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INFLUENCE OF DRIP IRRIGATION AND OF FERTILIZATION, ON THE PRODUCTIVITY OF PLUM VARIETIES. CASE STUDY

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Abstract

The large expanding and feedback from the consumers who enjoy common plum (Prunus domestica) is due to the rusticity of the trees, namely are the modest requirements for soil, climate, growing technology and the ability to easily adapt to the special ecological conditions compared with other varieties. The slight propagation by seed, grafting on the most common rootstock, the relatively early entry in bearing (3-4 years after planting), the high production and the long life of the trees, even under less favorable soil conditions, like heavy soils, podzols etc. The experiences during the years 2010-2012 aimed to experiment some technologies destined to maximize the productive potential of some plum varieties grown in the Moara Domneasca farm and widespread in the current range of varieties. Two productive varieties were used: Stanley and Anna Spath, grafted on rootstock Mirobolan. The fertilization comprised the administration of Megasol product which is a soluble fertilizer which is suitable to be used in the advanced irrigation systems, in particular the drip irrigation, at a dose of 2.5 kg/ha and 5.0 kg/ha. The irrigation consisted of the dripping administration of 2l/h and, respectively 4 l/h.

Key words**:** *fertilization, growing, increases, irrigation, production*

INTRODUCTION

The plum growing enjoys a special attention in all the countries with climatic conditions which comply with the biological requirements of the known species and varieties. [5]

The large extend and feedback from the consumers who enjoy common plum species (*Prunus domestica*) is due to the following features: the rusticity of the trees, namely the modest requirements the plum tree has for soil, climate, growing technology and the ability to easily adapt to the special environment conditions compared to other species [10]; easy multiplying by seed, grafting, the most common rootstock and relatively early entry in bearing (3-4 years after planting); the high productions that we can ensure and the long life of the trees, even under less favorable soil conditions like heavy soils, podzols etc. [4]; the long period of fruit capitalization (about 90 days), because of the many different varieties with ripening periods, from very early (late June) until very late (October) [3]; the food value of the plums results not only from the energy but also, and especially, from the diversity of the nutrients they contain. [7]

Grown for centuries in Romania, the plum tree was and remains one of the most popular and loved fruit species. The fact that it can be seen everywhere, from the hill to the plain, is another evidence that the plum tree is adapted relatively easily to a variety of climatic and soil conditions in our country[9]. For obtaining consistent and high production, it is necessary to ensure optimum conditions to pass the vegetation phases, both in terms of water and feed[1].

The administration of drip irrigation allows the application through the irrigation water of some easily soluble fertilizer products[8].The plants reaction to irrigation is proven, currently getting the performance in terms of production is not possible without ensuring the necessary fluid[6].The drip irrigation is one of the newest methods of irrigation, having mainly the advantage of administration of strict water in the root system and therefore

avoiding the degradation of the soil structure, the maintenance works are not disturbed and the soil can be maintained at a constant level of optimal humidity for every stage of the plant life [2].

MATERIALS AND METHODS

The content of the present paper is based on research, observations, experiments, extensive research of some aspects considered priority and processing of data comprising the whole range of aspects, from the irrigation and fertilization need. As a result, the entire paper is based almost exclusively on the results of own researches on the effect of irrigation and fertilization at plum tree in the conditions in Moara Domneasca Farm situated in South Muntenia, a few kilometers from Bucharest, the capital of Romania. The research work for the elaboration of this paper was carried out in the period 2010-2012.

The locality territory is included in the Romanian Plain relief, Vlăsiei Plain subdivision, in the transition area from steppe to forest area. The general relief is flat, with small bumps and numerous depressions called dales, of different shapes and sizes.

The groundwater is located at different depths, from 6 m to 10 m, depending on the relief.

The soil in Moara Domneascafarm belongs to a red brown type (preluvosoil) molic subtype.

The experimental plot was located in Belciugatele Didactical And Experimental Station, Moara Domneasca School farm and consisted of the study of two plum tree varieties grafted on Mirobolan.

The plantation was established in 2004, respectively in November 2004, the planting distances being of 5 m/4 m.

In order to achieve the proposed objectives, the created experiences were three factor type with the following experimental factors:

Factor A: variety; a1 Stanley; a2 Anna Spath.

Factor B: irrigation norm: b1 not-irrigated; b2 2 l/h; b3 4l/h.

Factor C: dose of fertilizer: c1 unfertilized, c2 2.5 kg/ha and c3 5.0 kg/ ha.

The experience was placed according to the subdivided plots method with the systematic factors A, B and C in three repetitions. The established moments for water administration were influenced by the plants need in certain phases of vegetation, namely: binding fruit, physiological fall, pits strengthening, intensive grow of sprouts and fruit, fruit bud differentiation. The needed rules of water were between 300 and 700 m^3/ha.

The fertilization consisted in the use of Megasol product which is a soluble fertilizer specifically designed to be used in the advanced irrigation systems, in particular in drip ones, and for the foliar and basic fertilization.

RESULTS AND DISCUSSIONS

From Table 1 it can be seen that the two varieties, considering the average of production of the three years of experimens, had the same productive potential highlighted by the climatic conditions of the growing and by several factors such as irrigation and fertilization. Comparing the productions obtained, it was remarked that there are no statistically differences between the two varieties, the production differences being 0.16 t/ha, Stanley variety achieving 1.1 % production gain.

Table1. The influence of the variety (A) on the production of plums, average of 2010-2012

Variety	Production t/ha	%	Difference	Significance
Anna Spath	14.00	98.9	-0.16	-
Stanley	14.32	101.1	0.16	-
average	14.16	100.0	-	Mt

Dl 5 %=0.488 t/ha
Dl 1 % =1.128 t/ha Dl 0.1 %=3.588 t/ha

From the data resulting from Table 2, it was found out that the Anna Spath variety, under not irrigation conditions recorded a higher production than Stanley variety, from 12.38 t/ha to 11.44 t/ha. The watering determined significant production increases in case ofthe both varieties. Anna Spath variety recorded a gain 1.79 t/ha, at rules of 2 l/h and 3.07 t/ha, at rules of 4 l/h. Stanley variety, at 2 l/ha obtained a production increase of 3.35 t/ha and at 4 l/h, an increase of 5.28 t/ha. Stanley variety capitalized the irrigation water much

better than Anna Spath variety, as it can be seen by higher increases.

Analyzing table 3 one can see that under the growing conditions without the influence of other factors, Anna Spath variety had a higher production potential compared to the one of the Stanley variety, 12.38 t/ha to 11.44 t/ha.

Table2. The influence of drip irrigation levels on productivity for the same variety of plums, average of 2010-2012 (BxA)

Variety	Anna Spath			Stanley		
Irrigation rule	Prod. t/ha	Dif. t/ha	Significance	Prod. t/ha	Dif. t/ha	Significance
Not irrigated	12.38	-	Mt	11.44	-	Mt
2 l/h	14.17	1.79	***	14.79	3.35	***
4 l/h	15.45	3.07	***	16.72	5.28	***

Dl 5 %=0.087 t/ha Dl 1 % =0.127 t/ha Dl 0.1 %=0.191 t/ha

Table3. The influence of variety on the production of plums for the same level of irrigation (AxB), average of 2010-2012

Irrigation rule	Not irrigated			2 l/h			4 l/h		
Variety	Prod. t/ha	Dif. t/ha	Significance.	Prod. t/ha	Dif. t/ha	Significance.	Prod. t/ha	Dif. t/ha	Significance.
Anna Spath	12.38	-	Mt	14.17	-	Mt	15.45	-	Mt
Stanley	11.44	-0.94	0	14.79	0.62	*	16.72	1.27	**

Dl 5 %=0.490 t/ha Dl 1 % =1.115 t/ha Dl 0.1 %=3.503 t/ha

Table4. The influence of irrigation levels on the production of plums for the same level of fertilization (BxC), average of 2010-2012

Dose of fertilizer	Not fertlized			2,5 kg/ha Megasol			5,0 kg/ha Megasol		
Irrigation rule	Prod. t/ha	Dif. t/ha	Significance.	Prod. t/ha	Dif. t/ha	Significance.	Prod. t/ha	Dif. t/ha	Significance.
Not irrigated	10.81	-	Mt	12.00	-	Mt	12.93	-	Mt
2 l/h	12.72	1.91	***	14.48	2.48	***	16.24	3.31	***
4 l/h	14.06	3.25	***	15.88	3.88	***	18.32	5.39	***

Dl 5 %=0.114 t/ha Dl 1 % =0.157 t/ha Dl 0.1 %=0.218 t/ha

Table5. The influence of the fertilization level(C) on the production of plums for the same variety (A) and the same level of irrigation (B) (CxAB), average of 2010-2012

Variety	Anna Spath						Stanley					
Factor BxC	Not irrigated		2 l/h		4 l/h		Not irrigated		2 l/h		4 l/h	
	Prod. t/ha	Dif.	Prod. t/ha	Dif.	Prod. t/ha	Dif.	Prod t/ha	Dif.	Prod. t/ha	Dif.	Prod. t/ha	Dif.
Not fertilized	11.08	-	12.43	-	13.34	-	10.54	-	13.00	-	14.77	-
2.5 kg/ha	12.49	1.41***	14.32	1.89***	15.28	1.94***	11.50	0.96***	14.64	1.64***	16.47	1.70***
5.0 kg/ha	13.57	2.49***	15.75	3.32***	17.73	4.39***	12.28	1.74***	16.73	3.73***	18.91	4.14***

Dl 5 % =0.165 t/ha Dl 1 % =0.225 t/ha Dl 0.1 % =0.301 t/ha

Table 6. The influence of irrigation level (B) on the production of plums for the same variety (A) and the same level of fertilization (C) (BxAC), average of 2010-2012

Variety	Anna Spath						Stanley					
Factor CxB	Not fertilized		2,5 kg/ha		5,0 kg /ha		Not fertilized		2,5 kg /ha		5,0 kg /ha	
	Prod. t/ha	Dif.	Prod. t/ha	Dif.	Prod. t/ha	Dif.	Prod. t/ha	Dif.	Prod. t/ha	Dif.	Prod. t/ha	Dif.
Not irrigated	11.08	-	12.49	-	13.57	-	10.54	-	11.50	-	12.28	-
2 l/h	12.43	1.35***	14.32	1.83***	15.75	2.18***	13.00	2.46***	14.64	3.14***	16.73	4.45***
4 l/h	13.34	2.26***	15.28	2.79***	17.73	4.16***	14.77	4.23***	16.47	4.97***	18.91	6.63***

Dl 5 % =0.161 t/ha Dl 1 % =0.222 t/ha Dl 0.1 % =0.308 t/ha

The application of irrigation resulted in increased productions and stimulate the productive potential of Stanley variety, which performed an increase of 0.62 Harvest t/ha, provided statistically as significant increase. At rules of 4 l/h, the same variety recorded with a production increase of 1.27 t/ha, increase ranked as distinct significantly.

As it is remarked during the experiments, the irrigation level led to production increases higher than those obtained after fertilization (Table 4). At the not fertilized variants, the productions were between 10.81- 14.06 t/ha, with gains of 1.91 t/ha and 3.25 t/ha. The application of a dose of 2.5 kg/ha Megasol resulted in increases in production of 2.48 t/ha 3.88 t/ha. At the dose of 5 kg Megasol, increases were achieved of 3.31 t/ha and 5.39 t/ha. The highest production increase was obtained in the irrigation rules of 4 l//h. All increases were recorded statistically and were rated as very significant.

It is found out that Anna Spath variety achieved the highest production increases under the influence of fertilization, although the productions were lower than those of Stanley variety. This shows a better use of the fertilization effect, by this variety. The highest production increase was obtained in the variants fertilized with a dose of 5 kg/ha Megasol, 4.39 t/ha, corresponding to a production of 17.73 t/ha. At the same variant, Stanley variety records an increase of 4.14 t/ha, corresponding to a production of 18.91 t/ha. Regardless of the dose administered, the production increases were very significant for both studied varieties (Table 5).

Stanley variety recorded the highest production increases compared to those recorded by Anna Spath variety, which leads to the conclusion that this variety highly exploits the effect of irrigation (Table 6). Increasing the water rules applied resulted in increases in production for the two varieties, at all experimental variants, which are very significant. Anna Spath variety obtained the lowest production, 11.08 t/ha at not irrigated and fertilized variant and the highest, at irrigated variant with 4 l/h and fertilized with 5 kg/ha, 17.73 t/ha, the difference between these two values is 6.65 t/ha. Stanley variety obtained the lowest production, 10.54 t/ha at not irrigated and fertilized variant, and the highest, at irrigated variant with 4 l/h and fertilized with 5 kg/ha, 18.91 t/h, the difference between these two values is 8.37 t/ha. The increase made by these varieties had statistical ensurance being very significant, at all analyzed variants.

CONCLUSIONS

The influence of variety on the production of plums, average of years 2010-2012

The two varieties, considering the average production of the three years of experimentation, have the same productive potential highlighted by the climatic conditions of the growing year and by several factors such as irrigation and fertilization.

The influence of the drip irrigation on productivity for the same variety of plums, average of years 2010-2012

Under not irrigation conditions, Anna Spath variety records higher production than Stanley variety. The application of irrigation water stimulates the production growth obtained by Stanley variety, which exceeds Anna Spath variety productions at both levels administered. The recorded increases were very significant in all cases. The highest productions were obtained at rules 4 l/h, 16.72 t/ha.

The influence of variety on the production of plums for the same level of irrigation, average of years 2010-2012

Anna Spath variety showed a higher production potential than Stanley variety, the difference between them is significant. Applying irrigation had positive effects on the production capacity of Stanley variety, its production increased while increasing the irrigation rules and exceeding Anna Spath variety productions with distinct significant increases of up to 1.27 t/ha.

The influence of irrigation on the production of plums for the same level of fertilization, average of years 2010-2012

The level of irrigation led to production increases higher than those obtained following the fertilization and rated as very significant for all levels applied. The highest productions

were obtained at rules 4 l/h, 18.32 t / ha with an increase of 5.39 t/ha.

The influence of irrigation on the production of plums for the same variety and fertilization level, average of years 2010-2012

Stanley variety recorded the highest production increases compared to those recorded by Anna Spath variety, which leads to the conclusion that this variety highly exploits the effect of irrigation. Increasing water rules applied resulted in increases in production for the two varieties, at all experimental variants, which are very significant.

The influence of variety on the production of plums for the same level of irrigation and fertilization, average of years 2010-2012

During the three years of experimentation, it was found out that Anna Spath variety achieved higher production than Stanley variety under not irrigation conditions, the differences are distinctly significant (1.29 t/ha). The application of irrigation increases the production of Stanley variety,the differences between varieties were reduced to insignificant, at rule of 2 l/h. The increase of rule at 4 l/h determines production increases of Stanley variety, the production difference between this variety and Anna Spath variety was distinctly significant (43 t/ha).

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