

CERCETĂRI PRELIMINARE PRIVIND INFLUENȚA IRIGĂRII ASUPRA CREȘTERILOR VEGETATIVE LA DOUĂ SOIURI DE PRUN DIN SORTIMENTUL CULTIVAT ÎN CÂMPIA ROMÂNĂ

PRELIMINARY RESEARCH ON THE INFLUENCE OF IRRIGATION ON VEGETATIVE GROWTHS IN TWO PLUM CULTIVARS FROM THE ASSORTMENT GROWN IN THE ROMANIAN PLAIN

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Abstract

Prunus domestica L. represents an important fruit crop in Romania, appreciated for its tasty and versatile fruits. To determine the effects of localized irrigation on vegetative growth in two plum cultivars, 'Anna Spăth' and 'Stanley', a bifactorial experiment was conducted using the split-plot method. Data collection took place over a two-year period (2022-2023) at the Moara Domnească Experimental Base, part of the RSFG Băneasa in Ilfov County. The measurements aimed to analyze vegetative growth (increase in trunk cross-sectional area (TCSA), total shoot length, average shoot length, and number of shoots). Comparative studies on 'Stanley' and 'Anna Spăth' cultivars revealed significant differences in shoot growth and TCSA under irrigated and non-irrigated conditions. In 2023, the irrigated 'Anna Spăth' cultivar recorded a significant increase in TCSA of 2.09 cm². Irrigation significantly increased the number of average shoots by 1.94 shoots/tree in 2022 and by 4.37 in 2023, with an average of 3.16 shoots over the two years. The total average shoot length increased by 208.21 cm in 2022 and by 450.77 cm in 2023. Additionally, the average shoot length increased significantly by 22.18 cm in 2022 and by 17.43 cm on average over the two years, particularly in the 'Stanley' cultivar. Moreover, the results indicate a variable response between the two cultivars to the irrigation regime, with 'Anna Spăth' showing greater sensitivity to water deficit compared to 'Stanley'. These findings underscore the positive influence of irrigation on the vegetative development of plum trees.

Cuvinte cheie: *Prunus domestica*, soi, irigare localizată, variante.

Key words: *Prunus domestica*, variety, localized irrigation, variants.

1. Introduction

The plum species (*Prunus domestica* L.) covers the largest area among all fruit species cultivated in Romania. This position is due to both the modest requirements of this species regarding vegetation factors and the vast and diverse possibilities for utilizing its fruits. However, there are situations when, in certain years, the average annual rainfall is insufficient for the proper growth of plum cultivars.

Research conducted at the RSFG Băneasa on the influence of drip irrigation and fertilization on the productivity of plum cultivars, especially 'Stanley' and 'Anna Spăth', has yielded several important conclusions: the use of drip irrigation significantly improves the productivity of plum trees. (Oltenacu and Oltenacu, 2014)

During our study the plum cultivars 'Anna Spăth' and 'Stanley' were analyzed to understand how they respond to different irrigation regimes under the specific conditions of the Vlăsia Plain.

Additionally, in certain years, even when the average annual rainfall values are adequate, their distribution throughout the growing season can be quite uneven. This leads to periods with high precipitation levels, especially in early spring, which cause temporary excess moisture in the soil, worsening its aerohydric conditions. At the same time, there are also periods with very low or even absent rainfall, significantly hindering the proper growth of the trees.

To contribute to understanding the role of localized irrigation application on the growth processes of two plum cultivars, research was conducted during the 2022-2023 period under the conditions of the Moara Domnească Experimental Base in Ilfov county.

2. Material and methods

The research was conducted on flat terrain with a general slope of approximately 0.5-1%. The soil was identified as reddish preluvosoil, with a clay-loam (30-45%) texture in the upper layer and medium clay-loam in the deeper layer.

Figure 1 highlights the annual average precipitation recorded over a period of 33 years at the meteorological station of the Meteorological Institute in Bucharest, located about 1.5 km from the site where the research was conducted. The average was 589.08 mm, with variability ranging from 327.2 mm recorded in 2022 to 1053.7 mm recorded in 2013. Thus, we established an experiment with the following factors: Factor A (a_1 - 'Stanley', a_2 - 'Anna Späth') and factor B (b_1 - irrigated, b_2 - non-irrigated).

Factor A - Cultivar

- a_1 'Stanley' cultivar was developed in the United States through the crossing of the 'Agen' and 'Grand Duke' cultivars. It is internationally recognized for its remarkable qualities. The tree has a medium vigor with a wide pyramidal crown. The branches are well-branched, and the tree enters production quickly. The flowers are resistant to late spring frosts. The fruits are large and elongated, with an average weight of 30-40 grams. The skin color is dark purple, almost black, covered with fine bloom. The flesh is yellow-green, firm, juicy, and sweet, with a pleasant taste. The pit is of medium size and easily separates from the flesh. Harvest maturity occurs at the beginning of September. Stanley is a semi-late cultivar with abundant and consistent fruiting. It is used for both fresh consumption and for drying or preservation, being appreciated for its quality in dried plum production. The cultivar demonstrates good resistance to diseases and pests, including viruses and moniliosis. It is tolerant of various soil and climatic conditions, adapting well to different growing regions.

- a_2 'Anna Spath' cultivar was developed in Hungary and is one of the oldest and most appreciated European plum varieties. The tree has medium to large vigor, with a wide, well-branched crown. The branches are robust and well-developed, with good resistance to wind. The fruits are large, round-oval, with an average weight of 40-50 grams. The skin color is red-violet, with a fine layer of wax. The flesh is yellow, firm, juicy, sweet-tart, with a pleasant and aromatic taste. The stone is small and easily separates from the flesh. Harvest maturity is from the end of August to early September. 'Anna Spath' is a semi-late variety with good and consistent productivity. This variety is ideal for fresh consumption due to its exceptional taste, but it is also used for processing, especially for jams, compotes, and other preserved products. It has moderate resistance to diseases and pests, requiring regular phytosanitary treatments. It is sensitive to drought, benefiting from irrigation during prolonged dry periods to ensure optimal production.

Factor B - Drip Irrigation Application, with the following gradations: b_1 - irrigated, b_2 - non-irrigated

The experiment was organized using the block method, with 4 repetitions, evaluating 3 trees within each repetition. The trees on which the measurements were taken were isolated, both along the row axis of the trees and from those on adjacent rows. Trunk cross-sectional area (TCSA) was calculated based on the increase in trunk diameter.

Diameter measurements were taken at fixed points marked on the trunk above the grafting point, using a digital caliper. The measurements were performed both along the axis of the tree row and perpendicular to it. These measurements were conducted immediately after tree planting and annually in autumn during the years 2022-2023, after leaf fall. The length of the shoots was measured using a measuring tape (in cm), while the number of branches per tree was determined through direct counting.

3. Results and discussions

3.1. Increase in trunk thickness

Table 1 presents the average monthly differences (in cm^2) in the TCSA, analyzed by cultivar (a_1 and a_2) and irrigation regime (b_1 and b_2) in an experiment conducted during the years 2022-2023.

Analyzing the data, no statistically significant differences were observed between the two plum cultivars (a_1 and a_2) in either year or in the overall average of both years. For example, in 2022, the difference between cultivars a_1 and a_2 was -0.10 cm^2 (n.s.), and in 2023 it was 0.314 cm^2 (n.s.), confirming the lack of statistical significance.

Regarding the effects of irrigation on TCSA, these varied from year to year. Although no statistically significant differences were observed between the irrigated and non-irrigated variants in the two-year average (for example, the difference between b_1 and b_2 was 0.76 cm^2 , n.s.), a significant difference was recorded in 2023 for cultivar a_2 . For the 'Anna Spath' cv. (a_2), the irrigated variant (b_1) showed a trunk thickness growth increase of 2.09 cm^2 compared to the non-irrigated variant (b_2), which was statistically significant.

3.2. The number of shoots per tree

Table 2 presents the influence of irrigation and cultivar on the average number of shoots per tree, over two years of experimentation (2022-2023). The results highlight the following aspects:

Across the entire experiment, the application of irrigation, compared to the non-irrigated variant, led to a significant increase in the average number of shoots per tree by 1.94 in 2022 and a distinctly significant increase of 4.37 average shoots per tree in 2023.

Additionally, over the two-year average (2022 and 2023), in the irrigated variant, compared to the non-irrigated one, the average number of shoots per tree was distinctly significantly higher by 3.16. This differentiation was solely determined by the data recorded for the 'Anna Späth' cultivar, which showed an average increase of 3.64 shoots per tree in the irrigated variant compared to the non-irrigated one over the two years.

3.3. Total shoot length per tree

The data in Table 3 shows that in the first year of experimentation (2022), in the irrigated variant compared to the non-irrigated variant, the total shoot length per tree was very significantly greater by 208.21 cm. This differentiation was more pronounced for the 'Stanley' cultivar, which recorded an increase of 262.7 cm per tree in the irrigated variant compared to the non-irrigated one.

During the second year of experimentation (2023), the application of irrigation, as compared to the non-irrigated variant, resulted in an increase in total shoot length per tree of 450.77 cm, with the difference being distinctly significant. This differentiation was even more evident in the 'Anna Späth' cultivar, which showed an increase of 451.77 cm per tree.

On average over the two years of experimentation (2022-2023), the application of irrigation led to a distinctly significant increase in the total shoot length per tree of 329.94 cm. Both the 'Stanley' and 'Anna Späth' cultivars showed significant impacts from irrigation on the increase of total shoot length per tree.

3.4 Average shoot length

In the first year of experimentation (2022), the average shoot length in cm was significantly greater by 22.18 cm per tree in the irrigated variant compared to the non-irrigated one. This difference was particularly evident in the 'Stanley' cultivar, where in the irrigated variant, the average length of a shoot was distinctly significantly greater by 26.39 cm.

In the second year of experimentation, the average length of a shoot in the irrigated variant was significantly greater by 17.06 cm. Over the course of the two years of experimentation (2022–2023), there was no significant increase in shoot length in the irrigated variant compared to the non-irrigated one. However, in the 'Stanley' cultivar, a significantly greater increase of 17.06 cm per shoot was observed in the irrigated variant compared to the non-irrigated one.

Throughout the two years of experimentation (2022-2023), irrigation resulted in a significant average increase in shoot length of 17.43 cm. This increase was particularly noted in the 'Stanley' cultivar (a1), where the average shoot length in the irrigated variant was 21.72 cm greater compared to the non-irrigated variant, with the difference being statistically significant. The results of our experiment, corroborated with data from the specialized literature, highlight significant differences regarding the influence of irrigation on the growth and production of two popular plum cultivars: 'Anna Späth' and 'Stanley'. It has been demonstrated that the application of drip irrigation significantly increases fruit yield, with studies indicating improvements of 32-37% in other fruit varieties under similar conditions (Iancu and Septar, 2009). Efficient water management through localized irrigation can lead to better growth metrics, such as trunk diameter and leaf area, which are crucial for the overall health of the trees (Stewart et al., 2005). Like the 'Stanley' and 'Anna Späth' cultivars, other fruit varieties have shown that irrigation can result in higher sugar content and dry matter, suggesting that these cultivars may exhibit similar benefits under optimal irrigation conditions (Iancu & Septar, 2009; Oltenacu et al., 2015). 'Anna Späth' cv. performed better under irrigation, with lower total losses, while 'Stanley' demonstrated superior quality and less deterioration under non-irrigated conditions, indicating varied responses to water management (Oltenacu & Oltenacu, 2014). While irrigation generally promotes better growth and yield, it is essential to consider that excessive or poorly managed irrigation can lead to water stress or competition with surrounding vegetation, potentially hindering growth (Stewart et al., 2005).

4. Conclusions

The results of our experiment highlight a variable influence of irrigation on the growth of plum trees ('Stanley' and 'Anna Späth' cultivars) depending on the evaluated parameters, cultivar, and year of experimentation. Overall, TCSA was not significantly influenced at either the cultivar level or within each of the two irrigation variants.

The application of irrigation significantly stimulated the increase in the number of shoots per tree for both cultivars, with a more pronounced effect observed in the 'Anna Späth' cultivar, particularly in the second year of experimentation.

The total shoot length per tree exhibited behavior similar to the number of shoots per tree. On average over the two years, the irrigated variant showed a significantly greater average increase in the average shoot length, particularly evident in the 'Stanley' cultivar.

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Tables and figures

Tabel 1. The influence of irrigation regime on the growth in trunk cross-section thickness in 'Stanley' and 'Anna Spath' varieties (2022-2023)

D	2022		2023		Average 2022-2023	
	E	F	E	F	E	F
a1-a2	-0.10	n.s.	0.314	n.s.	0.11	n.s.
b1-b2	0.16	n.s.	1.36	n.s.	0.76	n.s.
a1b1-a1b2	-0.13	n.s.	0.64	n.s.	0.26	n.s.
a2b1-a2b2	0.44	n.s.	2.09	*	1.26	n.s.
b1a1-b1a2	-0.39	n.s.	-0.41	n.s.	-0.4	n.s.
b2a1-b2a2	0.18	n.s.	1.04	n.s.	0.61	n.s.
D-noting the differences between the grading of the experimental factors (A,B) E-noting the values of the differences between the experimental factors F-analytical significance of the values presented in point E n.s - not significant, * - significant, ** - distinctly significant, *** - highly significant						

Tabel 2. Influence of irrigation regime on shoot growth per tree in 'Stanley' and 'Anna Spath' (2022-2023)

D	2022		2023		Average 2022-2023	
	E	F	E	F	E	F
a1-a2	-3.29	n.s.	0.38	n.s.	-1.46	n.s.
b1-b2	1.94	*	4.37	**	3.16	**
a1b1-a1b2	2.05	*	3.29	n.s.	2.67	n.s.
a2b1-a2b2	1.83	n.s.	5.45	*	3.64	*
b1a1-b1a2	-3.18	n.s.	-0.71	n.s.	-1.94	n.s.
b2a1-b2a2	-3.4	**	1.46	n.s.	-0.97	n.s.
D-noting the differences between the grading of the experimental factors (A,B) E-noting the values of the differences between the experimental factors F-analytical significance of the values presented in point E n.s - not significant, * - significant, ** - distinctly significant, *** - highly significant						

Tabel 3. Influence of irrigation regime on total shoot length growth per tree in 'Stanley' and 'Anna Spath' (2022-2023)

D	2022		2023		Media 2022-2023	
	E	F	E	F	E	F
a1-a2	-66.67	n.s.	136.55	n.s.	34.94	n.s.
b1-b2	208.21	***	450.77	**	329.46	**
a1b1-a1b2	262.7	**	449.795	n.s.	356.24	*
a2b1-a2b2	153.71	n.s.	451.74	*	302.72	*
b1a1-b1a2	-12.18	n.s.	135.58	n.s.	63.7	n.s.
b2a1-b2a2	-121.17	n.s.	137.52	n.s.	8.17	n.s.
D-noting the differences between the gradings of the experimental factors (A,B) E-noting the values of the differences between the experimental factors F-analytical significance of the values presented in point E n.s - not significant, * - significant, ** - distinctly significant, *** - highly significant						

Tabel 4. Influence of irrigation regime on the growth of the average shoot length per tree in 'Stanley' and 'Anna Spath' (2022-2023)

D	2022		2023		Media 2022-2023	
	E	F	E	F	E	F
a1-a2	4,82	n.s.	5,45	n.s.	5,13	n.s.
b1-b2	22,18	**	12,68	n.s.	17,43	**
a1b1-a1b2	26,39	**	17,06	*	21,72	**
a2b1-a2b2	17,958	n.s.	8,3	n.s.	13,13	n.s.
b1a1-b1a2	9,04	n.s.	9,83	n.s.	9,43	n.s.
b2a1-b2a2	0,6	n.s.	1,072	n.s.	0,84	n.s.
D-noting the differences between the gradings of the experimental factors (A,B) E-noting the values of the differences between the experimental factors F-analytical significance of the values presented in point E n.s - not significant, * - significant, ** - distinctly significant, *** - highly significant						

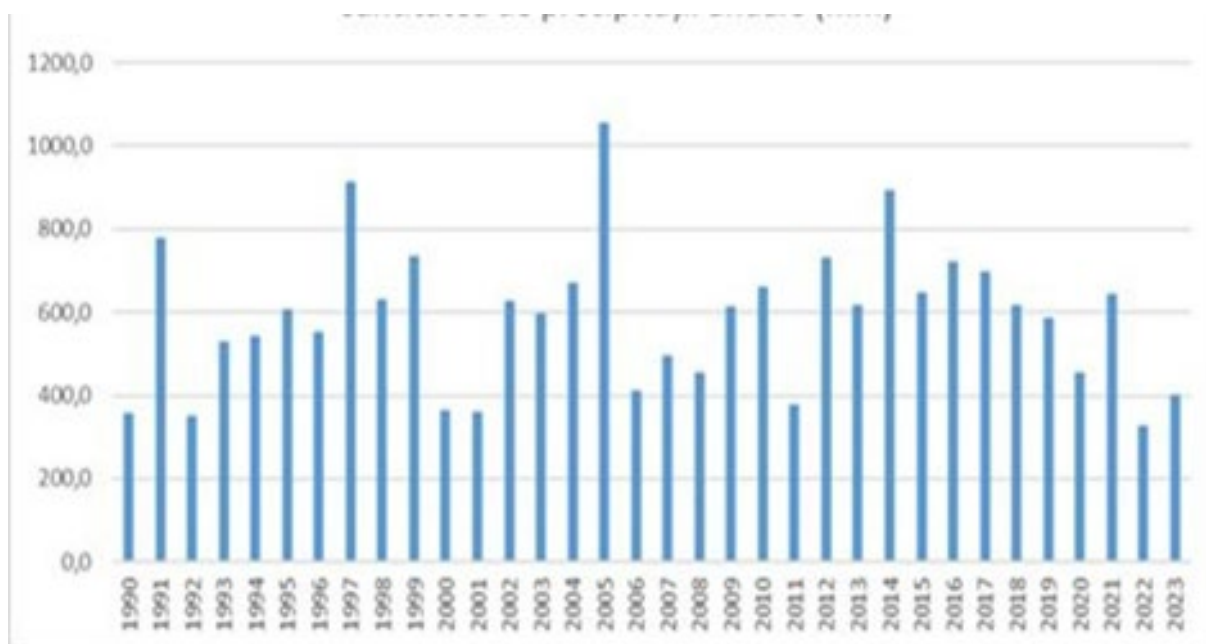


Fig. 1. Annual precipitation amount (mm)