

Evaluation of Vegetative, Quantitative and Qualitative Traits of Two Apple Cultivars on MM106 Rootstock and Seedling Rootstock

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Abstract

In this study, vegetative, quantitative and qualitative traits of Red Delicious and Golden Delicious cultivars on MM106 rootstock and seedling rootstock were studied factorially in a completely randomized design. Flowering onset, number of flowers, dropping, yield, fruit size, L/D, total acid, vitamin C, soluble solids, percentage of dry weight and branch and trunk growth were examined as variables. Regarding the climatic condition of the region, the onset of flowering in the cultivars tested was almost simultaneous so that there was a slight difference between them. The results showed that Golden Delicious cultivar on MM106 rootstock had the highest percentage of flowering and flower density. The percentage of first dropping and June dropping in golden delicious was higher than red delicious; However, pre-harvest dropping was higher in Golden Delicious. The results showed a significant increase in dropping at seedling rootstock compared to MM106 rootstock. The MM106 rootstock increased the yield. The rootstock had a significant effect on fruit size and weight. Red Delicious cultivar showed a heavier weight. Fruit acidity was higher in seedling rootstock than MM106 rootstock but total sugar, Tss, vitamin C and dry weight percentage were higher in MM106 rootstock. Soluble solids did not differ significantly between cultivars. Red Delicious cultivar had the highest branch growth and trunk diameter in terms of growth.

Keywords: MM106 Rootstock, Quantitative and Qualitative Traits, Red Delicious and Golden Delicious Cultivars

Introduction

The fertility of apple orchard depends on the production of a large amount of quality products and marketability (10). Using the right rootstock is one of the cheapest and most flexible ways to control the growth of trees (3). Determining the most suitable rootstock for propagation of commercial apple cultivars, Ghasemi reported that the grafted trees on M9 and M26 rootstocks started to bear fruit in the second year and on MM106 rootstocks in the third year, while the trees on the seed rootstock bore flower and fruit in the sixth year (1). Not all fruits formed during the flowering period reach full maturity due to premature dropping. Fruit drop necessarily expresses a kind of self-regulatory mechanism in plants that regulates the physiological ability of the tree (8). Sotiropoulos (2008) in the study on the yield of Imperial Double Red Delicious cultivar reported that the rootstock has an effect on the average fruit weight. The highest mean fruit weight in grafted trees was on lower growing rootstocks, such as M7 and MM106 and the lowest mean fruit weight in grafted trees was on seedling rootstock (9). In addition to high yield, quantitative and qualitative traits of the product should also be considered. One of the ways to increase yield and quality is to use cultivars on vegetative rootstocks in different regions (7). Considering the wide level of apple growing areas in the country and its great importance in domestic consumption and export abroad, determining the most appropriate vegetation rootstocks is of great importance regarding to the climatic condition and characteristics of the region and its development for economic production of the fruit.

Materials and Method

In this study, a factorial experiment was used as a completely randomized design with five replications in a 2.5-hectare garden in Kakareza village of the central part of Aleshtar city. The first factor included 2 rootstocks (MM106 rootstock and seed rootstock), the second factor consisted of two cultivars (Red Delicious cultivar and Golden Delicious cultivar) and each experimental unit consisted of three trees. Planting distances on rows were 2 m and spacing between rows was 3 m in MM106 vegetative rootstock and planting distances on and between rows were 6 m in seedling rootstock. A total of 60 trees were randomly selected and etched. At the end of the tree growing season, the diameter of the tree trunks was measured from 15 cm above the graft site and the length of five branches in each tree was measured. According to the conditions of the experimental site, when 5-10% of the flowers of each tree opened, it was recorded as the date of flowering and when about 80-85% of the flowers of each tree opened, it was considered as the date of full flowering. Counting the flowers, the amount of flowering and flower density were determined. Counting the number of fruits and subtracting them from the number of fruits in the previous stage, the amount of first dropping, June dropping and pre-harvest dropping was calculated. Given that both apple cultivars are among the late cultivars, the fruit was harvested in October and the yield of the trees was weighed by a scale, and the yield of each tree was obtained through this. After full fruit growth, six fruits from different parts of the tree were randomly selected, then fruit length and fruit diameter were measured using a caliper. A digital scale was used to measure the weight of the fruit. Acidity with a normal gain of 0.1 in the presence of phenolphthalein and vitamin C was obtained by titration using 3% metaphosphoric acid by dichlorophenol-indophenol reagent. A digital scale was used to measure the weight of the fruit. Acidity with a normal gain of 0.1 in the presence of phenolphthalein and vitamin C was obtained by titration using 3% metaphosphoric acid by dichlorophenol-indophenol reagent. A refractometer was used to measure soluble solids. To measure the dry weight of fruit, a 30 g sample was separated from several fruits and placed in an oven at 72 ° C for 48 hours.

Findings

Regarding the climatic condition of the region, the beginning of flowering in the cultivars tested was almost simultaneous so that there was a slight difference between them and the rootstocks did not have a significant effect on the flower bud opening and the whole flower stage. The results obtained from growth indices show that the vegetative growth in Red Delicious cultivar was higher than Golden Delicious cultivar (Table 1). The results showed that in Golden Delicious cultivar, the number of flowers, flower density and fruit formation was higher than Red Delicious cultivar and the rootstock effect on these traits was significant and these traits were higher in grafted trees at MM106 rootstock than seedling rootstock (Table 2). Table 3 shows that the drop in Golden Delicious cultivar was higher than Red Delicious cultivar, but the pre-harvest dropping in Red Delicious was higher than the Golden Delicious. Also, the effect of rootstock on dropping was significant and dropping in seedling rootstock was more than MM106 rootstock (Figure 1). The results of this study showed that the rootstocks have a very significant effect on the yield. The MM106 rootstock produced more produce than the seedling rootstock; This difference is due to the effect of dwarf rootstocks on early fruiting of trees (Table 4). According to Table 4, fruit size in Red Delicious cultivar was more than Golden Delicious cultivar. The rootstock had a significant effect on fruit size and weight. The size and weight of fruit in MM106 rootstock was more than seedling rootstock, but the rootstock did not affect the shape of fruit. Table 5 shows that the amount of sugar, vitamin C and dry weight percentage in Red Delicious cultivar was higher than Golden Delicious cultivar. The results showed that these traits were higher in MM106 rootstock than seedling rootstock. The level of acidity in seedling rootstock was higher than MM106

rootstock. Also, the amount of acid in Golden Delicious cultivar was higher than Red Delicious cultivar. There was no significant difference between soluble solids among cultivars but the effect of rootstock on this trait was significant and was higher in MM106 rootstock than seedling rootstock.

Discussion

Growth control is provided through the rootstock, but the amount of control depends on the apple cultivar grafted on the rootstock (3). The results show that the first drop and June drop in Golden Delicious cultivar was more than Red Delicious cultivar. These results were consistent with Mostafavi's research (4). Pre-harvest dropping occurs 2-3 weeks before harvest. This drop depends on the cultivar and weather condition, especially in summers when the weather is hot and dry condition cause much rain (4). Pre-harvest dropping was higher in Redspart cultivar than Golden Delicious cultivar; In general, the Golden Delicious cultivar had higher drop. These results were consistent with the results of the study by Mousavi (2005) (5). Rezaei et al. (2016) in the study on fruit growth and quality in 12 apple cultivars reported that the lowest fruit weight belonged to summer cultivars and the highest fruit weight belonged to Red Delicious cultivar. In addition to be a genetic trait, fruit weight varies under the influence of various factors such as climate, rootstock type, garden management, water and fertilizer consumption and the final load of tree (2). Finally, it is recommended that other new apple cultivars developed in the world and in similar climatic conditions, be continuously imported into the country and after comprehensive evaluations be introduced to nurseries and other breeding centers to dynamize the apple industry (2). The results showed that vegetative rootstocks are preferable to seedling rootstocks in terms of early fruiting and yield, then it is recommended to use vegetative rootstocks in the coming years to build new gardens, especially MM106 rootstock which has been tested and studied in different regions during the past years and can be used as an alternative vegetative rootstock to seedling rootstock.

Table 1. Results of vegetative indices

	Branch length (cm)	Trunk diameter (cm)
Golden Delicious cultivar	40.76	8.2
Red Delicious figure	49.15	9.2

Table 2. Results of vegetative traits

	Number of flowers	Flower density (flowers per branch length)	Number of first fruits
Golden Delicious cultivar	33.7	1.1	83.3
Red Delicious figure	28	0.9	62.3
rootstock MM106	36.8	1.2	76.1
Seedling rootstock	24.8	0.8	69.5

Table 3. Results of fruit drop percentage

	First drop	June drop	Pre-harvest dropping
Golden Delicious cultivar	63.4	19	16
Red Delicious figure	53.9	16	21
rootstock MM106	58.8	13.2	9.8
Seedling rootstock	58.5	22.8	27.1

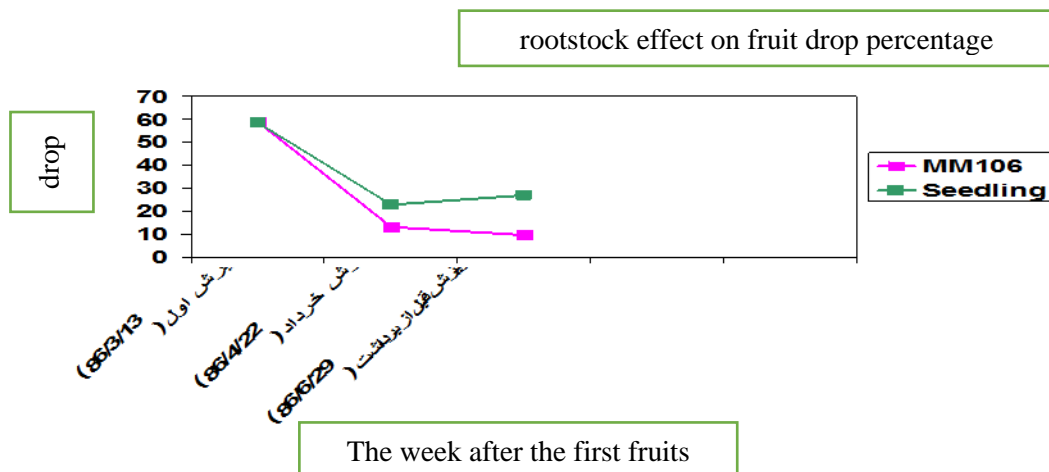


Table 4. Results of quantitative traits

	Yield (kg)	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (grams)	L/D
Golden Delicious cultivar	18.24	59.92	64.39	140.59	0.91
Red Delicious figure	17.4	62.01	68.84	171.53	0.89
rootstock MM106	30.39	61.34	67.52	166.54	0.9
Seedling rootstock	6.54	60.59	65.71	145.58	0.91

Table 5. Results of qualitative traits

	Total sugar (g/100cc)	Acidity (g/100cc)	Vitamin C (mg/100cc)	Tss	Dry weight (G)
Golden Delicious cultivar	12.1	0.4	3.88	17.54	18.1
Red Delicious figure	14.1	0.3	4.06	17.01	19.5
rootstock MM106	13.2	0.29	4.03	17.96	19.9
Seedling rootstock	13	0.32	3.91	16.6	17.6

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