarin plants respectively during in their trials on different rootstocks.

Statistical variation lacked significance for scion circumference among plants budded of different rootstocks evaluated during this trial [Table-1]. Highest value of this parameter was recorded in Olinda Valencia plants propagated on Rubidoux trifoliate followed by Swingle citrumelo. Plants on C-32 rootstock recorded lowest level of scion circumference. [6] while working on various stoinic combinations registered significant variation in increment of scion girth in kinnow mandarin as affected by different rootstocks. The records relating to stock circumference divulges that highest level of this factor was recorded in stoinic combination of Olinda Valencia and Rubidoux trifoliate while plants on C-32 citrange were the next to follow. However, plants on Swingle citrumelo recorded lowest level of this factor. Significant deviation was observed between Rubidoux trifoliate and Swingle citrumelo.

**Table-1** Influence of different trifoliate rootstocks on plant growth in Olinda Valencia

Rootstock	Plant height (m)	Plant spread (m)		Scion Circumference (cm)	Stock Circumference (cm)
		EW	NS		
Swingle citrumelo	3.47b	4.04c	4.23b	53.8a	67.1b
C-32 citrange	4.02a	4.57b	4.69a	50.8a	78.2ab
Rubidoux trifoliate	3.98a	5.00a	4.67a	56.7a	88.3a

**Physical characters of fruits:** The data in [Table-2], concerning impact of rootstocks on fruit weight of Olinda Valencia reveal that fruits from plants propagated on C-32 citrange were the heaviest while those from plants budded on Swingle citrumelo were next to follow. Fruits from plants budded on Rubidoux trifoliate were the lightest. Statistically fruit weight of all the combinations was at par with each other.

The data regarding fruit size is given in [Table-2]. Fruits from plants with C-32 citrange rootstock showed highest diameter. Rubidoux trifoliate and Swingle citrumelo recorded non-significant variation between each other but were significantly lower than C-32 citrange. Observations regarding variation in fruit diameter with different rootstocks were also made by [7] during their study on Navelate orange. The data in [Table-2] regarding fruit length shows similar trend as fruit diameter. Fruits from plants budded on C-32 citrange produced highest fruit length, followed by Rubidoux trifoliate but the variation between the two was non-significant. Lowest fruit length was registered in case of Swingle citrumelo.

Higher percent juice recovery was recorded in Olinda Valencia fruits from plants budded on C-32 citrange in comparison to those from plants budded on Swingle

citrumelo and Rubidoux trifoliate. However, the variation between C-32 citrange and Swingle citrumelo, the next best rootstock in producing fruits with higher juice percentage was non-significant. Rubidoux trifoliate registered minimum level of this parameter and was significantly lower than the other two rootstocks. [8] while studying long term performance of Ellendale mandarin found significant effect of Troyer on fruit juice percentage in comparison to Mazol and Lockyer, while its effect was statistically at par with Carrizo, Joppa, Parramatta and Emperor. Peel thickness was highest in fruits from plants budded on C-32 citrange. It was non-significantly higher than the next level attained by Swingle citrumelo. Rubidoux trifoliate contributed for thinnest peel in Olinda Valencia plants. The effect of rootstock on the seed number of Olinda Valencia fruits was compiled in [Table-2], which showed non-significant variation among all the combinations. Fruits from plants budded on Swingle citrumelo produced highest seed number while those from plants on C-32 citrange were next to follow. Plants propagated on Rubidoux trifoliate registered lowest seed number. [4] however observed significant effect of rootstocks on seed number per fruit in 'Nova' mandarin.

**Table-2** Influence of different trifoliate rootstocks on physical characters of Olinda Valencia fruits

Rootstock	Fruit Weight(gm)	Fruit Size (cm)		Fruit Juice (%)	Peel Thickness (mm)	Seed Number
		Diameter	Length			
Swingle citrumelo	146.7a	5.97b	5.73b	44.9a	4.67ab	6.33a
C-32 citrange	155.3a	6.74a	6.48a	46.7a	6.00a	6.00a
Rubidoux trifoliate	139.1a	6.31b	6.22ab	38.3b	3.33b	4.33a

**Biochemical characters of fruits:** The data presented in [Table-3] regarding Total Soluble Solids (TSS) shows that fruits of Olinda Valencia failed to register any significant variation in this parameter as influenced by different rootstocks. Fruits from plants budded on Swingle citrumelo showed highest level of this parameter followed by those on C-32 citrange. Lowest TSS level was observed in case of Rubidoux trifoliate. All the three rootstocks produced non-significant effect on juice acid content of the fruits of Olinda Valencia. Rubidoux trifoliate contributed for highest level of this parameter; while C-32 citrange was next to follow. Swingle citrumelo influenced for lowest fruit acidity content. [9], while working on horticultural performance of Folha Murcha sweet orange observed non-significant variation in TSS and acid content of fruits when budded on eleven

different rootstocks.

**Table-3** Influence of different trifoliate rootstocks on biochemical characters of Olinda Valencia fruits

Rootstock	TSS (%)	Acidity (%)
Swingle citrumelo	10.1a	0.73a
C-32 citrange	9.47a	0.80a
Rubidoux trifoliate	9.23a	0.81a

**Conclusion:** Rootstock is a limiting factor for success of a commercial citrus

cultivar in term of physical establishment and market profitability of its fruit in a specific region. The present study exposes the influence of citrus rootstocks in altering vegetative growth and fruit characters of Olinda Valencia. Budding of this cultivar on Swingle citrumelo resulted into highest dwarfing effect. Rubidoux contributed for highest scion and stock circumference. C-32 citrange was most suitable for producing heavy fruit with larger size, & higher percent juice content and may be recommended as most compatible rootstock for Olinda Valencia. On the other hand biochemical characteristics of the fruits were recorded best in case of Swingle citrumelo, though it remained statistically unaffected.

**Conflict of Interest: None declared**

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