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THE INFLUENCE OF FERTILIZATION LEVELS AND DRIP IRRIGATION NORMS ON THE APPLE HARVEST IN SOUTH-EASTERN ROMANIAN CONDITIONS

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Abstract

Making a modern fruit growing cannot be conceived without providing a corresponding hydric regime that fruit species need. Even in areas with abundant precipitation should be taken into account that they are unevenly distributed throughout the growing season and that there are critical moments in which trees need to consume water. Low humidity and lack of water can harm large harvest this year or next year to the fruit formation. Taking into account this aspect, in the present study, we wanted to put out the effects of application of modern methods of water located on the behaviour of apple fruit valuable in terms of the south-eastern Romania, where are encountered optimal culture conditions and find the best recommendations for production. The content of this paper is based on research, observations, experiments, extensive research of issues prioritized and data processing including the whole range of issues, starting from the foundation of the application irrigation necessity. As a result, the entire work is based almost exclusively on research findings on the effect of irrigation and fertilization level on apple at Moara Domneasca farm conditions.Factor A-variety: Generos and Florina. Factor B-irrigation norms: non irrigated witness; drop 2 litres / hour; drop 4 litres / hour. FactorC-fertilization levels: 2,5 kilo Megasol or 5 kilo Megasol.The irrigation level resulted in production increases and bonuses obtained as very significant statistically for the two levels of irrigation applied. The highest yields were recorded in variants where rules were applied 4 l / h, with production increases of 40.1%, and increases the harvest of 5.52 t / ha.

Key words: *drip irrigation, fertilization, harvest, water norms, varieties.*

INTRODUCTION

Making a modern fruit growing cannot be conceived without providing a hydric system that corresponds to the needs of the fruit species. Even in areas with heavy rainfall should be noted that these are distributed unevenly throughout the growing season and that there are critical moments in which trees need to consume water (Rzekanowski C., Rolbiecki S., 2000). Low humidity and lack of water can harm large crop of fruit in the current year or of the fruit formation in the next year (Cohen D., 1993).

Currently, irrigation is necessary to be understood, according to the principles of integrated fruit crops as a highly effective tool for regulating the activity of vegetative and productive trees (Botu I., Botu M., 2003). It is known that a mild water stress has the effect of picking the fruit bud differentiation phenomenon. Also, reducing excessive watering result a decrease of the vegetative growth exaggerated of the shoots and directing the assimilated towards the fruits (Atkinson D., 1977).

Even in areas where there is 600-700 mm annual rainfall, water scarcity is need to be cover from July through September, or sometime in the spring, in March-April, before and during flowering and autumn, in October during intensive growth roots. Over time, water saving problem has become increasingly important higher with global climate change, rising among other issues also that of the reduction and rationalization of water use for irrigation (Popescu M., Godeanu I.,1989).

Bearing this in mind, the present study, we aimed to emphasize the effects of localized application of modern methods of water, over the behavior of two valuable apple varieties, in the south-eastern Romania conditions, where are encountered optimal conditions of culture.

The research objective is to observe what is the impact of localized irrigation application on fruitfulness and establishing recommendations

for production of localized irrigation on apple application in the in the south-eastern Romania conditions

MATERIALS AND METHODS

The entire work is based on the results of personal research on the effect of apple irrigation in Moara Domneasca Farm conditions.
Researches to develop this work were conducted in 2008-2011 period. Relief locality is included in the Romanian Plain, Vlasiei Plain subdivision, in the transition from steppe to forest area. The general relief is flat with numerous small bumps and depressions, called dales, of different shapes and sizes. Groundwater is at different depths from 6 m to 10 m, depending on the terrain. In 2008, the accumulated rainfall was 378 mm, in 2009 was 559,4 mm, in 2010 was 494,8 mm and in 2011 was 288 mm. All values are below the 50-year annual average of 548.0 mm.
The soil type at the Moara Domneasca Farm is reddish brown (preluvosoil), softness subtype.
To achieve the objectives, it was imposed an organization of some tri factorial type experiences with the following experimental factors:
Factor A-variety: Generos and Florina.
Factor B-irrigation norms: non irrigated witness; drop 2 litres / hour; drop 4 litres / hour.
Factor C-fertilization levels: 2,5 kilo Megasol or 5 kilo Megasol.
Drip irrigation was started from March 20, administering it daily, for 4 hours. In periods where there were registered rainfalls, the irrigation was discontinued. In general, the number of watering recommended is 2-5.
Fertilization consisted of **Megasol** product administration, which is a soluble fertilizer designed specifically for use in advanced irrigation systems, especially through the drip, and foliar and basic fertilization. On fruit trees were applied 5 splashes using the doses mentioned above.

RESULTS AND DISCUSSIONS

The influence of the variety on the production of apples

Table 1. The Influence of the variety on the production of apples, average of 2008-2011

Variety	Prod. t/ha	%	Dif. t/ha	Signif.
Generous	16,53	100,1	0,02	-
Florina	16,49	99,9	-0,02	-
Average	16,51	100	-	Mt

Dl 5% = 0,244 t / ha Dl 1% = 0,563 t / ha Dl 0,1% = 1,791 t / ha

To analyze the influence of the variety on production, we have established as term of comparison-stander-by the average production of the two analyzed varieties, 16,51 t/ha.
The Generous variety achieved a production of 16,53 t/ha, at a non-significant difference (0,02 t/ha) compared to the stander-by.
Florina variety enrolled with a production of 16,49 t/ha, at a non-significant difference compared to the stander-by, but negative.
We can say that the varieties have a similar genetic potential production (Table 1)

The influence of the drip irrigation levels on the production of apples

Table 2. The Influence of the drip irrigation levels on the production of apples, average of 2008-2011

Irrigation norm	Prod. t/ha	%	Diff. t/ha	Signif.
Non-irrigated	13,75	100	-	Mt
2 l/h	16,51	120,1	2,76	***
4 l/h	19,27	140,1	5,52	***

DL 5% = 0,140 t/ha DL 1% = 0,203 t/ha DL 0,1% = 0,305 t/ha

As shown in Table 2., the irrigation level determined increases of the yields obtained and increases statistically confirmed as highly significant for the two levels of irrigation applied.
Compared to the control (irrigated) production standards achieved at 2 l/h were 20,1% higher, which means an increase of 2,76 t/ha, very significant.
An increase of 5,52 t/ha was recorded also at the irrigated variant with 4 l/h, which means an additional crop of 40,1%.

The influence of the level of fertilization on the production of apples

Table 3. The Influence of the level of fertilization on the production of apples, average of 2008-2011

Fertilizer Dose	Prod. t/ha	%	Diff. t/ha	Signif.
Unfertilized	14,82	100	-	Mt
2,5 kg /ha	16,52	111,5	1,70	***
5,0 kg /ha	18,18	122,7	3,36	***

DL 5% = 0,074 t/ha DL 1% = 0,101 t/ha DL 0,1% = 0,135 t/ha

To make an analysis of the data presented in Table 3. was considered as a stander-by production obtained on a unfertilized variant, 14,82 t/ha. In comparison with this, the recorded production on a dose of 2,5 kg/ha Megasol, 16,52 t/ha was higher by 1,70 t/ha, which is a very significant production increase. The dose of 5 kg/ha resulted in a production of 18,18 t/ha, with 22,7% over the stander-by production, meaning an increase of 3,36 t/ha, a very significantly increase. In conclusion, the fertilization causes very significant production increases for all levels of fertilizer applied.

Table 4. The Influence of fertilization levels on production of apples for the same level of irrigation, average of 2008-2011

Irrigated norm	Non-irrigated			2 l/h			4 l/h		
Fertilizer dose	Prod. t/ha	Dif. t/ha	Signif.	Prod. t/ha	Dif. t/ha	Signif.	Prod. t/ha	Dif. t/ha	Signif.
Non-fertilizer	12,84	-	Mt	14,89	-	Mt	16,74	-	Mt
2,5 kg/ha	13,81	0,97	***	16,53	1,64	***	19,23	2,49	***
5,0 kg/ha	14,59	1,75	***	18,12	3,23	***	21,84	5,10	***

The influence of fertilization levels on production of apples for the same level of irrigation

As noted previously, fertilization brings very significant production increases at all graduations used but irrigation application makes these increases higher than those obtained only after fertilization (Table 4). On non-irrigated variant, the production increase was 0,97 t/ha at a dose of 2,5 kg/ha and 1,75 t/ha at a dose of 5 kg/ha Megasol. With the water irrigation administration, benefits increased to 1,64 t/ha, respectively, 3,23 t/ha. Norms of 4 l/h caused increases of production of 2,49 t/ha, the fertilized variant with 2,5 kg/ha and 5,10 t/ha, the fertilized variant with 5 kg/ha. All registered harvest ups were very significant.

Table 5. The Influence of irrigation levels on the production of apples for the same level of fertilization, average of 2008-2011

Fertilized Dose	**Non-fertilized**			**2,5 kg/ha Megasol**			**5,0 kg/ha Megasol**		
Irrigated norm	**Prod. t/ha**	**Dif. t/ha**	**Signif.**	**Prod. t/ha**	**Dif. t/ha**	**Signif.**	**Prod. t/ha**	**Dif. t/ha**	**Signif.**
Non-irrigated	12,84	-	Mt	13,81	-	Mt	14,59	-	Mt
2 l/h	14,89	2,05	***	16,53	2,72	***	18,12	3,53	***
4 l/h	16,74	3,90	***	19,23	5,42	***	21,84	7,25	***

The Influence of irrigation levels on the production of apples for the same level of fertilization

The level of irrigation, on fertilization background brings very significant yield increases (Table 5). The highest yields from unfertilized variants were obtained from irrigation norms of 4 l/ h, 16,74 t/ha with a production increase of 3,90 t/ha. Production increases amounted to 5,42 t/ha, where were applied 2,5 kg/ha Megasol and were irrigated with and 4 l/h. The highest yields and hence the largest yield increases were obtained in irrigated variant with 4 l/h and fertilized with 5 kg/ha Megasol, 21,84 t/ha, an increase of 7,25 t/ha.

The Influence of the variety on the production of apples for the same level of fertilization

The data presented in Table 6., shows that Generous variety recorded high yields towards Florina variety, but yield differences are insignificant. The biggest difference of production was obtained from unfertilized variant, 0,28 t/ha. Florina variety gets higher production but only at the variant fertilized with 5 kg/ha, where production exceeds the

Generous variety with 0,19 t/ha, increase that was statistically uninsured.

Table 6. The Influence of the variety on the production of apples for the same level of fertilization), average of 2008-2011

Fertilizer dose	Non-fertilized			2,5 kg /ha			5,0 kg/ha		
Variety	Prod. t/ha	Dif. t/ha	Signif.	Prod. t/ha	Dif. t/ha	Signif.	Prod. t/ha	Dif. t/ha	Signif.
Generous	14,96	-	Mt	16,54	-	Mt	18,08	-	Mt
Florina	14,68	-0,28	0	16,51	-0,03	-	18,27	0,19	-

DL 5% = 0, 247 t/ha DL 1% = 0,523 t/ha DL 0,1% = 1,536 t/ha

The influence of the fertilization level on the production of apples for the same variety and the same level of irrigation

Table 7. The Influence of the fertilization level on the production of apples for the same variety and the same level of irrigation, average of 2008-2011

Variety	Generous						Florina					
Factor BxC	Non-irrigated		2 l/h		4 l/h		Non-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.
Non-fertilized	12,95	-	15,10	-	16,83	-	12,73	-	14,67	-	16,65	-
2,5 kg/ha	13,73	0,78***	16,57	1,47***	19,32	2,49***	13,89	1,16***	16,49	1,82***	19,14	2,49***
5,0 kg/ha	14,37	1,42***	18,11	3,01***	21,77	4,94***	14,80	2,07***	18,12	3,45***	21,90	5,25***

DL 5% = 0,182 t/ha DL 1% = 0,247 t/ha DL 0,1% = 0,331 t/ha

Analyzing the data in Table 7. and shows that the two varieties have similar production value but the biggest production increases were achieved at Florina variety. On irrigated variants were made between 12,73 and 21,90 productions t/ha. Production increases were statistically confirmed and were in the range of 0,78 to 5,25 t/ha, all being very significant. Generous variety was enrolled with the lowest production on non-irrigated, 12,95 t/ha and the highest in irrigated variety with 4 l/h and fertilized with 5 kg/ha Megasol, 21,77 t/ha, variant were the production growth achieved was 4,94 t/ha. Florina variety recorded the highest harvest at the same variant 21,90 t/ha and an increase of 5,25 t/ha. Irrigation combined with fertilization determines the increase of the production increases compared to variants where he acted only one factor.

The influence of irrigation level on the production of apples for the same variety and the same level of fertilization

Analyzing the data in Table 8. it observed that the application of irrigation causes very significant production increases at all variants studied. At a watering of 2 l/h, increases the crop increases were recorded as receiving concomitant irrigation and Megasol. To 2,5 kg/ha fertilizer, increases were 2,84 t/ha, the variety Generous and 2,60 t/ha, at Florina variety. At 5 kg/ha Megasol, increases were of 3,74 t/ha and 3,32 t/ha. Increasing the water quantity, administered at 4 l/ha resulted in a significant increase of production increases obtained. Thus, at the dose of 2,5 kg/ha Megasol was recorded an increase of 5,59 t/ha, at the Generous variety and 5,25 t/ha at Florina variety. Dose of 5 kg/ha resulted in increases of the production of 7,40 t/ha at the Generous variety and 7,10 t/ha, at Florina variety.

The Influence of variety on the production of apples for the same level of irrigation and fertilization

Comparing the data in Table 9. it is noted that between the varieties analyzed there are no differences of production statistically assured, which suggests a capacity approximately equal. The only variable that was a significant difference in the non-irrigated and fertilized was with 5 kg/ha Megasol (0,43 t/ha). Overall the production of Florina variety was lower than those of the Generous variety.

Table 8. The Influence of irrigation level on the production of apples for the same variety and the same level of fertilization, average of 2008-2011

Variety	Generous						Florina					
Factor CxB	Non-fertilized		2,5 kg/ha		5,0 kg /ha		Non-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.
Non-irrigated	12,95	-	13,73	-	14,37	-	12,73	-	13,89	-	14,80	-
2 l/h	15,10	2,15***	16,57	2,84***	18,11	3,74***	14,67	1,94***	16,49	2,60***	18,12	3,32***
4 l/h	16,83	3,88***	19,32	5,59***	21,77	7,40***	16,65	3,92***	19,14	5,25***	21,90	7,10***

DL 5% = 0,247 t/ha DL 1% = 0,350 t/ha DL 0,1% = 0,504 t/ha

Table 9. The Influence of variety on the production of apples for the same level of irrigation and fertilization, average of 2008-2011

Irrigation level	Fertilization level	Generous	Florina	Dif. t/ha	Signif.
Non-irrigated	Unfertilized	12,95	12,73	-0,22	-
	2,5 kg/ha	13,73	13,89	0,16	-
	5,0 kg/ha	14,37	14,80	0,43	*
2 l/h	Unfertilized	15,10	14,67	-0,43	0
	2,5 kg/ha	16,57	16,49	-0,08	-
	5,0 kg/ha	18,11	18,12	0,01	-
4 /h	Unfertilized	16,83	16,65	-0,18	-
	2,5 kg/ha	19,32	19,14	-0,18	-
	5,0 kg/ha	21,77	21,90	0,13	-

DL 5% = 0,311 t/ha DL 1% = 0,545 t/ha DL 0,1% = 1,263 t/ha

The variants fertilized with 5 kg/ha, regardless of irrigation level, Florina variety exceeded the production Generous variety, showing a greater capacity for recovery of the fertilizer, but insignificant.

CONCLUSIONS

Influence on the production of apple variety, average of the years 2008-2011. On average over the three years of experimentation, the Generous variety showed a higher yield potential than Florina variety, but yield differences between them are significant

Influence of drip irrigation level on apple production, average of the years 2008-2011

Irrigation level resulted in increases of the production obtained and increases as highly significant statistically assured for the two levels of irrigation applied. The highest yields were recorded in variants where were applied norms of 4 l/h, increases production of 40,1%, and increases of crops of 5,52 t/ha. **Influence of fertilization level on the production of apple, average of the years 2008-2011.**

Level of fertilization causes very significant production increases for all levels of fertilizer applied. The highest yields were achieved at doses of 5 kg/ha Megasol (18,18 t/ha), with increases of 22,7% (3,36 t/ha).

Influence of fertilization on the production of apples to the same level of irrigation, average of the years 2008-2011.

Fertilization brings very significant production increases at all graduations used but irrigation application makes these increases to be superior to those obtained only after fertilization. The highest yields were obtained at fertilization with a dose of 5 kg/ha, regardless of the norms of irrigation applied with a maximum increase irrigated with 4 l/h (5,10 t/ha).

Influence of irrigation level on the production of apples for the same level of fertilization, average of the years 2008-2011.

Irrigation resulted in very significant production increases regardless of fertilization, yields based on the value of 2,05 t/ha and reaching at a value of 7,25 t/ha. The highest yields and hence the largest yield increases were obtained in irrigated variant with 4 l/h and fertilized with 5 kg/ha Megasol, 21,84 t/ha, and an increase of 7,25 t/ha.

Influence of variety on the production of apples for the same level of fertilization, average of the years 2008-2011.

The only difference between the two varieties production was recorded in the unfertilized variant, where the Generous exceeded the production of Florina variety by 0,28 t/ha, which is a significant difference statistically assured being insignificant. Fertilizer administration has reduced the distance between productions, reaching at the dose of 5 kg/ha, Florina variety exceeds the production at the Generous variety, but the differences are insignificant.

Influence of fertilization level on the production of apples for the same variety and level of irrigation, average of the years 2008-2011.

Under the same conditions of fertilization and irrigation, the reaction was different varieties. Thus, Generous variety obtained yield increases in the range of 0,78 t/ha, at doses of 2,5 kg/ha to 1,16 t/ha obtained by Florina variety, up to 4,94 t/ha, achieved growth in a dose of 5 kg/ha towards 5,25 t/ha obtained by Florina variety. This variety has used more effectively the fertilization effect. All registered production increases at all graduations used, were very significant.

Influence of irrigation level on the production of apples for the same variety and level of fertilization, average of the years 2008-2011.

Applying irrigation causes very significant production increases at all variants studied.

Thus, Generous variety obtained yield increases in the range of 2,15 t/ha, the norms of 2 l/h compared to 1,94 t/ha obtained by Florina variety, up to 7,40 t/ha, increase made at norm of 4,94 t/ha, increase achieved at a dose of 4 l/h, compared to 7,10 t/ha,obtained at Florina variety. Generous variety exploited more efficiently the effect of irrigation.

All registered production increases at all graduations used were very significant. **Influence of variety on the production of apples for the same level of irrigation and fertilization, average of the years 2008-2011.**

There are no differences of production statistically assured between the varieties analyzed, which suggests a production capacity approximately equal. Overall the yields of Florina variety were lower than the Generous variety. The largest differences in production were of 0,43 t/ha and the lowest, of 0,01 t/ha.

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