ANNALS OF THE UNIVERSITY OF CRAIOVA

Series: ✓*Biology*
✓*Horticulture*
✓*Food products processing technology*
✓*Environmental engineering*

Vol. XXX (LXVI) - 2025

TREE MANAGEMENT SYSTEMS FOR HIGH-DENSITY CHERRY PLANTATIONS

Balan Valerian[1]*, Bîlici Inna[2], Șarban Vasile[3], Russu Stanislav[4]
[1]*Technical University of Moldova
[2] Technical University of Moldova
[3] Ministry of Agriculture and Food Industry
[4] Technical University of Moldova
* *Corresponding author E-mail:* inna.bilici@h.utm.md

Keywords*: Cherry; Crown form; Harvest; Fruit quality*

ABSTRACT

This research orchards were established in the central (2015) and northern (2018) areas of the Republic of Moldova, using Black Star, Regina, Summit and Sweet Sharetta varieties, grafted on Gisela 6 rootstock. For each variety- rootstock combination and training system, varying densities were established, ranging from 1250 trees/ha (for thin-stem, cup, Kym Green Bush) to 2500 trees/ha (for thin-stem, improved thin-stem, structured vertical axis). Black Star, grown under the thin-stem system, obtained the highest yields between 9.39 and 10.92 t/ha at the age of 7-10 years. For varieties Regina, Summit and Sweet Sharetta planted at 4x1 m spacing, the improved thin spindle crown shape had a modest impact on productivity, but provided important benefits on fruit size uniformity along the entire length of the axis. The thin spindle crown shapes and the vertical axis crown shape proved to be less efficient in distributing fruit evenly along the axis

INTRODUCTION

Cherry (Prunus avium L.) is one of the most appreciated fruit trees for its economic and nutritional value. The crown shapes and pruning methods of fruit trees are diverse and depend on the species, variety, available space, purpose of harvesting and crop management. (Asanică A. 2012; Cimpoieș Gh. 2018). In cherry (C. avium) are used crown forms of tiered crowns with large volume, with well-distributed and open branches to allow light penetration and air circulation, tiered pyramidal crowns with shorter and well-arranged lateral branches for good exposure to light, vase-shaped crowns - Spanish Bush, Improved Vase, Late Vase with well-distributed lateral branches in space, fusiform crowns – Super Fuss Axis, Thin Spindle, Super Slender Ax (SSA), Tall Spindle Axe (TSA), Tall Fusiform Axis, i.e. elongated and narrow with well-balanced branching, with main and secondary branches arranged in a balanced manner for uniform exposure to light, favoring photosynthesis and fruit development (Balan et al. 2022, 2023; Long Lynn et al.).

In most cherry orchards trained according to the fusiform system, the basic characteristic is that pruning is mainly carried out on branches aged 1-3 years, which is an innovative management approach. However, crown formation in cherry varieties varies depending on the planting density and tree maintenance management. The objective of this research was to compare training systems

suitable for high-density orchards, in combination with different varieties, grafted on the Gisela 6 rootstock, to evaluate the control over vegetative growth and productivity

MATERIAL AND METHODS

Research on the creation of modern cherry plantations with a high level of productivity is ongoing (2018-2024) and is being carried out within the framework of two experiences, using the Black Star, Regina, Summit and Sweet Sharetta varieties, grafted onto the Gisela 6 rootstock. in the central fruit-growing area, at Ustia SRL "Staragrogroup", Dubăsari district, as well as in the northern area, at Sturzeni, Rîșcani district, Republic of Moldova. This research

The orchard established in the fall of 2015 includes the Black Star varieties, with trees planted at a distance of 4x2 m, trained in low-volume crown shapes, namely: Thin spindle, Cup and Kym Green Bush The orchard was started in the fall of 2018, with trees planted at a distance of 4x1 m and managed according to the crown shapes: V1- Super Slender Axe (SSA), V2- Tall Spindle Axe (TSA) and V3- Enhanced thin spindle (Balan et al. 2024). Soil maintenance, irrigation, fertilization and protection of trees from diseases and pests are carried out as appropriate (Balan et al. 2001; Babuc 2012). (Figure 1, 2, 3)

Figure 1. Super Slender Axe (SSA)

Figure 2. Tall Spindle Axe (TSA)

Figura 3. *Kym Green Bush System, Year 4*

The physiological studies of the trees were carried out annually, at the end of the growing season. The yield was determined at the stage of fruit maturity, on 32 trees in particular, expressed in kg of fruit per tree and reported per hectare. During fruit harvesting, their distribution (kg/tree) was evaluated on the tree height at a distance from the ground of 0 – 160 cm, 160 – 240 cm and 240 – 400 cm, on 8 identical trees of each variant. The fruits were divided into 3 fractions according to their diameter (22 – 26 mm; 26 – 30 mm; larger than 30 mm). The results of the study were verified at a significant level of 0.05 using the Tukey test

RESULTS AND DISCUSSIONS

Based on the morphological indicators of the crown, the level of soil coverage with the crown projection, lateral area and crown volume was calculated (Table 1). Trees of the

Black Star variety at the age of 7 years use over 60 % of the area reserved for the tree, form a lateral area of the crown of 21650-22025 thousand m^2/ha, being higher in the case of the Kym Green Bush crown form. The crown volume, as an indicator of the synthesis of the parameters of the fruit plantation, was from 15483–19318 m^3/ha. Trees formed according to the cup crown system and Kym Green Bush formed the highest values by 14.6-24.7 % compared to the thin spindle crown form. In conclusion, we note that the structure of the vegetative ensemble of the Black Star cherry plantation, grafted on Gisela 6, planted at a distance of 4x2 m ensures a continuous crown volume in the direction of the row, which at the age of 7 years receives over 60 % of solar energy.

Table 1

Structure of the vegetative ensemble of cherry trees, Black Star variety, depending on the shape of the crown (Planting distance 4x2 m, tree age 7 years)

Crown shape	Soil cover level, %	Lateral crown area, thousand m^2/ha	Crown volume, m^3	
			tree	ha
Thin spindle	60,0	21650	12,3	15483
Cap	60,2	21700	14,2	17744
Kym Green Bush	60,2	22025	15,4	19318

Cherry cultivation technology, including the crown management system and orchard management, determines solar energy conversion, precocity, constant yield and market-competitive fruit quality (Balan 2015; Balan et al. 2021). The fruit yield of cherry trees of the Black Star variety, grafted on Gisela 6 rootstock, planted at a distance of 4x2 m, differs by year and crown shape (table 2). The data presented show that the harvest in 2021 was small (2.99 – 4.40 kg/tree) due to climatic conditions during flowering, and in the following years the yield was 6.12 – 7.97 kg/tree or 7.96 – 10.92 t/ha, being significantly higher in trees formed after the thin spindle crown. Thus, in the Black Star variety it can be observed that the thin spindle crown during the fruiting period of the trees has the highest distinctly significant values (9.39 – 10.92 t/ha) in comparison with the cup crowns (8.11 – 9.67 t/ha) and Kym Green Bush (7.65 – 8.22 t/ha).

Table 2

Fruit yield of cherry trees of the Black Star variety depending on the crown shape (Planting distance 4x2 m, tree age 7-10 years)

Crown shape	Tree age, Kg/tree				Tree age, t/ha			
	7	8	9	10	7	8	9	10
Thin spindle	4,40	7,51	7,97	8,72	5,50	9,39	9,96	10,92
Cap	2,99	7,04	6,49	7,74	3,73	8,81	8,11	9,67
Kym Green Bush	3,12	6,37	6,12	6,58	3,90	7,96	7,65	8,22
DL 5 %	0,39	0,28	1,17	1,34	0,39	0,28	1,17	1,34

The fruit yield (Table 3) in high-density plantations was 4.56–4.76 kg/tree for the Regina variety and 6.43–6.97 kg/tree for the Sweet Sharetta and Summit varieties, increasing insignificantly in the case of the thin spindle crown shape compared to the vertical axis and the improved thin spindle. If we refer to the yield reported per hectare, compared to the data presented by other authors (Stehr, 2008; Lugli and Musacchi, 2010) it can be noted that the yield of the varieties studied is average to those considered normal.

Table 3.

Fruit yield of cherry trees depending on the variety and crown shape, mm (Planting distance 4x1 m, year 2024)

Crown shape	Regina		Sweet Sharetta		Summit	
	Kg/tree	t/ha	Kg/tree	t/ha	Kg/tree	t/ha
V1	4,76	11,91	6,9	17,25	6,8	17
V2	4,56	11,41	6,63	16,58	6,43	16,08
V3	4,63	11,58	6,97	17,40	6,43	16,08
DL 5 %	1,39	1,85	1,39	1,85	1,39	1,85

During harvesting, the distribution of fruits along the tree height was assessed in the sectors from the ground 0–160 cm, 160–240 cm and 240–400 cm (Figure 4). In the case of the thin spindle crown shape at the distance from the ground 0-160 cm, the diameter of fruits of 22–26 mm constituted 32.8 %, of 26–30 mm – 48.8 % and larger than 30 mm were only 18.4 %. In the central part of the crown (160-240 cm) the number of fruits with a diameter of 26–30 cm (50.03 %) and larger than 30 mm (26.43 %) increased. In the upper third of the crown, the number of fruits with a diameter of over 30 mm increased significantly and reached 38.03 %. The share of fruits in the vertical axis system practically changes identically to the thin spindle crown, being 45.52 % fruits with a diameter of 26–30 mm.

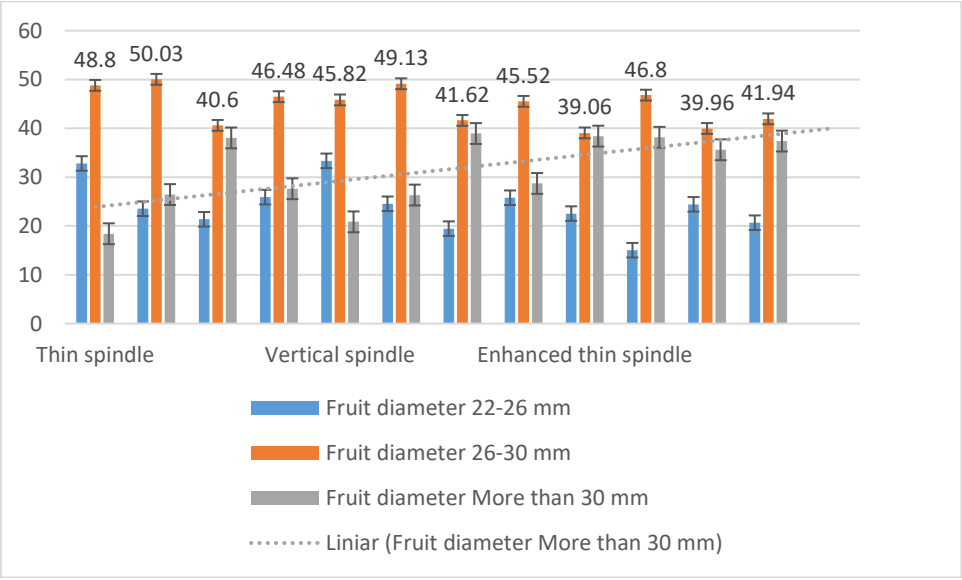

Figure 4. Share of fruits in cherry trees of the Regina variety depending on the crown shape, % (Planting distance 4x1 m, year 2024)

The distribution of fruits in the improved spindle crown changes significantly compared to the thin spindle and vertical axis crowns, with a percentage of fruits larger than 30 mm in size over the height of the tree. Thus, at a distance from the ground of 0 – 160 cm, the share of fruits larger than 30 mm was 38.4 %, at 160 – 240 cm – 38.16 % and 35.6 % in the upper part of the crown.

CONCLUSIONS

The thin spindle crown shape, used in the Black Star cherry variety, grafted on Gisela 6 rootstock and planted at a distance of 4x2 m, proved to be the most effective in ensuring a higher yield and a continuous crown volume in the row direction, which, at the age of 7 years, captures over 60 % of the available solar energy.

For the varieties Regina, Summit and Sweet Sharetta, grafted on Gisela 6 and planted at a density of 2500 trees/ha, the improved thin spindle crown shape had a modest impact on productivity. However, it brought important benefits in terms of uniformity of fruit size along the entire length of the axis, facilitating more efficient harvesting and marketing.

The thin spindle crown shapes and the vertical axis crown shape proved to be less efficient in distributing fruit evenly along the axis, compared to the improved shape. In conclusion, the improved thin spindle crown shape is recommended for cherry crops grafted on Gisela 6 rootstock, as it ensures an optimal balance between productivity and quality, being a suitable choice for obtaining high-quality and high-yielding crops.

ACKNOWLEDGMENT

This research was supported by the Technical University of Moldova within the institutional subprogram the *Research and Extension Centre in Agriculture, Biodiversity and Rural Development*.

REFERENCES

Asanică A. 2012. Cireșul în plantațiile moderne. București: Cireș, 151 p. ISBN 978-973-40-0957-2.

Babuc V. 2012. Pomicultura. Chişinău. 662 p. ISBN 978-9975-53-067-5.

Balan V. 2015. Formarea coroanei după sistema „Fus subţire” în plantaţiile intensive de cireş. În: Pomicultura, viticultura şi vinificaţia: Publicaţie șt.-practică, analitică şi de informaţie. nr. 1(55), pp. 20-23. ISSN 1857-3142.

Balan V. 2015. Tehnologii în intensificarea culturii mărului și cireșului. Academos 2, pp. 74-79

Balan V., Cimpoieş Gh., Barbăroşie M. 2001. Pomicultura. Chișinău: MUSEUM, 452 p. ISBN 9975-906-39-7.

Balan V., Pește anu A., Manziuc V., Vamașescu S., Șarban V. 2023. Baze științifice ale tehnologiei intensive de cultivare a fructelor de cireș. Chișinău: Print-Caro, 292 p., ISBN 978-9975-175-37-1.

Balan V., Peşteanu A., Nicolaescu Gh. 2021. Bunele practici de creştere a fructelor, strugurilor şi pomuşoarelor în contextul schimbărilor climatice. Chişinău: Bons offices, 150 p. ISBN 978-9975-87-781-7.

Balan V., Russu,S., Buză C., Şarban V. Procedeu de formare a pomilor de cireş în formă de fus subţire ameliorat. 2024. Brevet MD de scurtă durată nr. 1802. Nr. depoz.: s 2024 0011.Data publ.: 2024.02.09. In: MD - BOPI 12/2024

Balan V., Șarban V., Ivanov I. 2022. Optimizarea conceptului de conducere și tăiere a plantațiilor de cireș prin ameliorarea relației intre creștere și fructificare. Revistă de Știință, Inovare, Cultură și Artă Nr. 2 (65), p 99-108. ISSN 1857-0461, E-SSN 2587-3687.

Cimpoieș Gh. 2018. Pomicultura specială. Chișinău: Print Caro, p.65-94. ISBN 978-9975-56-572-1.

Ivanov I. 2023. Creşterea şi fructificarea cireşului în funcţie de sistemul de conducere şi tăiere a pomilor. Rezumatul tezei de doctor în ştiinţe agricole. Chișinău, 37 p.

Long Lynn E., Long Marlene, Pește anu A, Gudumac E. 2014. Producerea cireșelor. Manual tehnologic. Chișinău, p. 119-126.

Lugli S. and Musacchi S. 2010. Ultra high-density sweet cherry plantings. Compact Fruit Tree April: p.15–19.

Stehr R. 2008. Further experiences with dwarfing sweet cherry rootstocks in northern germany. Acta Horticulturae, pp. 185-190.