

Economic Performance Indicators of Promising Kiwi Varieties Cultivated in the Lankaran Region

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Abstract. *This article extensively investigates the main agronomic and biological characteristics of promising kiwi cultivars grown in the southern subtropical zone of Azerbaijan, particularly in the Lankaran-Astara region. The aim of the study was to conduct a comparative evaluation of the productivity potential, fruit quality, ecological adaptability, and economic efficiency of different kiwi cultivars. The research focused on four cultivars of *Actinidia deliciosa*: Hayward, Bruno, Shahla, and Abbott. The research was conducted in specialized plantations located in the Lankaran-Astara region and included long-term phenological observations, biometric measurements, and laboratory analyses. Phenological stages (flowering, fruit set, and ripening), plant biometric parameters (shoot length, leaf area, fruit weight), as well as productivity and fruit quality indicators (sugar content, acidity, dry matter content) were studied. The obtained results were statistically analyzed, and the economic efficiency of the cultivars was evaluated based on production costs and market revenues. The results showed that the Hayward and Shahla cultivars had higher productivity, larger fruit weight, better market appearance, and superior taste qualities. The Bruno and Abbott cultivars, while satisfactory in terms of certain agro-biological characteristics, perform less well than in overall economic efficiency. Overall, the Hayward and Shahla cultivars are considered more promising for the Lankaran-Astara region. The obtained data are of significant scientific and practical importance for the expansion of kiwi cultivation in the region, the selection of optimal cultivars, and the development of export-oriented production.*

Keywords: kiwi, *Actinidia deliciosa*, cultivar, yield, economic indicators, subtropical zone

Introduction

Kiwi (*Actinidia deliciosa*) is a subtropical fruit crop with high nutritional value, rich biochemical composition, and wide utilization potential, and it is among the rapidly expanding fruit species worldwide (Huang, 2016; Testolin et al., 2019). Kiwi fruit is particularly characterized by its richness in vitamin C, organic acids, mineral elements, and bioactive compounds (Korkmaz et al., 2023). These characteristics make it a valuable raw material for both fresh consumption and the processing industry.

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The fruit's unique chemical composition, along with its diverse medicinal and organoleptic properties, has contributed to the widespread cultivation of this valuable subtropical crop (Liu et al., 2016). Kiwi fruits are rich in vitamins C, A1, B1, B2 and P, as well as mineral salts, aldehydic compounds, and phenolic compounds (Korkmaz et al., 2023). All of these contribute to increased resistance to infectious diseases in the human body, support the maintenance of hemoglobin levels in the blood, and have a positive effect on cell regeneration and muscle strengthening (Testolin et al., 2019).

One of the main bioecological characteristics of kiwi plants is their relatively high frost tolerance (down to -15 °C), with some species even capable of withstanding temperatures of -25 to -30 °C (Richardson et al., 2018). The plant has a well-developed root system concentrated in the upper soil layer (25–30 cm), and its resistance to diseases and pests enables its cultivation alongside other subtropical crops (Peterson & Willett, 2000).

The kiwi vine is also widely used as an ornamental plant in recreational areas, along water bodies, and in parks (Müller et al., 2015). In addition, pruned kiwi shoots are utilized for weaving baskets and producing various souvenirs.

In recent decades, the role of agriculture, particularly fruit production, has increased in the development of Azerbaijan's non-oil sector. The Lankaran-Astara subtropical zone, with its unique humid climate, mild winters, and fertile soils, is considered a highly suitable region for kiwi cultivation (Mammadov, 2018). The area under kiwi orchards in this region has been expanding year by year. However, the proper selection of cultivars remains a key factor in ensuring high productivity efficiency.

In this context, the scientific assessment of the ecological adaptability, productivity, and fruit quality traits of promising kiwi cultivars based on sound scientific principles is of significant theoretical and practical importance (Liu et al., 2016). The present study provides a comprehensive analysis of the main agronomic characteristics of the widely cultivated Hayward, Bruno, Shahla, and Abbott cultivars in the Lankaran-Astara region (Mammadov, 2018).

Methods

The main agronomic characteristics of kiwi plants play an important role in evaluating their suitability for production and their economic efficiency. These indicators reflect the crop's yield potential, fruit quality attributes, and profitability in relation to cultivation costs (Ferguson & Huang, 2007).

In kiwi cultivation, yield is determined by the amount of produce obtained per plant and per hectare. Under subtropical conditions and with proper agronomic management, an average yield of 30–50 kg per plant and 15–25 tons per hectare can be achieved (Eynard et al., 1992).

Results and Discussion

The average fruit weight varies between 70 and 120 g depending on the cultivar. Large and uniformly shaped fruits are considered more suitable for the market. Fruit quality is characterized by dry matter, sugar, organic acids, and vitamin C content. Dry matter ranges from 12–18 %, while sugar content varies between 8–12%. Kiwi fruits contain more than 160 mg% vitamin C and over 170mg% vitamin A, as well as a high level of mineral salts (Ca, Mg, P, Fe, K, etc.) (Korkmaz et al., 2023).

Although kiwi fruits are not particularly attractive in external appearance, the emerald-green flesh is aromatic and characterized by a sweet-sour taste with a flavor profile reminiscent of feijoa, strawberry, blackberry, pineapple, watermelon, and banana. Actinidia fruits play an crucial role in

regulating dietary balance. They enhance the body's resistance to diseases, promote tissue regeneration, and strengthen muscles (Testolin et al., 2019).

The results of phenological observations of the studied kiwi cultivars during the research years are presented in Table 1 below.

Table 1
Phenological observations of the studied kiwi cultivars

Kiwi cultivars	Age of the plant	Growth stage	Bud swelling	Bud burst	Shoot formation	Leaf development	Budding	Flowering	Fruit formation	Fruit ripening
Hayward	10	Initial stage	25.III	27.III	07.IV	10.IV	10.IV	16.V	20.V	12.XI
		Large-scale	26.III	02.IV	9.IV	15.IV	15.IV	19.V	26.V	18.XI
Shahla	10	Initial stage	22.III	25.III	02.IV	09.IV	09.IV	18.V	19.V	15.XI
		Large-scale	24.III	27.III	04.IV	14.IV	14.IV	25.V	21.V	21.XI
Bruno	10	Initial stage	25.III	02.IV	05.IV	08.IV	09.IV	18.V	24.V	14.XI
		Large-scale	27.III	03.IV	09.IV	13.IV	15.IV	25.V	29.V	22.XI
Abbott	10	Initial stage	23.III	04.IV	10.IV	11.IV	11.IV	15.V	18.V	5.XI
		Large-scale	25.III	06.IV	12.IV	17.IV	17.IV	22.V	21.V	10.XI

Kiwi cultivars begin bearing fruit in the third to fourth year after planting, while full productivity is typically observed in the sixth to eighth years. The vegetation period averages 210–240 days (Yuan et al., 2023).

Kiwi fruits have good storage and transportability and can be stored under refrigerated conditions for 4–6 months without significant loss of quality, which increases their export potential. Compared with other subtropical crops, this is a relatively high indicator (Wei et al., 2025).

In terms of economic indicators, high yield and long storage life ensure the profitability of kiwi production. The income obtained from one hectare of kiwi orchard can be higher compared to other subtropical fruit crops.

During the research period, the yield characteristics of promising kiwi cultivars were studied comparatively. It was found that there are significant differences among cultivars in terms of yield per plant and per hectare.

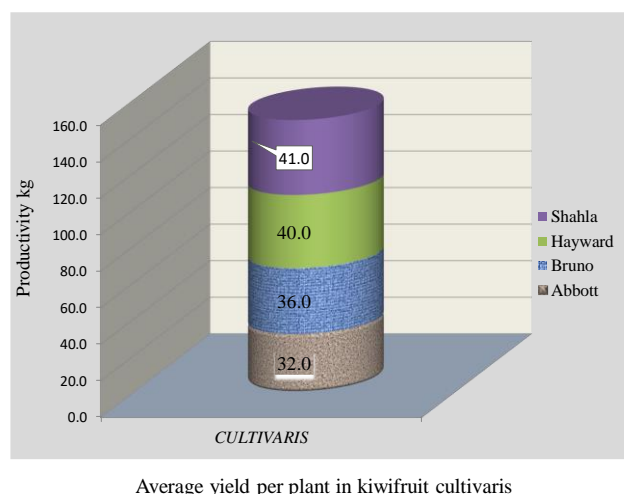


Figure 1
Comparative yield performance and stability of kiwifruit cultivars
(Shahla, Hayward, Bruno, Abbott)

As shown in the diagram, the Shahla cultivar demonstrated the most stable and consistently high yield over the study years. On average, it produced 36–41 kg per plant and 19–21 tons per hectare. The Hayward cultivar showed relatively high productivity; however, inter-annual variability was observed (36–40 kg per plant). The Bruno cultivar exhibited comparatively lower yield, also with noticeable year-to-year fluctuations (34–36 kg per plant). Although the Abbott cultivar is early-maturing, it lagged behind the other cultivars in terms of yield (28–32 kg per plant).

These indicators demonstrate that the Shahla and Hayward cultivars are more promising for the Lankaran-Astara region. Fruit quality parameters, including average fruit weight, dry matter content, sugar content, and taste characteristics, were studied. The analyses showed that the average fruit weight of the Shahla cultivar ranged between 100–120 g. In the Hayward cultivar, it ranged from 90–110 g. In the Bruno cultivar, this parameter was 80–95, while in the Abbott cultivar it was 70–85 g. (Hasanov & Aliyev, 2012).

The dry matter content was 16–17% in Shahla, 14–16% in Hayward, 13–15% in Bruno, and 12–14% in Abbott. In terms of sugar content, the Bruno cultivar showed relatively higher values, which is crucial factor enhancing both market and taste quality of the fruit.

The market value of promising kiwi cultivars is mainly determined by fruit size, external appearance, transportability, and storage capacity. The Hayward and Shahla cultivars are distinguished by their large fruit size and their ability to maintain quality during long-term storage and transport. These features make them more attractive as export-oriented products.

Economic calculations showed that the cultivation of Shahla and Hayward cultivars provides higher profitability compared to the other cultivars. The net income per hectare was higher than that of the Bruno and Abbott cultivars. In this regard, the Hayward cultivar was evaluated as the most economically efficient. At the same time, the sustainability and profitability of kiwi production are closely related to risk management and agricultural insurance mechanisms, which play an important role in protecting farmers against climatic and market uncertainties (Famiani et al., 2012).

Conclusion

Based on comprehensive comparative agronomic evaluation of promising cultivars, it was determined that under the soil and climatic conditions of the Lankaran-Astara subtropical region, the Hayward

and Shahla cultivars are superior in terms of yield, fruit quality, and economic efficiency. The Bruno cultivar is notable for its productivity but is inferior to Hayward in fruit quality and storage capacity. The Abbott cultivar has the advantage of early fruiting; however, it is relatively weaker in overall yield and economic indicators.

The obtained results are of significant scientific and practical importance for the proper selection of kiwi cultivars in production, the expansion of kiwi cultivation, and the development of horticulture in subtropical regions. Thus, the conducted research enabled scientifically based evaluation of the agronomic performance of promising kiwi cultivars and the selection of optimal cultivars for production.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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