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Quality Characteristics of Peach Fruits from Trees Trained Using Different Canopy Systems (Case of Fergana Region)

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Abstract: This study investigated the effects of different canopy training systems on the fruit quality characteristics of the peach cultivar Muyassar under the agro-climatic conditions of the Fergana Region. Fruit quality was evaluated by analyzing average fruit weight, external appearance, taste, sugar content, and overall quality score in trees trained using vase-shaped, bush-shaped, sparse-tiered, and four-leader Spanish Bush systems. The results revealed significant differences among the training methods. Trees trained under the sparse-tiered and four-leader Spanish Bush systems produced fruits with superior marketability and consumer quality attributes compared with the other treatments. These findings indicate that appropriate canopy management can play an important role in enhancing peach fruit quality and commercial value in intensive orchard production systems.

Keywords: Peach, Muyassar cultivar, canopy training systems, sparse-tiered system, Spanish Bush system, fruit quality, marketability, sugar content, sensory evaluation, horticulture.

Introduction: In recent years, substantial efforts have been undertaken to reform the agricultural sector and promote the adoption of market-oriented mechanisms in agricultural production. As a result of these initiatives, Uzbekistan has strengthened its position in international agricultural markets. Currently, more than 80 types of agricultural products produced in the country are exported to 66 countries worldwide. In particular, the export volume of fruits, vegetables, and legume crops nearly doubled between 2016 and 2021, reflecting the growing competitiveness and export potential of the horticultural sector [5].

At the same time, there is a growing need to maximize the efficient use of land areas being reallocated from cotton and wheat production. Particular attention is being directed toward expanding the cultivation of export-oriented horticultural crops, including fruit trees, vineyards, melons, vegetables, legumes, and oilseed crops. Achieving sustainable growth in this sector requires the development of effective land-use systems that not only enhance agricultural productivity but also encourage the participation of broader segments of the population. Therefore, the implementation of scientifically grounded approaches and evidence-based research has become essential for ensuring the successful development and competitiveness of the agricultural sector [1].

To ensure the effective implementation of these governmental policies and strategic initiatives, extensive efforts are being undertaken across the agricultural sector. In particular, significant progress has been achieved in horticultural research and development through the breeding of high-yielding cultivars with enhanced resistance to diseases and

pests, as well as strong market and export potential. Furthermore, the adaptation and acclimatization of introduced cultivars and hybrids to local environmental conditions have been successfully carried out, contributing to the diversification and improvement of fruit production systems.

METHODS

Experimental observations were conducted using local and introduced peach cultivars belonging to the peach gene pool as research objects, and all field studies were carried out in accordance with internationally accepted methodological standards applied in the field of fruit growing. In this study, the comparative assessment of biometric indicators of peach Kh. Ch. Buriev and others [2; 64 p.], E.N. Sedov, T.P. Ogoltsova [4; 378-399 p.] and Yu.B. Ryabushkin [3; 44 p.] was performed according to the methods recommended by scientists.

The research conducted under the conditions of the Fergana region was also aimed at addressing various issues and their solutions in the field of horticulture. It focused on the development of peach trees in these soil and climatic conditions, and on forming general conclusions based on the results of phenological and biometric analyses obtained from different cultivars. Experiments were also carried out to study the advantages and disadvantages of various training (tree shaping) methods.

It is known that fruit quality is characterized by indicators such as size, taste, uniformity, yield of marketable grades, harvest time, duration of fresh storage (storability), chemical composition, and technological properties. All these indicators are evaluated after the trees reach full bearing stage, and their relationship with weather conditions, location of the site, and agrotechnical practices is also determined [2; 64 p.].

Before forming (training) any fruit tree, it is necessary to study its fruiting characteristics. Pruning and shaping cannot be carried out without first identifying which branches are fruit-bearing. Peach produces fruit on one-year-old shoots, and because its branches grow vigorously, nearly 50% of the newly grown shoots are pruned each year. [7; 9 p.]

RESULTS AND DISCUSSION

In the conducted experiment, particular attention was given to evaluating the marketability of fruits based on indicators such as average fruit weight, attractiveness of external appearance, and taste qualities. During the study, the influence of different tree training systems on the marketable and consumption value of the yield was assessed. The main criteria included average fruit weight, external appearance, tasting score, sugar content, and overall quality indicators.

The results showed variation in the marketability indicators of fruits of the ‘Muyassar’ peach cultivar depending on the tree canopy training method. According to the obtained data, the highest average fruit weight was recorded in trees formed under the open-centre system, reaching 138.9 g. This value was 10.6 g or 8.3% higher compared to the control variant. In trees trained using the four-leader “Spanish bush” system, the average fruit weight was 134.4 g, while in the bush-shaped system it was recorded at 127.8 g.

The increase in fruit weight may be associated with optimal canopy formation of the trees, which allows better penetration of light into the inner parts of the crown, enhances photosynthetic activity, and ensures more efficient allocation of assimilates to generative organs. Since the difference between the mean values exceeded $EKF_{0.5}$ = 0.73 g, the results were considered statistically reliable.

In terms of external appearance, higher scores compared to the control (cup-shaped form, 4.0 points) were recorded in the experimental variants formed under the open-centre and four-leader “Spanish bush” systems. In these variants, the external appearance of ‘Muyassar’ peach fruits was rated at 4.1 and 4.2 points, respectively. In the bush-shaped variant (3.6 points), the fruits received slightly lower scores compared to the control treatment.

These results indicate that the architecture of the tree canopy has a significant influence on fruit coloration, uniform development, and external aesthetic appearance. In particular, the even distribution of light within the “Spanish bush” system contributed to the formation of fruit quality traits that meet market requirements. The observed differences in external appearance exceeded the $EKF_{0.5}$ = 0.09 point threshold, confirming their statistical reliability.

The taste quality scores in the open-centre and four-leader “Spanish bush” training systems were at the same level as the control variant. Only in the bush-shaped system (3.5 points) was the fruit taste rated slightly lower compared to the control treatment (see Table).

Table

Quality indicators of fruits of peach cultivars in the collection orchard under the conditions of the Fergana region (2022–2024)

№	Training method	Average fruit weight (g)	External appearance (score)	Taste (score)	Sugar content (%)	Overall score
1	Cup-shaped (control)	128,3	4,0	3.9	12,3	4,0
2	Bush-shaped	127,8	3,6	3,5	12,9	3,6
3	Open-centre (sparse tier)	138,9	4,1	3,9	11,7	4,0
4	Four-leader “Spanish bush”	134,4	4,2	3,8	13,1	4,0
	EKF_{05}=	*0,73*	*0,09*	*0,08*	*0,26*	*0,09*
	$Sx_{\%}$=	*2,07*	*2,16*	*2,20*	*2,09*	*2,18*

The formation of taste depends on the ratio of sugars, organic acids, and other biologically active compounds in the fruit. It can be assumed that in the bush-shaped system, the relatively dense canopy worsened the light regime, reduced the efficiency of photosynthetic processes, and consequently led to a decrease in the tasting score. The differences in taste indicators were found to be statistically reliable at $EKF_{0.5}$ = 0.08 points.

Biochemical analyses showed that the sugar content of the fruits varied depending on the training system. The highest value was recorded in the four-leader “Spanish bush” system, reaching 13.1%. In the bush-shaped variant, the sugar content was 12.9%, in the control variant 12.3%, and in the open-centre system 11.7%.

The higher accumulation of sugars can be explained by the high activity of the tree’s photosynthetic apparatus and the intensive translocation of assimilates into the fruits. In particular, in the “Spanish bush” system, good canopy illumination accelerated carbohydrate biosynthesis and improved the eating quality of the fruits.

All studied indicators were reflected in the overall fruit quality score. In this regard, the overall quality rating of fruits in the open-centre and four-leader “Spanish bush” training systems was at the same level as the control variant (4.0 points). Only the bush-shaped system (3.6 points) showed a slightly lower overall score compared to the control treatment.

This indicates that tree training methods influence not only morphological traits but also organoleptic characteristics of the yield. In particular, the open-centre and “Spanish bush” systems ensured a higher level of marketability and consumption quality of the fruits [6; 104–106 p.]

CONCLUSION

The results of the study conducted under the conditions of the Fergana region showed that different training systems of peach trees have a significant effect on fruit quality indicators. The highest average fruit weight was recorded in trees trained under the open-centre system, reaching 138.9 g. In terms of fruit appearance and sugar content, the four-leader “Spanish bush” system demonstrated the best results.

The findings indicate that optimal canopy formation contributes to a more uniform distribution of light within the tree crown, enhances photosynthetic activity, and ensures efficient translocation of assimilates to the fruits. As a result, fruit size, coloration, taste, and overall consumption quality were improved.

Overall, the open-centre and four-leader “Spanish

bush" training systems proved to be effective in improving the marketability and quality of peach fruits. Therefore, the application of these methods in intensive orchard management is considered appropriate. In contrast, the bush-shaped system showed relatively lower performance across the studied indicators and is recommended for limited use under production conditions.

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