



# The effect of amino acids and fulvic acids on the growth, yield, and quality of apple varieties in the conditions of the Republic of Armenia

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## ABSTRACT

**Background:** Apples are widely recognized as a source of bioactive compounds, including polyphenols, flavonoids, dietary fiber, and antioxidant constituents that support cardiometabolic and metabolic health. Agricultural practices, environmental conditions, and nutrient management strategies can significantly influence the accumulation of these health-promoting compounds. Intensive orchard systems, particularly in foothill zones, offer a promising opportunity to enhance both yield and the functional quality of fruit.

**Objective:** This study aimed to evaluate how high-intensity orchard management practices—including foliar nutrition with macro- and microelements, phytohormones, and fruit load normalization—affect the growth, yield, and functional quality indicators of *Gala Schnico Red* and *Red Velox* apple varieties cultivated in the foothill zone of Armenia. A secondary objective was to assess how these practices contribute to the nutritional and bioactive compound profile of apples within a functional food framework.

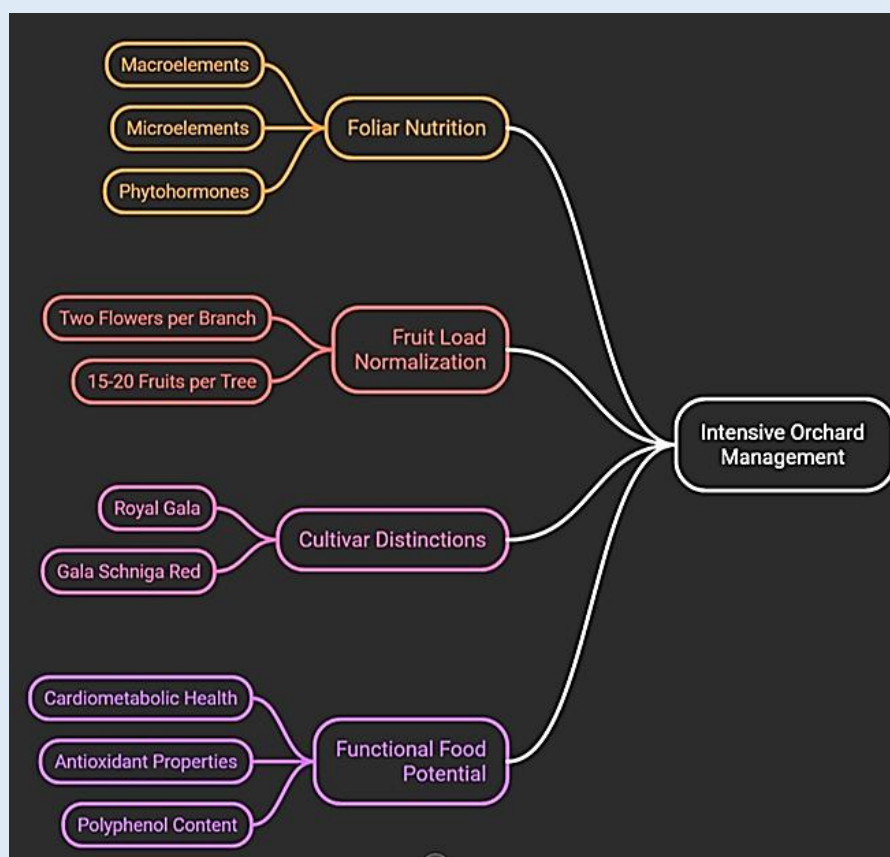
**Methods:** Tree growth, phenological stages, yield, and fruiting capacity were assessed according to I.V. Michurin's methodology. Experiments were conducted in three replications, with 5–10 trees per replication. Standard entomological and phytopathological methods were used for pest and disease monitoring. Fruit samples were analyzed for dry matter, total carbohydrate content (Bertrand method), and quality grading. Orchard treatments included foliar applications of Promalin + Tekamin Max, macro- and micronutrient sprays, pruning, flower and fruit normalization, soil mulching, and application of organic and mineral fertilizers. Data were statistically evaluated using dispersion analysis.

**Results:** Foliar nutrition combined with fruit load regulation significantly improved yield structure, fruit size uniformity, and biochemical markers relevant to nutritional and functional quality, including increased dry matter and carbohydrate accumulation. Orchard management practices also contributed to improved classification of harvested fruit into higher product grades, with only 1.5% falling outside regulatory standards. These findings suggest that intensification practices may positively influence factors associated with bioactive compound concentration and functional value.

**Novelty:** This study is the first to evaluate the growth dynamics, yield performance, and functional-quality indicators of Gala Schnico Red and Red Velox apple varieties cultivated under intensive orchard conditions in the foothill zone of Armenia (1000–1600 m). The work integrates modern horticultural intensification practices with functional food science by linking orchard management strategies to nutritional and bioactive-related quality parameters. These findings provide region-specific evidence supporting the development of apples as functionally enhanced agricultural products.

**Conclusions:** In intensive two-year orchards, high-quality and selective apple harvests can be achieved through foliar feeding with macro- and microelements, application of Promalin + Tekamin Max, and precise fruit load normalization (two flowers per fruiting branch; 15–20 fruits per two-year-old tree). These optimized horticultural practices not only enhance yield and quality but may also support the development of apples with improved nutritional and functional properties, contributing to their positioning as evidence-based functional foods.

**Keywords:** intensive orchard system, bioactive compounds, nutritional quality, foliar nutrition, phytohormones, fruit load normalization, functional food potential



**Graphical Abstract:** The effect of amino acids and fulvic acids on the growth, yield, and quality of apple varieties.

## INTRODUCTION:

Apples are a functional food thanks to their high fiber content, vitamins (C, B, A, P, E), minerals (potassium, magnesium, iron, zinc), and antioxidants (polyphenols, quercetin), which support the heart, brain, immune system, and metabolism, lower cholesterol and blood sugar levels, and aid in weight management. They improve gut microflora and make an excellent low-calorie snack that promotes heart, vascular, nervous system, and skin health.

Amino acids are natural organic substances, they are most fully absorbed by the body when taken with food, and not as part of medicinal preparations. Fulvic acids improve the quality of apples, increasing the assimilation of nutrients by plants, which leads to firmer fruits with better taste, color and freshness, and increase resistance to diseases, acting as natural growth stimulants.

The main aim of the high-intensity farming system is to maximize yield per unit area by planting more trees and using various resources efficiently [1-2]. During the period, of which leads to an in the quality the in an intensive orchard, all trees are not only productive, but also of the same size and shape, very uniform and homogeneous, without qualitative deviations, which brings several advantages. [3-5].

It is important to update the varieties with new, more productive low-growing apple varieties imported to the Republic of Armenia, which have already undergone mutation. It is essential to replace the varieties with new, more productive, and low-growing clones to increase the plantation's productivity.

In the Republic of Armenia, apple cultivation is concentrated across almost all agrarian zones. Still, years of experience show that local apple varieties yield high-quality crops in the foothills at altitudes of 1000-1600 meters above sea level [6-8].

As part of a new research initiative, an effective way to achieve high-quality, high-yield foliar nutrition with

macro- and microelements and phytohormones, as well as fruit normalization, has been thoroughly studied.

Applying nutrients while planting apple tree seedlings can improve the environmental adaptability and growth status of apple saplings [9-11].

## MATERIAL AND METHODS

In the garden, the process of tree phenophase transition and yield were determined according to the methodology. The ability of each variety to produce shoots, leaf area, total growth of the current year, and the number of fruiting organs were determined in the plantation [12-14].

Pest and disease studies were conducted according to methods accepted in entomology and phytopathology [15-17].

The experiments were set up 3 times repetitively, with 5-10 trees recorded in each repetition. The harvest data were subjected to statistical analysis using the dispersal analysis method [18-19].

The determination of dry substance in the fruits of the varieties was determined by weight analysis in a fresh sample, and total carbohydrates were determined by the Bertrand method [20-22].

To determine the economic efficiency of the proposed production options, total monetary investments and income were considered [23-25].

**RESULTS AND DISCUSSIONS** (Analysis of Experimental Results): The experiments were conducted in the Nairi (Yeghvard) community of Kotayk province, and the varieties under study were planted in two plots.

The Gala Shniko Red variety was planted on a 4.15 ha plot, and the Red Velox variety was planted on a 4.21 ha plot. The length of the plots was 200 meters, and the width was 215 meters.

The pollinator Malus zumi Professor Sprenger was planted with the Gala Schniko Red variety, and the pollinator Golden Delicious was planted with the Red

Velox varieties. The pollinator varieties were grown in a checkerboard pattern. The M 9 (Malling 9) rootstock was used in the orchard, which is a dwarf, low-growing rootstock. There were 63 rows in each plot [26-27].

The selected feeding area in the garden was 3.4 x 0.8 m, and the planting scheme per plant was 2.72 m<sup>2</sup>. The experiments were conducted in 2022-2023.

The experiments were conducted in four variants:

In the first option, on an area of 2.0 ha, we had fruit norming: 1 branch - 2 fruit or 15-20 fruit/tree, and foliar nutrition with micro- and macroelements and Tekamin Max (amino acids) to stimulate growth and ensure crop quality.

In the second option, on an area of 2.0 ha, we had fruit rationing: 1 fruit branch - 2 fruit or 15-20 fruit/tree, and foliar nutrition with micro and macro elements, and Promalin - a unique growth stimulant, was given to increase the percentage of fruiting and increase the color and size of the fruit.

In the third option, on an area of 2.0 ha, we had fruit rationing: 1 fruit branch: 2 fruit or 15-20 fruit/tree and foliar nutrition with micro, macro elements and Promalin+ Tekamin max (amino acids).

In the fourth option, on an area of 2.0 hectares, we had foliar nutrition with micro and macro elements, without phytohormones and without fruit norming.

During the entire vegetation period, at foliar nutrition we used: Urea (nitrogen) (carbamide) - 2-4 kg/ha, 8-10 repetitions, Monopotassium phosphate - 1% solution, single application with urea in early spring, Zincsulphate - zinc sulfate - 0.15-0.1 l/ha, 3-4 repetitions, Mantrac - manganese - 0.2-0.5 l/ha, 4-6 repetitions, Boron - Bortrac - boron - 1 l/ha, 5-6 repetitions, BitterMag - magnesium sulfate - 3 kg, two repetitions, 2-3 repetitions, Promalin - 0.15 l/ha, 1-2 repetitions, Tekamin max (amino acids) - amino acids - 1-2.5 l/ha, 3-6 repetitions, Controlphyt PK-3.5l/ha, 3-5 times, Stopit-5l/ha, 3-6 repetitions, MAP (MonoAmmonium

Phosphate) - 1kg/ha, 8-10 repetitions, with consumption rates. Foliar nutrition was carried out along with treatment activities:

The garden had an automated fertilization and drip irrigation system; there was also a reservoir and filtration system. When spraying or feeding phytopreparations and fertilizers during foliar feeding, 500-1500 liters of water did not exceed 6.5 km/h, and the machine speed did not exceed 6.5 km/h. Foliar feeding was done on a dry leaf surface in a non-windy environment. Before fertigation, the pH, EC, and TDS of the nutrient solution and soil were measured. The water temperature should be <10 ° C, in this case, 10-15kg of fertilizer was dissolved in 100 liters of water, and if the temperature was > 15 ° C, it was possible to dissolve 20 kilograms of highly soluble fertilizer. Usually, two tanks are used so that sulfates and phosphates do not mix with calcium, and acids are in a separate tank, which was automatically supplied by a dosing device /pump/. During fertigation, the fertilizer compatibility table was also considered. During fertigation, monopotassium phosphate was applied - 10 kg/ha, ammonium sulfate - 10 kg/ha + iron chelate - 5 kg/ha 2-3 times, monoammonium phosphate - 10 kg/ha, Hmistar - 5 kg/ha, 2-4 times, Mugasol-5-10kg/ha, 10 times [28-29].

At different times during the growing season, measures were taken to combat pests and diseases in the orchard. Modern and innovative preparations were chosen for spraying.

Among the pests, the following ones stood out for their harmfulness: *Laspeyresia pomonella*, against which spraying was carried out with Koragen and Proclaim preparations, *Aphis pomi* with Konfidor and Movento preparations, *Scolytus mali* with Dursban preparation, *Bryobia redikorzevi*, *Panonychus ulmi* with Vertimec, Oberon 240, Envidor preparations.

Among the diseases, *Podosphaera leucotricha* stood out for its harmfulness, against which spraying was carried out with Topas, Nimrod, Strobe, and Flint

preparations, *Nectria galligena* Bres., *Cytospora schulzeri* Sacc. Et Syd., *Venturia inaequalis*, against which spraying was carried out with Scor, Delan, Captan, and Polyram preparations.

During the vegetation period, mechanized loosening of the tree trunk areas, spring and summer pruning, the Fusetto formation system was applied, flower norming was performed, the pruned branches were ground and spread on the soil surface as mulch, spraying was carried out, and in the fall, semi-decomposed manure + supercompost + volcanic slag was widely applied in the near trunk areas at a rate of 20 t/ha.

A four-story reinforced concrete column-wire system was installed in the garden; the distance between columns was 9.6 meters, and there was a tent-shaped anti-hail protection net.

The establishment of the garden was carried out with consideration of the region's soils, climate, and geographical location. An agrochemical examination of the soil was carried out before establishing the garden, which is presented in Tables 1 and 2.

**Table 1:** Results of agrochemical soil testing

Plot of land	Sample depth: 0-40 sm	Mechanical composition	Soil composition, %	Humus (%)	Soil salinity (%)	Organic matter, %	PH	Carbonate content %	Total nitrogen content, %	Soil nutrient content (mg/100g)			
										P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Mg	B
1		sandy clay	sand -57,0	2,7-2,8	0,29	1,72-	7,31	5,04	0,82	17,0	30,0	30,0	1,14
2			silt -34,0										
3			clay -9,0										
4			common lime -7,0										

The data shows that the soil had an average yield and a pH that is generally normal, if not slightly high, indicating that fertilizers were not abused.

The result of the soil sample analysis fell in the intermediate range for sulfur sulfate content. P was very low, K was very high, Mg was very high, Ca was very high, Na was low, Fe was low, Mn was high, Zn was very high, Cu was very high, and B was low. Micro and macro elements in the soil were compared with the normative table given after the analysis.

The results of the nutrient solution drainage analysis show that there was a high content of carbonates and iron, there were significant amounts of silt and sand, and a high chlorination capacity index for ammonium oxalate [30-31].

Results of phenological observations: Correctly defining the timing of the transition of phenophases during the vegetation period of fruit trees was of great importance for organizing agrotechnical measures (Table 2).

**Table 2:** The dates of leaf fall and vegetation duration of apple varieties in a 2-year-old orchard /2022-2023/

Variety name	Swelling of vegetative buds and separation of scales	Deciduous			Vegetation duration, days
		beginning	mass	End	
Gala Shniko Red	22.04.	15.10	25.10	06.11.	193
Red Velox	29.04.	27.10	07.11	18.11.	195

Studies have shown that the difference in vegetation duration between varieties is approximately 2 days.

Data on growth and leaf area indicators of 2-year-old orchard varieties are presented in Table 3.

As a result of observations and calculations, we have concluded that various agricultural measures (pruning, fertilization, foliar nutrition, shaping) have a significant impact on the annual growth intensity and leaf area of apple trees [32-34].

In terms of leaf area per tree, the 4th version of the Red Velox variety was inferior to the 1st version (3600

cm<sup>2</sup>), the 2nd version (7280 cm<sup>2</sup>), and the 3rd version (10416 cm<sup>2</sup>).

The number of fruiting branches of the studied varieties is presented in Table 4.

As can be observed from the data in Table 4, foliar feeding with growth and fruiting hormones clearly yields higher results than cultivation technology without these hormones. The number of fruiting branches in the Gala Shniko Red variety in the 2nd variant is 26, and 34 in the 3rd variant. Table 5 presents the data from the study of generative fruit buds.

**Table 3** Growth and leaf area index of varieties /in a 2-year-old orchard: 2022-2023/

Experiment options	Varieties	Per tree		Number of skeletal shoots, piece	Number of leaves on a shoot, piece	Surface area of one leaf, cm <sup>2</sup>	Leaf area of one tree, cm <sup>2</sup>
		Length of the shoots /average of 10 shoots/, cm	Number of shoots, piece				
Variant I	Gala	30	18	4	10	32	5760
Variant II	Shniko	36	20	4	12	38	9120
Variant III	Red	45	22	4	14	40	12320
Variant IV		20	16	4	8	26	3328
Variant I	Red Velox	32	20	4	12	36	8640
Variant II		44	22	4	14	40	12320
Variant III		55	23	4	16	42	15456
Variant IV		25	18	4	10	28	5040

**Table 4** Number of fruit-bearing branches of the studied varieties /in a 2-year-old orchard: 2022-2023/

Experiment options	Varieties	Number of fruit-bearing, flowering branches per tree (pcs)	Annual fruit shoots	Generative branches, pcs.		
				fruit bud (peduncle)	lance	fruit-bearing
I	Gala Shniko Red	22	8	6	4	6
II		26	8	8	6	8
III		34	10	10	8	10
IV		18	7	4	4	4
I	Red Velox	26	10	8	6	8
II		30	10	10	8	10
III		39	10	12	10	12
V		22	8	6	6	6

**Table 5.** Changes in generative (fruit) buds /2022-2023 average data/

Varieties	Buds swelling	Bud opening	Flowering			Fruit formation	The beginning of fruit ripening	Full ripening of the fruit
			Beginning	Mass	End			
Gala Shniko Red	12.04.	17.04	25.04	01.05	08.05	16.05	08.08.	01.09.
Red Velox	18.04.	23.04	01.05	06.05	13.05	21.05	20.08	15.09

Yield is greatly influenced by pruning. The performance of which, depending on variety, is explained as follows. The studied varieties bear fruit mainly on short fruiting branches, on the fruit bud (peduncle), on a smaller number of fruiting shoots and lances, and on the fruit-bearing shoots.

These branches are long-lived, living 12-15 and sometimes 17-20 years; give a good harvest in the 6th-8th years of their lives; and are densely arranged on the

base of skeletal and semi-skeletal branches. In their fruit-giving year, a single weakly developed bud emerges from the fruit sac, which, opening the following year, gives a leaf rosette. A 2-3 cm-long shoot often develops from the fruit sac of the fruit-bearing plants at the edges of the foliage, which forms a rosette the following year. On the opposite side of that shoot is a small bud with a sharp tip, which, when opened, gives rise to a more extended shoot.

**Table 6.** Calculation of the yield of varieties /2-year-old orchard with average data for 2022-2023/

Experiment options	Name of varieties	Average fruit weight, grams	Yield per tree, kg	Yield per hectare, t/ha
I	Gala Shniko Red	160	2,0	7,3
II		170	2,5	9,1
III		180	3,0	11,0
IV		120	1,5	5,5
I	Red Velox	160	2,4	8,8
II		180	3,0	11,0
III		200	3,5	12,8
IV		130	1,8	6,6

The experimental error was  $Sx_0\% = 4.89\%$ , and the least significant difference was  $LSD_{0.5} = 1.32$ .

Given that the crop was not formed in the first year of planting because the flowers were shed en masse, the data in Table 6 show that the Red Velox variety stood out in terms of yield in the 3rd version. We planted 3677 trees per hectare.

After each harvest, the fruit was evaluated by the organoleptic method. The basis was the interstate standard GOST 34314-2017.

According to the requirements specified in the regulatory document, the following indicators of the fruits were evaluated: appearance, smell and taste,

degree of maturity, and size. In addition, the weight fraction of fruits that did not meet regulatory requirements was determined, as were the numbers of fruits with injuries, diseases, and the presence of pests and foreign impurities. The table above shows the marketable yield, while the non-marketable yield is 5-10%. According to the product evaluation indicators, the fruits were divided into the corresponding product groups: high, first, and second. 1.5% of the total harvest did not meet regulatory requirements. The indicators mentioned are presented in Table 7 below by variety. The fruits of all product groups were well-formed, of an appropriate degree of maturity, healthy, fresh, whole,

clean, but not washed (as required), typical of the pomological variety, without mechanical or pest damage, without excess surface moisture, and with a fruit stalk [35-37].

The data in Figure 1 shows that the sugar content of the fruits did not differ significantly between the variants, while the dry matter content showed 2-3% differences between the variants [38-40]. In the studied varieties, when applying the 3rd method, we recorded high levels of total carbohydrates and dry matter, which are

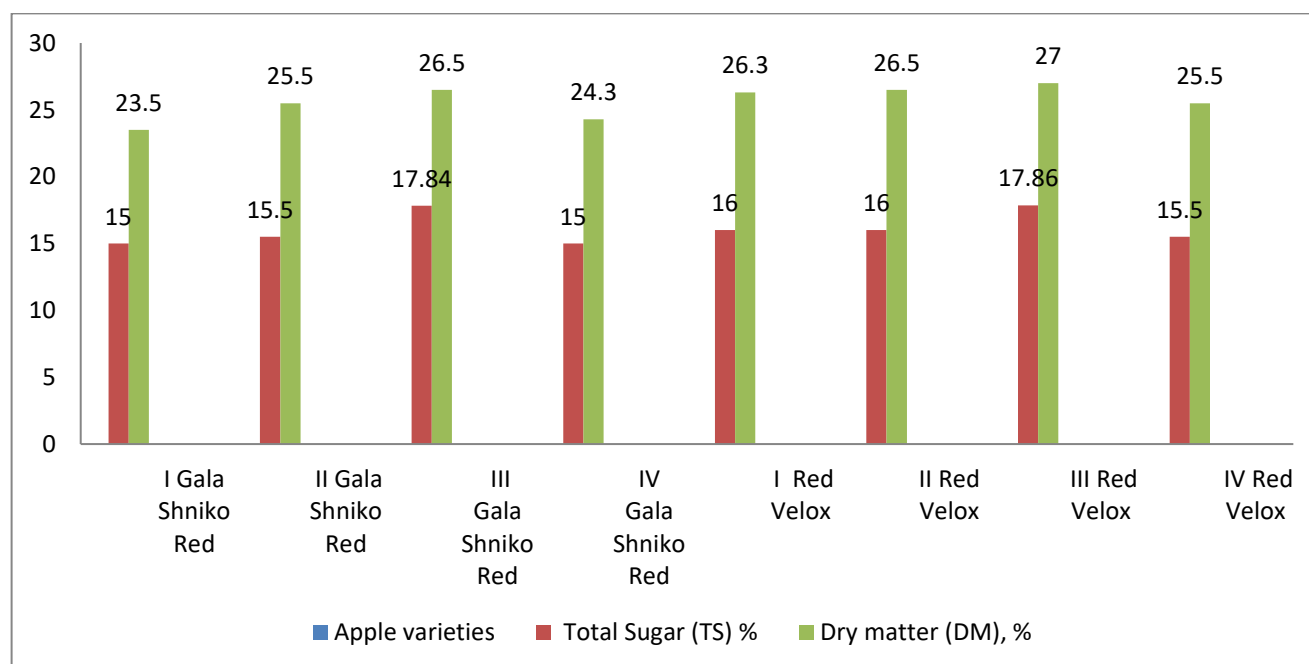
important as functional food components in the human diet.

From the data in Table 8, it was found that our production costs per hectare amounted to 5 million drams or 13,072.52\$, and our costs for the additional harvest amounted to 1.0 million drams or 2,614.50\$.

According to the options, the harvested fruits' sugar and dry matter content were analyzed, and the results were determined.

**Table 7.** Yield of apple varieties by product group.

Experiment options	Apple varieties	Product groups %		
		High	First	Second
I	Gala Shniko Red	63,5	32,5	2,5
II		65.1	30.7	2.9
III		71.9	25.4	1.5
IV		25,8	24,5	40,5
I	Red Velox	58,5	38,2	1,5
II		60.2	33.4	4.9
III		76.2	19.2	3.4
IV		22,5	25,5	50,5



**Figure 1.** Fruit quality characteristics of apple varieties

**Table 8.** Evaluation of the economic efficiency of apple varieties for 1 ha of orchard.

Experiment options	Variety name	Yield, t/ha	Additional harvest received, t/ha	Additional harvest income, thousand/dram or US dollar	Average selling price of fruit, AMD or US dollar/kg	Cost of additional harvest, AMD or US dollar/kg	Additional profit received, thousand AMD or US dollar
I	Gala	7,3	1,8	1080,0=2823,66	600=1,57	555,5=1,45	80,0=209,16
II	Shniko	9,1	3,6	2160,0=5647,33		278=0,73	1160,0=3032,82
III	Red	11,0	5,5	3300,0=8627,86		182,0=0,48	2300,0=6013,36
IV		5,5	-	-		-	-
I	Red	8,8	2,2	1320,0=3451,14	600=1,57	454,54=1,19	320,0=836,64
II	Velox	11,0	4,4	2640,0=6902,29		227,3=0,59	1640,0=4287,79
III		12,8	6,2	3720,0=9725,95		161,3=0,42	2720,0=7111,45
IV		6,6	-	-		-	-

**Bioactive Compounds Comparison:** Gala and Gala Schniga Red were compared with several common commercial cultivars by quantifying major phenolics and flavonoids and by profiling cultivar-specific differences.

The table below summarizes available quantitative data reported in the supplied studies and notes where the corpus does not provide numeric values.

**Table 9.** Comparison of Bioactive Compound Content in Gala and Gala Schniga Red with Common Commercial Apple Cultivars.

Variety	Reported Bioactives	Notes
<b>Royal Gala (Gala)</b>	Chlorogenic acid: 15.69 ± 0.09 mg/g fw; Quercetin: 18.96 ± 0.08 mg/g fw	Royal Gala showed high chlorogenic acid and quercetin among five Australian-grown cultivars [41].
<b>Red Delicious</b>	Total phenolic: 121.78 ± 3.45 mg/g fw; Total flavonoid: 101.23 ± 3.75 mg/g fw	Red Delicious had the highest reported total phenolic and flavonoid values [41].
<b>Fuji</b>	Listed among comparative cultivars; specific values not provided	Cultivar appears in comparative studies, but no particular mg/100 g numbers [41-42].
<b>Golden Delicious</b>	Higher carotenoids in peel; total phenolics are higher in red-skinned cultivars	Peel studies reported cultivar-specific trends but not complete values [43].
<b>Granny Smith</b>	Insufficient evidence for specific concentrations	No quantitative numbers are retrievable from the provided abstracts.
<b>Braeburn</b>	Insufficient evidence for specific concentrations	No quantitative numbers are retrievable from the provided abstracts.
<b>Gala Schniga Red</b>	Highest total saccharide content and intensely red peel; highest semiquinone radicals	HPLC/GC-MS and EPR analyses report elevated saccharide content and distinct red pigmentation [44].
<b>General (peel vs flesh)</b>	Quercetin glycosides in peel: ~203 ± 108 mg/100 g; Phenolic acids in flesh: ~10 ± 5 mg/100 g	Peel concentrates flavonols; older cultivars have higher flesh polyphenol content [45].

Key cultivar distinctions: Royal Gala stands out for its high levels of chlorogenic acid and quercetin [41]. At the same time, Gala Schniga Red is especially notable for high soluble saccharide content, intense dark-red blush, and unique radical signatures [44].

**Functional Food Potential:** Royal Gala's high chlorogenic acid and quercetin content supports antioxidant- and polyphenol-focused product concepts such as concentrated juices, standardized peel extracts, and polyphenol-enriched powders for functional beverages and nutraceutical capsules [41-45]. Reviews associate

these polyphenols with potential reductions in cardiometabolic and inflammatory risk markers [46].

#### Processing and formulation considerations:

- **Postharvest treatment impact:** Application of 1-MCP on Gala mutants altered physicochemical characteristics and antioxidant activity, indicating that storage and postharvest protocols can modulate final polyphenol availability [47].
- **Juice and concentrate applications:** Comparative juice studies show cultivar-dependent total phenols and antioxidant capacity; using high-polyphenol cultivars can increase functional value [42].
- **By-product valorization:** Peel and core fractions concentrate phenolics and are viable feedstocks for extracts, powders, or fortificants suitable for nutraceutical use [48].
- **Powder and inclusion formats:** Development of natural powders from organic apple varieties and addition of fruit pieces into dairy desserts show practical routes to incorporate apple bioactives into functional foods [49,50].
- **Practical development roadmap:**
- **Ingredient route:** Produce peel-enriched extracts or spray-dried powders from Royal Gala to leverage high chlorogenic acid/quercetin levels [41,45,48].
- **Product route:** Formulate juices and dairy-based desserts incorporating Gala/Gala Schniga Red concentrates; optimize postharvest handling to preserve polyphenol levels [42,47,49-50].
- **Analytical route:** Perform cultivar-specific HPLC quantification and processing tests prior to scale-up [45, 47-48].

**Scientific Innovation:** The scientific for the first time, the growth and yield characteristics of the Red Velox and Gala Schnico Red varieties have been studied in an

intensive orchard located in the foothill zone of the Republic of Armenia. The variety study was carried out under the conditions of the cultivation technology used in the intensive orchard, as a new, effective way to obtain a high-quality, high-quantity harvest. Foliar nutrition with macro-, microelements, and phytohormones was studied in depth, as well as fruit norming. Solely apple tree is generally considered a golden fruit, as it is suitable for people with all types of health conditions.

**Practical Implications:** This study's in our work, the following cultivation technologies used in intensive orchards were studied: autumn fertilization in the near-trunk zones, mechanized weeding and soil loosening in the near-trunk areas, spring and summer pruning, formation using the Fusetto system, creation of mulch from pruned branches, an automated drip fertigation and irrigation system, treatments, the use of a four-level trellis system and hail-protection netting, and the thinning of flowers and fruits. In this context, fertilization—particularly foliar feeding with macro- and microelements combined with phytohormones and fruit thinning—was highlighted as an effective and reliable method for improving growth, yield, and fruit quality.

#### CONCLUSION

According to analysis the results of our experiment, it is recommended for production based on the background of the application of all general measures of cultivation technology in a two-year intensive orchard, as an effective means of cultivation technology for obtaining high and specific yields, along with foliar nutrition with micro and macro elements, cultivation using Promalin, Promalin + Tekamin max and standardizing each fruit-bearing branch with two flowers and fruits, and 15-20 fruits per two-year-old tree is recommended for production.

**Abbreviations:** Ca: calcium; Fe: iron; Mg: magnesium; P: phosphorus; K: potassium; Zn: zinc; M: manganese; Cu:

copper; F: fluoride; Se: selenium; N: nitrogen; DM: dry matter; TS: total sugar Ha: 10,000 square meters area; AMD: Armenian dram; 1000 AMD is 2,61\$ or US dollar.

**Competing Interests:** The authors declare that they have no competing interests.

**Authors' Contributions:** GS, DM, and CM discussed the article's concept and developed the content. KA and GG reviewed numerous literary sources., AY, and AM conducted analyses. MGH, AM, AY, and GG carried out the data collection and compiled the tables. MS, GG and GarushS, GG edited the article and contributed to its editing, formatting, and creation of the graphical abstract. All authors have read and approved the final version of the manuscript.

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