THE INFLUENCE OF VARIETY AND SOME TECHNOLOGICAL FACTORS ON FRUIT FIRMNESS AND PRODUCTIVITY ON THREE APRICOT VARIETIES CULTIVATED AT THE RESEARCH AND DEVELOPMENT STATION FOR FRUIT GROWING BĂNEASA, BUCHAREST

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Abstract

The nutritional value of apricots, the high production potential of apricot trees, the fact that the trees bear fruit relatively early, and the ripening of the fruit occurs during a period when there is a scarcity of other fruits, making it relatively easy to market at high prices, make apricot a species desired by farmers for their orchards. In order to study the influence of certain technological factors on fruit quality, particularly regarding resistance to handling, transport, and storage, we selected three well-known varieties on the market: Amiral, Goldrich, and Olimp grafted on to the rootstock Constanta 14, which imparts favorable characteristics. We also conducted determinations on the influence of planting distances on productivity, analyzing planting distances of 4.0 x 1.5 m and 4.0 x 2.0 m. The best results were obtained for the Amiral variety, where the statistical results were rated as significant compared to the other varieties, for both planting distance variants (4.0 x 1,5 m - 9.02 t/ha and at 4.0 x 2,0 m - 10.90 t/ha. Till the end of the growing season, treatments with calcium-based products were applied, with the final objective of observing their effect on the firmness of the fruit pulp. Among the analyzed varieties, the best firmness, important for good storage resistance, was determined for the Goldrich variety planted at 4.0 x 2.0 m- 2.67 kgf/cm² treated with Ca compared to the variant planted at 4.0 x 2.0 m but not treated with calcium with the firmness value-1.82 kgf/cm². There are varieties that may respond differently to treatments, as Olimp variety, which had a higher yield without treatment. This shows that not all varieties respond uniformly to treatments and that there may be genetic variability in their ability to utilize available nutrients.

***Key words**: productivity, apricot varieties, calcium treatments, firmness, planting distances*

INTRODUCTION

The apricot, scientifically known as Prunus armeniaca L., belongs to the Rosaceae family and is considered one of the most valuable fruit trees globally. The term "apricot," adopted by the Romans, originates from the combination of the Latin word *praecocia*, meaning "early ripening," and the Arabic *albarquq*, referring to a "short ripening period."

According to the available documents, the origin of apricots dates back to 5,000 years ago in China (Wang Y & Liu Q, 1998). There are about 3,000 apricot cultivars in the world, 2,000 of which are found in China.

The apricot tree is a medium-sized tree with a wide, dense crown and numerous market opportunities. However, in Romania, apricot plantations are not very widespread and represent only 5-6% of the total orchard area. In Romania, there are over 40 apricot varieties with early, mid-season, or late fruit ripening. The varieties are both Romanian and foreign, and can generally be consumed from June to August.

Most apricot varieties are self-fertile, but there are also self-sterile varieties that require pollinator varieties to bear fruit. It is important to mention that all apricot varieties are early-bearing, coming into fruit in the 3rd or 4th year after planting.

According to FAO statistics (2022), in the last twenty years, the average apricot production in the world was 3,719,974 million tons, the highest percentage (57.5%) being of Asia mainly due to the large farms established (Turkey, Iran, Uzbekistan, Pakistan) and Africa (Algeria, Morocco, Egypt). It is followed with 25.4% by the European production, that increased at a lower rate, while in North America and Oceania production has decreased. Turkey ranks first in the world in production with an average of 624,256 tons among the ten apricot-producing countries in the past twenty years (FAOSTAT, 2022).

Apricots are valuable sources of vitamins, minerals and nutrients that are extremely beneficial for the body, including potassium, phosphorus, calcium, riboflavin, iron, vitamin A, magnesium, zinc, beta-carotene and vitamin C, as well as selenium, manganese, thiamine, copper, folates, vitamin B6, pantothenic acid and choline (Gherghi,Burzo,2001).

The high beta-carotene content is very important as it lowers bad cholesterol levels in the blood and so protects the heart, vitamin A maintains good eyesight and its antioxidant powers protect against the action of free radicals that can damage the body's tissues and cells.

Today, apricot research has been done in various fields, such as: evaluation and improvement of fruit quality characteristics (Wang et al., 2018). Apricot is one of the most important stone fruits that can be eaten fresh or processed. Most research on this fruit is associated with improving the quality of the fruit, such as taste, skin color, firmness of the fruit, the amount of TSS, acidity of the fruit, and the shelf life of the fruit.

Selecting the suitable rootstock is another issue studied in most research, which is due to the climatic and soil conditions of the region. In most cases, the research has tried to select the best rootstock according to the climatic conditions of the region to improve tree growth conditions and fruit quality, resistance to diseases and biological stresses in each region, and also early and late ripening of fruit.

A suitable rootstock influences not only graft quality but also the long-term performance of trees, including scion functionality, fruit size and quality, tree growth, productivity, nutritional traits, and the absorption of water and nutrients. Because of the limited compatibility between scions and rootstocks from varying climatic regions, it is crucial to study and assess the climatic adaptability of different apricot rootstocks. In each cultural system, depending on the climatic conditions, the right combination of rootstocks and scions should be determined and selected in research programs (Opriță & Gavat,2018). Globally, the apricot cultivation area was nearly 560,000 hectares, which led to the harvest of about 4 million tons per year (FAO, 2022). Romania presents a considerable risk to climate change, its effects being clearly reflected by changes in temperature and precipitation, mainly since 1961 and until now. The most affected areas, according to relevant international reports and analyses climatological data series for the period 1901- 2020 conducted by the National Meteorological Administration, being located in the southern, south-eastern and eastern part of the country. The main risks that Romania faces in the short and medium term consist in the significant increase of the average annual temperature, the decrease of precipitations and the general occurrence of extreme climatic events.(Pîrvan et al., 2021) Compared to the initial firmness depending on the cultivar, many fruits after storage showed decrease firmness values, depending on the cultivar (Oltenacu & Oltenacu, 2013, p. 99). The main quality characteristics of fruits and vegetables determine their qualitative value (Oltenacu, Iova, & Lascar, 2017, p. 231).

The objectives of rootstock improvement for apricot, peach and almond are the following: obtain new rootstocks with superior biological characteristics, the identification and selection of valuable genotypes from wild and cultivated tree flora, establishment and enrichment of the germplasm fund and its study in order to find the best parents, creation of new rootstocks through intra- and interspecific hybridization and self-pollination, study of elite rootstocks in competition crops in nursery and orchard in combination with several varieties, refinement and rationalization of technological links, mass propagation and movement of viroid- and mycoplasma-free propagating material, study of the adaptability to local soil and climatic conditions of valuable rootstocks of the Romanian and world assortment in order to their correct zoning.

However, the main factors limiting the wider spread of apricot cultivation among fruit growers is: the disease of the generative organs of low temperatures at the end of the rest period and late spring premature wilting of trees (apoplexy), infection with viruses the absence of a wide assortment of modern varieties and rootstocks that would allow to intensify the culture, to obtain productions high, constant and competitive (Balan et al., 2008; Cociu et al., 1993; Maria & Sosna, 2006; Peșteanu et al., 2018).

Researchers are concerned about obtaining apricot varieties that start late in vegetative and resist winter frost. (Opriță et al.,2022). Several years of observations indicate that the 'Goldrich' apricot cultivar shows some resistance to early spring frosts.

Apart from genetic traits, fruit quality is significantly influenced by cultivation techniques. The apricot and peach fruits pose a serious challenge during their utilization due to the high level of perishability and to the very high temperatures during the harvesting time (Balan, et al., 2008). At present, in the varietal conveyer of these fruit tree species in Romania, in some climatic conditions, many deficient or high productions are reported. Therefore, maintaining the fruit quality for a certain period of time in order to diversify the fruit sort out of season and to stimulate the export are very timely problems (Chira et al., 2018).

MATERIALS AND METHODS

The research was carried out at the Moara Domneasca Experimental Base of SCDP Baneasa. The study area is dominated by soils of the Luvisols class, with reddish Preluvosols as the predominant soil type. Reddish Luvisols and Stagnosols are also found in the depressional areas and in the crovs. Reddish eroded Preluvosols can be found on the slopes of the Pasărea valley, while in the meadow area Hydrisols and Gleysols are present.

The experiment carried out in 2023 is classified as trifactorial, with the first factor being the variety (Goldrich, Amiral and Olimp), the second factor, the planting distances (4.0 x 2.0 m and 4.0 x 1.5 m), and the third factor, calcium treatment, applied in two variants: treated and untreated. For all three varieties were given Borocal, a foliar fertilizer based on calcium, boron and magnesium, designed to prevent and correct problems associated with the firmness and elasticity of developing fruit tissues. The applied dose was 3l/ha in 1000 l water, applied in the Fruit Formation and Fruit Development phases. Twenty fruits of each variety and varietal were analyzed, determining weight (g), firmness (kgf/m2), height (mm), small and large diameter (mm), sugar content (%BRIX), pH, citric acid (%) and dry matter (%). The physic-chemical analysis methods used in the experiment were as follow: the fruit firmness was determined by using an Effegi penetrometer with 8 mm piston diameter. Digital Refractometer Hanna Instruments HI 96800 to determine the amount of sugar in fruit from aqueous solutions, pH-Meter Hanna HI 700630 for pH level, Electronic Subducer with display to determine the height, small diameter and large diameter of fruit, balance XT620M to determine the weight. The citric acid level was determined with a Mini titratable acidity meter for titratable acidity in fruit juices, 230V, Hanna Instruments brand. The variants were V1 - variety Amiral, untreated, planting distance 4.0 x 1.5 m; V2 - Amiral variety, untreated, planting distance 4x2.0 m; V3 - Amiral variety, Ca-treated, planting distance 4.0 x 1.5 m; V4 - Amiral variety, Ca-treated, planting distance 4.0 x 2.0 m; V5 - Variety.

The apricot tree (*Prunus armeniaca*) has been selected for this study as it is one of the most cultivated fruit tree species worldwide, especially in the warm temperate climate regions.

Olimp variety is an apricot cultivar obtained at Research Station for Fruit Growing (RSFG) Baneasa and patented in 1994 (Photo 1). **Goldrich** is a cultivar of apricot of American origin (Foto 3). **Amiral**, the tree is one of high vigor, the fruit is medium to large spherical-elongated, orange skin color on the shady side and carmine red on the sunny side, orange flesh, medium juiciness, medium, not sticky to the stone. Ripening time: 3rd decade of June - 1st decade of July, (foto 2). These varieties have been grafted on the Constanta 14 rootstock which gives the varieties high vigor, good productivity and good fruit quality. **Constanța 14** generative rootstock for apricot obtained by selection in 1979 by Indreias Alexandra, approved in 1997. It has good productivity as a seed, very good seedling productivity (57-77%), high production of STAS seedlings (240-441 thousand/ha), good grafting affinity with all the varieties in the assortment, high production of STAS trees (34-46 thousand/ha).

Figure 1. Fruits of the apricot variety Olimp
Own photo source, Moara Domneasca Experimental Station

Figure 1 shows us the Olimp variety originates from Romania, specifically from SCDP Baneasa. The tree has high vigor, and the variety is self-fertile. The fruit weighs between 69 and 94 grams and has an oblong shape, large size; skin: orange with carmine red on the sunny side; flesh: orange, consistent, with medium juiciness, not pithy; taste: aromatic, ripening time: June 26 - July 5; productivity: high. General assessments: The variety is productive, coming into bearing from the 4th year. Generally used in industrialization for nectar and jam. Flowering season is late andabundant.

Figure 2. Fruits of the Amiral apricot. Own photo source, Moara Domneasca Experimental Station.

Amiral variety is from Romania, SCDP Constanta.; tree: high vigor; variety: self-fertile; fruit: 69-94 g; shape: oblong, large size; skin: orange with carmine red on the sunny side as you can see in figure 2; flesh: orange, firm, medium juicy, not pithy; taste: aromatic; ripening time: June 26-July 5; productivity: high.

General assessments: The variety is productive, it comes into bearing from the 4th year. Generally used in industrialization for nectar and jam. Flowering is late and abundant. Resistant to the main diseases specific to apricot.

Figure 3. Goldrich apricot fruit. Own photo source, Moara Domneasca Experimental Station

Goldrich fruit is large to very large (80-90g), orange flesh with a pleasant flavor, excellent for fresh consumption. The color is orange-orange with red shades as shown in figure 3 on the sunny side. The flesh is firm, resists very well to handling and storage, not stone-sticky. The tree is of medium-high vigor and productivity is very high. Ripening period first half of July.

Table 1. Climate dates from 2023. Source: ADCON Station, Moara Domneasca

Month	Temperature			Humidity			Rain fall
	Min	Max.	Media	Min	Max.	Media	
I							
II	-8.6	21	3	0	97	70	2.58
III	-4	22	8	17	98	71	9.83
IV	1.7	22	11	34	98	77	59.44
V	4	29	16	30	96	70	22.14
VI	9.7	36	19	32	97	72	8.78
VII	12.7	41	25	26	94	63	35.33
VIII	12.2	39	26	27	97	58	13.42
IX	10.2	34	22	21	94	58	0.33
X	1.9	31	16	26	98	67	26.12
XI	-1.9	22	9	35	98	82	53.57
XII	-4.2	18	4	44	99	87	29.8

Agrochemical characterization

Table 2. Chemical properties of the soil at Moara Domneasca 2019
Source : Own determinations

Oriz	Depth (cm)	pH	Total content			
			Humus %	N-NO_3 %	P_2O_5 %	K_2O %
Ap	0-20	5.27	2.46	0.135	0.159	1.65
A/B	20-45	5.20	2.3	0.120	0.130	1.05
Bt	45-150	5.10	2.17	0.100	0.108	0.99
Cca	150-200	5.35	1.85	0.07	0.115	1.23

Soil chemical properties are a key aspect in evaluating land for various agricultural crops. In order to characterize the soil at Moara Domneasca, a study was conducted in 2019, as shown in Table 2. Soil biodiversity can have a major impact on the resistance and resilience of the ecosystem to climate change, which is particularly relevant for the management of future crops. (Pîrvan A. G., Basarabă A.,2021).

The data include determinations at different depths, as the root systems of fruit trees and shrubs explore the soil vertically to identify the mineral and water resources needed for growth and fruiting. From the study it was found that the soil at Moara Domneasca has in general favorable characteristics for the cultivation of fruit trees and shrubs. The low total porosity of 1.53 g/cm³ at 0-20 cm and 1.50 g/cm³ at 20-40 cm and the moderate bulk density may influence the degree of soil compaction, with direct consequences on the deterioration of the aeration regime in the root system of shrubs. With regard to the state of soil NPK supply, in order to achieve an optimal nutrient regime, given the low amounts of nitrogen (0.135), phosphorus (59 mg/kg) and potassium (105 mg/kg), additional amounts of NPK are necessary.

In conclusion, the conditions for growing fruit trees are favorable (loamy-clayey texture and slightly acidic pH of 5.27), but there are also limiting factors (bulk density and low porosity) that require further attention.

The variable climate with extreme temperatures and annual rainfall, which in combination with evapotranspiration, negatively influence soil moisture and crop development, is another risk factor present at the Moara Domneasca Experimental Base according to the values in Table 1.

RESULTS AND DISCUSSIONS

Table 3. Yields of fruit treated and untreated with Ca.
Source : Own determinations

Variety	Yields t/ha treated with Ca			Yields t/ha untreated with Ca		
	4.0 x 1,5 m	**4.0 x 2,0 m**	**Mean**	**4.0 x 1,5 m**	**4.0 x 2,0 m**	**Mean**
Amiral	9.02	10.90	9.96	9.11	9.38	9.25
Olimp	7.19	7.62	7.41	8.67	8.85	8.76
Goldrich	8.10	9.68	8.89	8.17	9.21	8.69

In table 3 it is observed that larger planting distances, such as 4.0 x 2.0 m, lead to higher yields compared to the 4.0 x 1.5 m distance, influencing fruit size, which is reflected in increased production. The Amiral variety surpassed the yields of the other two analyzed varieties, followed by the Goldrich variety.

Table 4. Fruit firmness (kgf/cm²)
Source: Own determinations

Variety	Fruit firmness (kgf/cm²) treated with Ca.		Fruit firmness (kgf/cm²) untreated with Ca.	
	4.0 x 1,5 m	4.0 x 2,0 m	4.0 x 1,5m	4.0 x 2,0 m
AMIRAL	1.70	1.85	1.33	1.68
OLIMP	1.75	2.05	1.69	1.79
GOLDRICH	2.85	2.67	2.20	1.82
Average	2.10	2.19	2.74	1.76

Fruit firmness was significantly higher in the Calcium-treated variants compared to the untreated ones, with the best firmness observed in the Goldrich variety, which recorded higher values than the other studied varieties (table 4). Higher firmness values were determined in the variants with larger planting distances 4.0 x 2.0 m compared to the values obtained in the variant with planting distances of 4.0 x 1.5 m.

Table 5. Firmness and average yield of Goldrich as a function of planting distance and treatment. Source : Own determinations

Variety	Distance m	Treatment	Average firmness (kgf/cm2)	Average production/ tree kg
Goldrich	4.0 x 2.0	calcium	2.67	6.05
Goldrich	4.0 x 2.0	untreated	1.82	2.63
Goldrich	4.0 x 1,5	calcium	2.85	5.55
Goldrich	4.0 x 1,5	untreated	2.20	2.55

The table presents data on average firmness and average yield per tree for the Goldrich variety, depending on planting distance and calcium treatment. In the calcium-treated variants, the average firmness was 2.67 kgf/cm² at a distance of 4.0 x 2.0 m and 2.85 kgf/cm² at 4.0 x 1.5 m, leading to an average yield of 6.05 kg per tree for 4.0 x2 m and 5.55 kg for 4.0 x 1.5 m. These values indicate a positive correlation between firmness and yield.

On the other hand, untreated variants had lower firmness, with values of 1.82 kgf/cm² at 4.0 m x 2.0 m and 2.20 kgf/cm² at 4.0 m x 1.5 m, while the average production/ tree kg was significantly reduced, at 2.63 kg for 4.0 m x 2.0 m and 2.55 kg for 4.0 m x 1.5 m. These results in table 5 suggest that calcium treatments and smaller planting distances contribute to improving both firmness and yield of the fruits, thereby demonstrating the importance of these factors in cultivating the Goldrich variety.

Table 6. Firmness and total yield of Olimp according to treatment and planting distance.Source: Own determinations

Variety	Planting Distance-m	Treatment	Average firmness (kgf/cm2)	Average production/ tree kg
Olimp	4.0 x 2.0	calcium	1.68	6.19
Olimp	4.0 x 2.0	untreated	1.85	10.18
Olimp	4.0 x 1,5	calcium	1.70	5.64
Olimp	4.0 x 1,5	untreated	1.33	5.26

These results suggest that, although calcium treatment had an impact on firmness (1.68 kgf/cm² and 1.70 kgf/cm²), total production/ tree kg was higher in the untreated variants (10.18 kg and 5.26 kg). The values in the table 6 indicates that the firmness does not influence the production increases. In conclusion, it is important to carefully analyze the effects of treatments and planting distances on fruit quality and quantity for the variety Olimp.

Table 7. Firmness and total yield of Amiral according to treatment and planting distance. Source: Own determinations

Variety	Planting Distance m	Treatment	Average firmness (kgf/cm2)	Average production/ tree kg
Amiral	4.0 x 2.0	calcium	2.05	9.14
Amiral	4.0 x 2.0	untreated	1.79	2.41
Amiral	4.0 x 1,5	calcium	1.96	2.62
Amiral	4.0 x 1,5	untreated	1.75	0.48

Table 7 shows results regard the firmness average and yield average per tree for the variety Amiral, according to planting distance and calcium treatment. Calcium-treated variants showed average firmness of 2.05 kgf/cm² at 4.0 m x 2.0 m spacing and 1.96 kgf/cm² at 4.0 m x 1.5 m spacing, with average yields of 9.14 kg and 2.62 kg per tree, respectively. In contrast, the untreated variants had lower firmness of 1.79 kgf/cm² at 4.0 m x 2.0 m and 1.75 kgf/cm² at 4.0 m x 1.5 m, but yield was significantly lower, with 2.41 kg at 4.0 m x 2.0 m and only 0.48 kg at 4.0 m x 1.5 m.

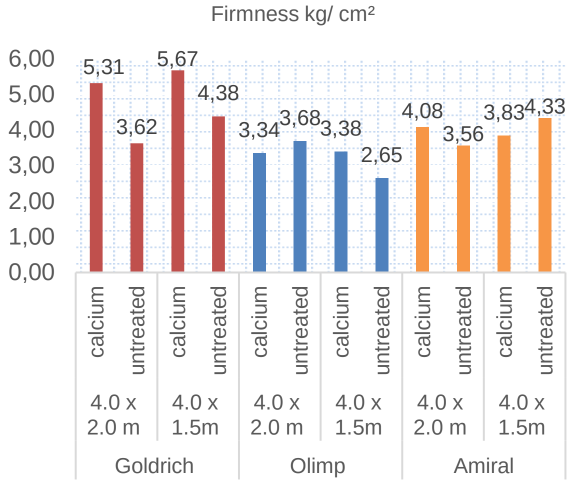

Figure 4. Effect of planting distance, variety and calcium on average fruit firmness.

According to Figure 4, calcium treatment has a positive impact on fruit firmness for most of the analyzed varieties. In the Goldrich variety, calcium-treated trees show a significantly higher firmness, especially at 2 meters distance, where the firmness is 5.31 kgf/cm², compared to only 3.61 kgf/cm² in untreated trees. At a distance of 1.5 meters, calcium-treated trees have a firmness of 5.67 kgf/cm², while untreated trees reach 4.37 kgf/cm². The Olimp variety has a notable peculiarity where, although calcium treatment improves firmness at a distance of 2.0 meters, with a value of 3.34 kgf/cm², untreated trees at the same distance have a higher firmness of 3.68 kg/fcm². At a 1.5 meters distance variant, the calcium-treated trees show a firmness of 3.38 kgf/cm², compared with 2.65 kgf/cm² for untreated trees. In the case of the Amiral variety, calcium treatment has a clearly positive effect, especially at a distance of 2.0 meters, where the firmness reaches 4.08 kg/cm², compared with 3.56 kgf/cm² for untreated trees. Without treatment, however, the firmness of Amiral is considerably reduced, especially at 1.5 meters, where untreated trees have a firmness of 3.89 kgf/cm², while calcium-treated trees reach 4.33 kgf/cm². In conclusion, calcium treatment improve firmness, but there are variations by variety and planting distance, with exceptions such as the variety Olimp, which shows higher firmness in untreated trees at 2.0 meters.

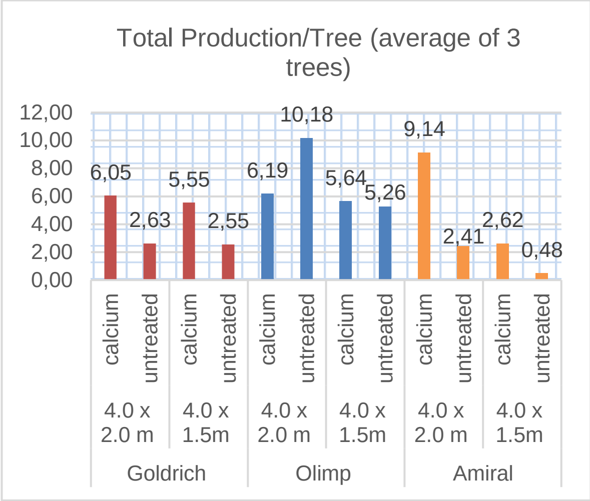

Figure 5. Average yield/tree (kg) by variety, planting distance and treatment.

As shown in Figure 5, calcium treatment has a positive impact on the average yield per tree for most of the varieties analyzed. In the Goldrich variety, calcium-treated trees show a significantly higher yield, especially in the 2.0 meter planting distance variant, where the yield is 6.05 kg per tree compared to only 2.63 kg in untreated trees. At 1.5 meters, treated trees yielded 5.55 kg, while untreated trees yielded 2.55 kg. In the Olimp variety, although calcium treatment improves productivity in the 2.0 meter spacing variant (6.19 kg), untreated trees at the same spacing have the highest yield in the whole graph, 10.18 kg, even exceeding the calcium-treated variants. At a distance of 1.5 meters, the calcium-treated trees produce 5.64 kg, while the untreated ones also have a similar yield of 5.26 kg. In the case of the Amiral variety, the calcium treatment has a clearly positive effect, especially at a distance of 2.0 meters, where the yield reaches 9.14 kg, compared to 2.41 kg for untreated trees. However, without treatment, the yield of the Amiral is considerably reduced, especially in the 1.5 meter planted variants, where only 0.48 kg were obtained, while the calcium-treated ones reach 2.62 kg.

In conclusion, calcium treatment tends to improve yield, but there are variations by variety and planting distance, with exceptions such as the variety Olimp, which recorded higher yield without treatment at a planting distance of 2.0 meters.

D	E	F
a1-a2	1,48	***
a1-a3	0,78	**
a2-a3	-0,7	n.s.
b1-b2	-0,12	n.s.
c1-c2	0,58	*
a1b1c1-a1b1c2	1,7	n.s.
a1b2c1-a1b2c2	1,293	n.s.
a2b1c1-a2b1c2	-0,34	n.s.
a2b2c1-a2b2c2	0,73	n.s.
a3b1c1-a3b1c2	0,517	n.s.
a3b2c1-a3b2c2	-0,44	n.s.
b1c1a1-b1c1a2	1,97	**
b1c1a1-b1c1a3	1,23	n.s.
b1c1a2-b1c1a3	-0,74	n.s.
b1c2a1-b1c2a2	-0,067	n.s.
b1c2a1-b1c2a3	0,05	n.s.
b1c2a2-b1c2a3	0,11	n.s.
b2c1a1-b2c1a2	2,29	n.s.
b2c1a1-b2c1a3	1,78	n.s.
b2c1a2-b2c1a3	-0,51	n.s.
b2c2a1-b2c2a2	-1,72	*
b2c2a1-b2c2a3	0,043	n.s.
b2c2a2-b2c2a3	-1,67	*
a1c1b1-a1c1b2	-0,36	n.s.
a1c2b1-a1c2b2	-0,764	n.s.
a2c1b1-a2c1b2	-0,043	n.s.
a2c2b1-a2c2b2	1,023	*
a3c1b1-a3c1b2	0,19	n.s.
a3c2b1-a3c2b2	-0,77	n.s.
D- noting the differences between the gradings of the experimental factors (A,B,C) E- noting the difference values between experimental factors F- analytical significance of the values presented in the E points n.s - not significant, * - significant,** - distinctly significant, *** - highly significant		

Table 8. Statistical comparisons of differences between experimental factors

Factor A: Apricot variety (a1: Goldrich, a2: Olimp, a3: Amiral); **Factor B: Planting distance** (b1: 2 m, b2: 1.5 m); **Factor C: Treatment** (c1: Treated with calcium, c2: Untreated).

Factor A, variety, includes three options: a1 (Goldrich), a2 (Olimp), and a3 (Amiral). Comparing the differences between these varieties, from a statistical significance perspective shown in table 8, reveals the following: a1- a2 shows a difference of 1.48 with a "highly significant" level (*)**, suggesting a strong variation between Goldrich and Olimp. a1-a3 has a difference of 0.78, with a "distinctly significant" level ()**, indicating a moderate difference between Goldrich and Amiral. a2-a3 shows a difference value of -0.7, statistically insignificant (n.s.), suggesting similarity between Olimp and Amiral. These results indicate that the Goldrich variety (a1) differs significantly from the other two varieties, especially from Olimp, while Olimp and Amiral show no significant differences between them. Comparison of Factor B (planting distance) Factor B, "planting distance," has two levels: b1 (2.0 m) and b2 (1.5 m). The differences between these levels were insignificant (value of -0.12), indicating that a planting distance of 2.0 m versus 1.5 m did not produce statistically relevant variations in the dependent variable analyzed. Comparison of Factor C (treatment). Factor C, "treatment," with levels c1 (calcium treatment) and c2 (untreated), shows a difference of 0.58, which is statistically significant (*). This result suggests a difference between calcium-treated and untreated plants, indicating a potential influence of calcium on the measured variable. Interaction between combinations of experimental factors. Comparisons between the different combinations of factor levels (e.g., a1b1c1 - a1b1c2) indicate a series of differences; however, most of these are insignificant (n.s.), suggesting that the combined effects of these factors are not large enough to produce substantial variations. However, there are some notable interactions:b1c1a1 - b1c1a2 shows a difference of 1.97 with a "distinctly significant" level (), indicating a relevant variation based on variety (Goldrich vs. Olimp) and treatment (calcium treatment).** b2c1a1- b2c2a2 shows a difference of -1.72, which is statistically significant (*), suggesting that there is an interaction between the variety and treatment factors, depending on the planting distance of 1.5 m. The difference between these two combinations is 1.67, indicating a statistically significant variation (*). This suggests that the Amiral variety (a3) behaves differently from Olimp (a2) under a planting distance of 1.5 m and without calcium treatment. a1c2b1-a2c1b2 shows a difference of 1.023 and is statistically significant (*), suggesting a significant interaction between variety and treatment, influenced by the planting distance as well. In conclusion Variety has a significant impact, particularly the Goldrich variety, which differs considerably from Olimp and Amiral. The calcium treatment shows a weakly significant effect.

CONCLUSIONS

The production of the Amiral variety recorded without treatment at the same distance was only 2.41 kg. However, at a distance of 1.5 m, the effect of calcium treatment is less pronounced, the production of treated trees being 2.62 kg while the untreated ones had a production of only 0.48 kg. These observations highlight the fact that although calcium treatment improves firmness and yield for most varieties, the effects vary depending on the planting distance and variety, with the Olimp variety being a special case where untreated resulted in higher production.

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