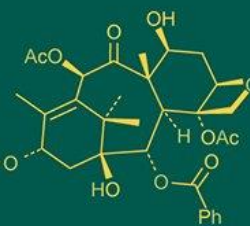
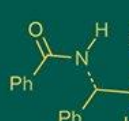


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Performance of apple varieties on M-7 clonal rootstock under high density orcharding

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Abstract

Present investigations on performance of apple cultivars on M-7 clonal rootstock were carried out in the Experimental orchard of Division of Fruit Science, SKUAST-Kashmir, Shalimar, Srinagar (J&K) on 10-years old apple plants of varieties Oregon Spur, Vance Delicious and Well Spur raised on M-7 clonal rootstock and spaced at 3m x 3m. Results obtained revealed that highest fruit yield was recorded in variety Well Spur followed by Oregon Spur. Highest fruit weight, fruit length and fruit breadth were also recorded in apple variety Well Spur. Fruit TSS was higher in varieties Well Spur and Vance Delicious. Fruit titratable acidity was lowest in varieties Vance Delicious and Well Spur however fruit total sugars were highest in variety Vance Delicious followed by Well Spur and Oregon Spur.

Keywords: Apple, varieties, clonal rootstock, yield, fruit quality

Introduction

Apple (*Malus domestica* Borkh.) is one of the most important temperate fruit crops, cultivated worldwide. In India, apple is cultivated in an area of 3.03 lac hectares with production of 26.64 lac MT (Anonymous, 2025) ^[2] and among different regions, UT of Jammu and Kashmir is largest producer of apples in the country with production of 20.64 lac MT from an area of 1.72 lac hectares (Anonymous, 2024) ^[1]. In the apple growing regions of the country, traditional orchards raised on seedling rootstocks results in large trees spaced widely apart, with delayed bearing and low yield efficiency. The introduction of dwarfing and semi-dwarfing rootstocks enabled the development of high-density planting systems, which maximize productivity per unit area and improve orchard profitability. Rootstocks influence scion growth, physiology, and adaptability, making their selection critical for high density plantings. Among different clonal rootstocks of apple used in high density orcharding, M-7 is a semi-dwarf with a vigor of approximately 50-65 percent compared to seedlings. On good, deep soil, trees on M.7 are free-standing and the root system tend to be vertically oriented. Production usually begins in the third year. Rootstocks significantly influence different growing parameters of fruit trees, precocity, productivity and quality of apple trees, (Fallahi *et al.*, 1994) ^[8] and drought (Tworowski *et al.*, 2016) ^[11], anchorage of a tree, depth of the root system, resistance and tolerance to pests a diseases (Beers *et al.*, 2007) ^[5]. Thus present investigations were undertaken to study the performance of three apple varieties on M-7 rootstock under high density orcharding.

Materials and Methods

Present investigations were carried out in the Experimental orchard of Division of Fruit Science, SKUAST-Kashmir, Shalimar, Srinagar (J&K) on 10-years old apple plants of varieties Oregon Spur, Vance Delicious and Well Spur raised on M-7 clonal rootstock and spaced at 3m x 3m. Experiment was laid out a randomized block design with five replications. Fruits of apple varieties Oregon Spur and Vance Delicious were ready for harvesting during last week of August to first week of September however fruits of variety Well Spur was harvested during last week of August. Data on fruit yield (Kg/plant) under different apple varieties was recorded at the time of fruit harvest by weighing the total fruits on top pan balance. Data on fruit length and breadth of five fruits per tree was measured with the help of a digital Vernier Calliper and average was expresses in millimeter (mm). The five selected fruits taken for recording the fruit size data were weighed on electronic top pan

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balance and the average fruit weight was expressed in gram per fruit (g fruit⁻¹). Total soluble solids (TSS) in fruits were determined with the help of Erma hand refractometer (0-32 °Brix) by putting a few drops of fruit juice on its prism and expressed in degree brix (°B). Before use, the refractometer was calibrated with distilled water. Fruit titratable acidity was determined by taking 10gm fruit sample which was crushed and added to 100 ml distilled water and then filtered

through Whatman No.1 filter paper. 10 ml of aliquot was titrated against N/10 N NaOH solution using phenolphthalein as an indicator. The end point was noted with change in colour from colorless to light pink. Titratable acidity was calculated on the basis of one ml NaOH equivalent to 0.0067 g of anhydrous malic acid and the results were expressed as percent acidity as per the method described in A.O.A.C. (1990) [3].

$$\text{Titratable acidity} = \frac{\text{Titre value} \times \text{normality of NaOH} \times \text{volume made up} \times 67 \times 100}{\text{Weight of sample} \times \text{volume of aliquot taken} \times 1000}$$

Fruit total sugars content was expressed as percentage of juice weight as per the method of A.O.A.C. (1990) [3], using formula as:

$$\text{Total sugars (\%)} = \frac{0.05 \text{ ml} \times \text{volume made}}{\text{Titre value} \times \text{weight of sample taken}} \times 100$$

The data generated from the investigation was appropriately designed, computed, tabulated, analysed and interpreted as per the methods described by Gomez and Gomez (1984) [9].

Results and Discussion

The data recorded in present investigation on fruit yield and quality characteristics of fruit in terms of average fruit weight, fruit length, fruit breadth, fruit TSS, titratable acidity and total sugars of different apple varieties raised on M-7 apple clonal rootstock under high density plantings is presented in Table 1.

Fruit yield

It is evident from the data presented in table 1 that fruit yield was significantly influenced by different varieties under study. Highest fruit yield per plant was recorded in variety Well Spur (16.80 Kg) followed by Oregon Spur (15.70 Kg). However lowest fruit yield (13.70 kg/plant) was recorded in Vance Delicious variety. Differences in fruit yield in different varieties under study may be due to the genetic behaviour of these varieties as well as rootstock influence and results obtained are in accordance with the findings of Sharma and Chauhan (2008) [13] and Hasani *et al.* (2014) [10].

Fruit weight

Data presented in table 1 revealed that the fruit weight was significantly different among studied varieties. Highest average fruit weight (198.75 g) was recorded in variety Well Spur followed by variety Oregon Spur (190.39 g). However lowest fruit weight (180.65 g) was recorded in Vance Delicious variety. Differences in fruit weight in different varieties under study may be due to variable fruit leaf ratio, amount of photosynthates as well the genetic behaviour of these varieties and results obtained are in accordance with the findings of Bhat *et al.* (2018) [6].

Fruit length

It is evident from the data presented in table 1 that the fruit length was significantly different in all varieties. Highest average fruit length (75.86 mm) was recorded in variety Well Spur followed by variety Vance Delicious (71.03 mm). However lowest fruit length (69.88 mm) was recorded in Oregon Spur variety. Differences in fruit length in different

varieties under study may be due to variable fruit leaf ratio, amount of photosynthates as well as genetic behaviour of these varieties and results obtained are in accordance with the findings of Kumar and Singh (2020) [11].

Fruit breadth

Data presented in table 1 revealed that the fruit breadth was significantly different among varieties. Highest average fruit breadth (78.14 mm) was recorded in variety Well Spur followed by variety Vance Delicious (74.33 mm). However lowest fruit breadth (73.11 mm) was recorded in Oregon Spur variety. Differences in fruit breadth in different varieties under study may be due to variable fruit leaf ratio, amount of photosynthates as well as the genetic behaviour of these varieties and results obtained are in accordance with the findings of Ara *et al.* (2008) [4].

Fruit TSS

It is evident from the data presented in table 1 that the differences in fruit TSS was non-significant in different varieties. Higher fruit TSS (14.5 °B) was recorded in varieties Well Spur and Vance Delicious, however slightly lower fruit TSS was recorded in Oregon Spur variety (14.4 °B). Differences in fruit TSS in different varieties under study may be due to the genetic behaviour of these varieties and results obtained are in accordance with the findings of Drogoudi *et al.* (2008) [7] and Hasani *et al.* (2014) [10].

Fruit titratable acidity

Data presented in table 1 revealed that the fruit titratable acidity was not significantly different in different varieties. Lower fruit acidity (0.21%) was recorded in varieties Well Spur and Vance Delicious. However slightly higher fruit acidity (0.22%) was recorded in Oregon Spur variety. Differences in fruit acidity in different varieties under study may be due to the genetic behaviour of these varieties and results obtained are in accordance with the findings of Drogoudi *et al.* (2008) [7].

Fruit total sugars

It is evident from the data presented in table 1 that the fruit total sugars content was significantly different in all varieties. Highest fruit total sugars content (12.45%) was recorded in variety Vance Delicious followed by variety Well Spur (12.16%). However lower fruit total sugars content (11.83%) was recorded in Oregon Spur variety. Variation in total sugars content in these apple varieties may be due to variable fruit leaf ratio, amount of photosynthates, variable amount of starch in young fruits which in turn get converted into sugar at maturity and the results are in conformity with the findings of Kumar *et al.* (2006) [12].

Table 1: Fruit yield and quality characteristics of apple varieties on M-7 rootstock.

Variety/Rootstock	Fruit Yield (Kg/plant)	Fruit weight (g)	Fruit length (mm)	Fruit breadth (mm)	Average TSS (0B)	Titrateable acidity (%)	Total sugars (%)	Harvesting time
Oregon Spur	15.70	190.39	69.88	73.11	14.4	0.22	11.83	Last week of August to first week of September
Vance Delicious	13.70	180.65	71.03	74.33	14.5	0.21	12.45	Last week of August to first week of September
Well Spur	16.80	198.75	75.86	78.14	14.5	0.21	12.16	Last week of August
C.D. (0.05)	0.55	1.50	1.82	1.32	NS	NS	0.16	-

Conclusion

From the studies carried on 10-years old apple plants of varieties Oregon Spur, Vance Delicious and Well Spur raised on M-7 clonal rootstock and spaced at 3m x 3m it was concluded that fruit yield was highest in variety Well Spur followed by Oregon Spur. Highest fruit weight, fruit length and fruit breadth were also recorded in apple variety Well Spur. Fruit TSS was higher in varieties Well Spur and Vance Delicious. Fruit titrateable acidity was lower in varieties Vance Delicious and Well Spur however fruit total sugars were highest in variety Vance Delicious followed by varieties Well Spur and Oregon Spur.

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