STUDIES REGARDING THE INFLUENCE OF IRRIGATION ON FRUIT YIELD AT APPLE TREES IN IARA – TURDA, TRANSYLVANIA CONDITIONS

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Abstract. The paper presents the results of the experiments that were carried out during 2012-2014 period, in the Iara-Turda depressionary area conditions. The research`s general objective is the study of agroproductivity at Jonagold, Florina, Generos, Idared, Jonathan, Granny Smith and Golden Delicious apple varieties, all grafted on to a semi-vigourous M106 rootstock. The influence of the irrigation and fertilization regime was studied in an polifactorial experiment that aimed the study of the interactions of three factors and the specific and cumulative effects on growth and fructification parameters of the apple tree varieties in the pedoclimatic context of the studied area. The present paper refers only to the interaction and effect of the irrigation regime in relation to the studied factors.

Keywords: irrigation, fertilization, apples, apple tree variety, yield

INTRODUCTION

Apple trees are considered a specie with high demands regarding soil moisture, which should represent 70-75% of the field capacity, and regarding relative air humidity (CIMPOIEŞ 2012,). Apple tree varieties have different resistance to drought conditions, so some varieties are more drought-tolerant, as the summer, autumn and some winter varieties such as Idared and Golden Delicious, having a greater resistance to low levels of soil moisture and air humidity (CIMPOIEŞ 2012, GHENA et al. 2004). The irrigation regime is influenced by natural factors and agrotechnical techniques. Among the natural factors, the decisive influence is represented by the climate conditions such as rainfall distribution and quantity, temperature distribution and evolution, relative air humidity, droughts (LUCA, NAGY 1994). For appropriate water management of the irrigation regime, the active humidity that is useful to plants and the proportion of water that is available for plants from the field capacity, has to be known. To this end, the Active Humidity Interval (A.H.I.) and the Active Humidity Coefficient (A.H.C.) are calculated. (LUCA et al.2013). Through the vegetation phenophases, the largest amounts of water are required during the period of intensive growth of shoots and fruits (from May to late July) but during the fruit maturation season less water is required (25-40% of AHI).

MATERIAL AND METHOD

The experiences that were conducted for this research were organized and located in the experimental field in Cacova Ierii, Iara-Turda region, Cluj County (46° 32'36.3 "N 23° 27'46.1" E) onto a even area regarding fertility and microrelief conditions, at ~545m medium elevation. The orchard with high-density planting system, based on the use of a high number of apple trees (1.250 trees ha) was planted in 2006. The trees were planted at 4m x 2m distance, the crown being trained to grow to a palmette shape with the help of a

trellis system. The location test method consists of subdivided parcels, with three repetitions (n = 3), the number of experimental variants being 28 (v = 2 x 2 x 7). A one way ANOVA test was carried for statistical interpretation of yield data in a polifactorial experience with 3 factors in 3 replications for 3 years.

As a whole, in terms of thermal regime, 2012 was characterized as a warm year, with an annual monthly average of +10,3^{0}C, 1,4^{0}C above multi-annual average recorded at the meteorological station in Câmpia Turzii. In terms of rainfall, 2012 is characterized as a dry year, negative differences of more than 40 mm rainfall were registered compared to the multi-annual rainfall average, but as a whole, the normal periods alternated to dry and rainy periods, the average humidity being 71%, with minimum values of 13% recorded in August and September.

Regarding the thermal regime, 2013 is characterized overall as being a cool year, with a annual monthly average of +7,8^{0}C, 1,1^{0}C below the annual average. As regards the recorded rainfall values, 2013 is estimated as a very dry year, ~ 80mm less precipitation being recorded compared to the annual average, with average relative humidity of 77% and a minimum 13% recorded in May.

The first three quarters of 2014 are characterized by normal temperatures, but the overall values of rainfall were higher than the annual average, so in the first quarter of the year, a higher average temperature was recorded (4.3 ^{0}C above annual average). In terms of rainfall, January was excessively rainy, February was a little dry, and in March normal values for rainfall were recorded.

In the second quarter of 2014, normal temperatures were registered, with an average of 15^{0}C, 1^{0}C higher than the annual average of the last 55 registered years, but in terms of rainfall, very high amounts of rainfall were registered in April, normal rainfall was registered in May and June was characterized as a very dry month, `35mm below annual average.

The third quarter of 2014 was also characterized as normal in terms of temperature mean value, only one degree above the annual average multi-annual temperatures and in terms of rainfall, this period was characterized as rainy, with ~34mm above the average multi-annual values. In July excessive rainfall was recorded, ~67mm excessive related to normal values.

During the investigations, for the experimental field, the installation of a drip irrigation system was imposed. The groundwater drip irrigation system is powered by a feed pump that carries the water to the buffer pools and then to the pipeline system through the control panel. The main pipeline is made of PVC and has 50 mm diameter. The watering pipeline system is made of plasticized PVC with diameters of 12-16 mm, with dripping devices for each tree individually, the whole system being mounted on a downward pointing aligned bearing wire, 40-60cm tall. The irrigation flow rate is 6-8 l/h, and the amount of water supplied once for a tree is 30-50 liters.

For irrigation regime factor, two versions were tested: non-irrigated and irrigated at 50% of Active Humidity Interval (A.H.I.), the non-irrigated version being the control variant.

The main objectives of the fertilization regime plan in apple orchards are: constant fruit yield, maintaining and increasing soil fertility, high productivity and superior fruit quality characteristics, achieving positive economic indicators, preserving the ecological balance. The fertilization regime for the current experience consists in radicular fertilization and extraradicular application of fertilisers, differentiated for each of the experimental variants. Extraradicular, additional fertiliser is applied complementary to the

radicular fertiliser and it mainly aims short term omission of deficient nutrients, especially trace elements, and optimization of plants mineral nutrition during certain critical vegetation phenophases throughout the growing season, when there is an increased consumption of one or more nutrients. This is why, extraradicular fertilisation is a very important component, mandatory to the fertilization regime, highly significant for increased yield and fruit quality (BABUC, et al, 2009). Also, the uptake of macro and microelements is more efficient and fast, by applying fertilisers on tree foliage than their absorption trough the root system. For the second factor of the experiment, the fertilization regime, two variants were tested: radicular fertilisation and radicular fertilisation + extraradicular fertilisation.

The biological material used for the experiments carried out in the Iara – Turda, consists of seven apple tree varieties: Jonagold, Florina, Generos, Idared, Jonathan, Granny Smith and Golden Delicious, all grafted on to a semi-vigourous M106 rootstock. The orchard, with high-density planting system (1,250 trees/ha) was planted in 2006 on a trellis system and is productive since 2010.

Table 1

Summary of the experimental factors

Factorii studiați	**Graduări**
Factor A **Irigation regime**	a_1 –non-irrigated
	a_2 – irrigated at 50 % IUA
Factor B **Fertilisation**	b_1 – radicular fertilisation
	b_2 – radicular fertilisation + extra-radicular fertilisation
Factor C **Variety**	c_1 – Jonagold
	c_2 – Florina
	c_3 – Generos
	c_4 – Idared
	c_5– Jonathan
	c_6– Granny Smith
	c_7 – Golden Delicious

RESULTS AND DISCUSSION

The general average for 2012 yield obtained in the experimental field, is considered to be a very good rate for apple tree yield obtained in this area (28225.36 kg / ha), due to the fact that 2012 had been a warm year and that the lack of precipitations were compensated with supplimentary water imput for the irrigated variants.

Analysis of the effects of the first one of the three factors studied, the irrigation regime on apple production in the conditions of Iara - Turda, during 2012, showed higher yields for the irrigated variants, than for the non-irrigated variants. Registered yield value growth, due to the irrigation regime was 4446.43 kg / ha (17.1%), distinct statistically significant difference.

The interaction of the irrigation factor influenced the production of apples, differentiated, in relation to B factor, fertilisation, the best results being registered by the variants where extra radicular fertilizer was added to the radicular treatment. The influence of the interractions of the fertilisation and irrigation regimes is statistically distinct significant, for both of the variants: 4562.86 kg/ha, respectively 18.1%. for the irrigated

raducular fertilised crop and 4330,0 kg/ha, respectively 16.2% for the irrigated radicular and extra radicular fertilised crop, as showed below in the Table 3.

Table 2

Influence of the A factor- *irrigation regime* on the apple production, Iara – Turda, 2012

Variant	Average yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
a_1 - non irrigated	26002.14	100.0	0.00	Mt.
a_2 – irrigated at 50 % AUI	30448.57	117.1	4446.43	**
			LSL (p 5%)	1447.12
			LSL (p 1%)	3341.83
			LSL (p 0,1%)	10634.63

Table 3

Interraction of A factor correlated to B factor – *irrigation regime* x *fertilization* on the production of apples, Iara – Turda, 2012

Variant	Average yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
a_1 b_1	25235.71	100.0	0.00	Mt.
a_2 b_1	29798.57	118.1	4562.86	**
a_1 b_2	26768.57	100.0	0.00	Mt.
a_2 b_2	31098.57	116.2	4330.00	**
			LSL (p 5%)	1603.50
			LSL (p 1%)	3387.57
			LSL (p 0,1%)	9735.44

Table 4

Influence of interraction of A factor to C factor – *irrigation regime* x *biological material (cultivated variety)* on the production of apples, Iara - Turda, 2012

Variant	Medium yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
a_1 c_1	15070.00	100.0	0.00	Mt
a_2 c_1	19670.00	130.5	4600.00	**
a_1 c_2	29445.00	100.0	0.00	Mt
a_2 c_2	37440.00	127.2	7995.00	***
a_1 c_3	29240.00	100.0	0.00	Mt
a_2 c_3	32465.00	111.0	3225.00	*
a_1 c_4	23535.00	100.0	0.00	Mt
a_2 c_4	27165.00	115.4	3630.00	**
a_1 c_5	32340.00	100.0	0.00	Mt
a_2 c_5	37725.00	116.7	5385.00	**
a_1 c_6	22390.00	100.0	0.00	Mt
a_2 c_6	25155.00	112.3	2765.00	*
a_1 c_7	29995.00	100.0	0.00	Mt
a_2 c_7	33520.00	111.8	3525.00	**
			LSL (p 5%)	2111.63
			LSL (p 1%)	3341.80
			LSL (p 0,1%)	6684.40

The influence of interractions of A factor – *irrigation* correlated to C factor – *biological material (variety)* on the production of apples is presented above in Table 4. The average production of the a_2c_2 variant, (Florina variety), during 2012 was statistically very significant positive, 7995 kg / ha (27.2%), statistically distinct significance was recorded for a_2c_1, a_2c_4, a_2c_5, a_2c_7 variants, (Jonagold, Idared, Jonathan, Golden Delicious varieties) and statistically significant differences were recorded for a_2c_3 and a_2c_6 variants (Generos and Granny Smith varieties).

In 2012, the experiences from Iara – Turda were carried out, analyzing the influence of the interraction of three factors: the irrigation regime, fertilisation and biological material on the production of apple trees and increased yield was reported for all by-combinations in which graduation a_2 – irrigated at 50% IHA was part, compared to the combinations of the graduation a_1, non- irrigated variants. The results are presented in the Table 5, below.

Table 5

Influence of A factor to B and C factor – *irrigation regime* to *fertilisation regime* to *biological material (cultivated variety)* on the production of apples, Iara - Turda, 2012

Variant	Medium yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
$a_1b_1c_1$	14260.00	100.0	0.00	Mt.
$a_2b_1c_1$	19130.00	134.2	4870.00	**
$a_1b_1c_2$	29060.00	100.0	0.00	Mt.
$a_2b_1c_2$	36640.00	126.1	7580.00	***
$a_1b_1c_3$	28190.00	100.0	0.00	Mt.
$a_2b_1c_3$	31960.00	113.4	3770.00	*
$a_1b_1c_4$	22860.00	100.0	0.00	Mt.
$a_2b_1c_4$	26610.00	116.4	3750.00	*
$a_1b_1c_5$	31020.00	100.0	0.00	Mt.
$a_2b_1c_5$	36540.00	117.8	5520.00	**
$a1b_1c_6$	21770.00	100.0	0.00	Mt.
$a_2b_1c_6$	24510.00	112.6	2740.00	-
$a_1b_1c_7$	29490.00	100.0	0.00	Mt.
$a_2b_1c_7$	33200.00	112.6	3710.00	*
$a_1b_2c_1$	15880.00	100.0	0.00	Mt.
$a_2b_2c_1$	20210.00	127.3	4330.00	**
$a_1b_2c_2$	29830.00	100.0	0.00	Mt.
$a_2b_2c_2$	38240.00	128.2	8410.00	***
$a_1b_2c_3$	30290.00	100.0	0.00	Mt.
$a_2b_2c_3$	32970.00	108.8	2680.00	-
$a_1b_2c_4$	24210.00	100.0	0.00	Mt.
$a_2b_2c_4$	27720.00	114.5	3510.00	*
$a_1b_2c_5$	33660.00	100.0	0.00	Mt.
$a_2b_2c_5$	38910.00	115.6	5250.00	**
$a_1b_2c_6$	23010.00	100.0	0.00	Mt.
$a_2b_2c_6$	25800.00	112.1	2790.00	-
$a_1b_2c_7$	30500.00	100.0	0.00	Mt.
$a_2b_2c_7$	33840.00	111.0	3340.00	*
			LSL (p 5%)	2802.52
			LSL (p 1%)	4168.37
			LSL (p 0,1%)	7255.93

The yield values that were registered in 2013 in Iara – Turda region, were very high (35649.64 kg/ha), especially compared to the general yield of apples in the surrounding area (most of the orchards nearby registered very low productivity attributed to different causes: failure of fruit to set, offyear, insects and diseases, hail, cultural practices, soil exhaustion etc.) and to the fact that 2013 was characterised as generally cold and with pronunciated deficit in precipitations (~80 mm lower compared to the averege registered in the last 55 years at Câmpia Turzii weather station).

Analysis of the interraction and effect of the first one of the three factors studied, the irrigation regime on apple production in the conditions of Iara - Turda, during 2013, showed higher yield level at the irrigated variants, compared to the non-irrigated variants. Registered production growth due to irrigation was 5980.72 kg/ha (18.3%), highly statistically significant difference, as showed in the table below.

Table 6

Influence of the A factor- *irrigation regime* on the apple production, Iara – Turda, 2013

Variant	Average yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
a1 – non-irrigated	32659.29	100.0	0.00	Mt.
a2 – irrigated at 50 % AHI	38640.00	118.3	5980.72	***
			LSL (p 5%)	373.36
			LSL (p 1%)	862.19
			LSL (p 0,1%)	2743.74

The irrigation regime influenced the production of apples, differentiated, in relation to B factor, *fertilisation*, the best results being registered in 2013, by the irrigated variants where extra radicular fertilizer was added to the radicular treatment. The influence of the irrigation regime shows highly statistically significant difference, for both of the fertilisation schemes: 6458.57 kg/ha, respectively 20.5%. for the irrigated raducular fertilised crop and 5502.86 kg/ha, respectively 16.3%. for the irrigated raducular and extra radicular fertilised crop, as presented in Table 7, below.

Table 7

Interraction of A factor and B factor – *irrigation regime* x *fertilization* on the production of apples, Iara– Turda, 2013

Variant	Average yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
a_1 b_1	31570.00	100.0	0.00	Mt.
a_2 b_1	38028.57	120.5	6458.57	***
a_1 b_2	33748.57	100.0	0.00	Mt.
a_2 b_2	39251.43	116.3	5502.86	***
			LSL (p 5%)	1603.50
			LSL (p 1%)	3387.57
			LSL (p 0,1%)	9735.44

The influence of interraction of A factor – *irrigation*, correlated to C factor – *biological material (variety)* on the production of apples, as represented below, in Table 8, shows that the average production of all the variants, presented statistically significant difference, correlated with very high yield rates.

Table 8

Influence of interraction of A factor to C factor – *irrigation regime* to *biological material (cultivated variety)* on the production of apples, Iara - Turda, 2013

Variant	Medium yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
a_1 c_1	15535.00	100.0	0.00	Mt
a_2 c_1	21960.00	141.4	6425.00	***
a_1 c_2	30185.00	100.0	0.00	Mt
a_2 c_2	38210.00	126.6	8025.00	***
a_1 c_3	41650.00	100.0	0.00	Mt
a_2 c_3	44000.00	105.6	2350.00	***
a_1 c_4	41150.00	100.0	0.00	Mt
a_2 c_4	51845.00	126.0	10695.00	***
a_1 c_5	32960.00	100.0	0.00	Mt
a_2 c_5	36150.00	109.7	3190.00	***
a_1 c_6	35145.00	100.0	0.00	Mt
a_2 c_6	42170.00	120.0	7025.00	***
a_1 c_7	31990.00	100.0	0.00	Mt
a_2 c_7	36145.00	113.0	4155.00	***
			LSL (p 5%)	979.94
			LSL (p 1%)	1375.83
			LSL (p 0,1%)	2094.68

In 2013, the influence of the interaction of the irrigation regime to the other two factors: the fertilization scheme and the biological material on the level of production of apples, showed gains obtained in the by-combinations, in which graduation a_2 – irrigated was part, compared to the combinations of the graduation a1, non- irrigated. The $a_2b_1c_3$, $a_2b_2c_3$, $a_2b_2c_5$, and $a_2b_2c_7$ variants presented statistically distinct significance (Generous, Jonathan and Golden Delicious variants), the rest of all the variants, presented highly statistically significant difference. The results are presented in the table below.

In the first three trimesteres of 2014, the registered temperatures had normal values, but during the blooming season, which this year took palce very early, due to elevated temperatures registered in January and February (mean value of more than $4,3^0$C above normal), the buds withstood lower temperatures than the blossoms during February and March, when periods of negative temperatures alternated with warm periods. There is a very close relation between the mean spring temperature and the production of apples. The analysis of spring temperatures and total production of apples indicates that if the temperatures registered from early February to late March are above normal, it may usually be expected that blossoming will be early and that many orchards can be damaged by frost so the results will cause low yiels. Conversely, if the mean temperature for this period is below normal, blossoming will be delayed and yields will usually be consistent. Regarding rainfall, the first three trimesters of 2014, are considered to be very consistent in precipitation: excessively rainy in most of the months (mean values of up to 67 mm above normal in July), excepting June, wich was a dry month (recorded mean values of ~ 36mm below normal).

Apple trees, as generally cared for in the region, tend to bear every other year, with exceptions caused by different natural causes or applied agrotechnical methods, on the other hand. The majority of the trees do not tend to bear heavily and set fruit buds the same

year. After one year of heavy crop, the tendency is for the orchard to bear a light crop the next year. Well nourished trees, properly pruned and cared for, tend to bear every year. Thus irregular bearings is, to a considerable extent, taken out of the category of generaly normal behaviour and by means of proper crop care, constant yields of high quality fruits can be harvested.

The registered mean value for the yield of apples in 2014 is lower than in 2012 and 2013 (14817.14 kg/ha), but still considered a good production rate for this region, due to good cultural practices, proper measures for disease and pest control, prevention tratments, irrigation regime, pruning etc.

Table 9

Influence of interractions of A factor to B and C factor – *irrigation regime* to *fertilisation regime* to *biological material (cultivated variety)* on the production of apples, Iara - Turda, 2013

Variant	Medium yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
$a_1b_1c_1$	15230.00	100.0	0.00	Mt.
$a_2b_1c_1$	20720.00	136.0	5490.00	***
$a_1b_1c_2$	29250.00	100.0	0.00	Mt.
$a_2b_1c_2$	37500.00	128.2	8250.00	***
$a_1b_1c_3$	41280.00	100.0	0.00	Mt.
$a_2b_1c_3$	43590.00	105.6	2310.00	**
$a_1b_1c_4$	40090.00	100.0	0.00	Mt.
$a_2b_1c_4$	51470.00	128.4	11380.00	***
$a_1b_1c_5$	31850.00	100.0	0.00	Mt.
$a_2b_1c_5$	35500.00	111.5	3650.00	***
$a1b_1c_6$	33210.00	100.0	0.00	Mt.
$a_2b_1c_6$	41930.00	126.3	8720.00	***
$a_1b_1c_7$	30080.00	100.0	0.00	Mt.
$a_2b_1c_7$	35490.00	118.0	5410.00	***
$a_1b_2c_1$	15840.00	100.0	0.00	Mt.
$a_2b_2c_1$	23200.00	146.5	7360.00	***
$a_1b_2c_2$	31120.00	100.0	0.00	Mt.
$a_2b_2c_2$	38920.00	125.1	7800.00	***
$a_1b_2c_3$	42020.00	100.0	0.00	Mt.
$a_2b_2c_3$	44410.00	105.7	2390.00	**
$a_1b_2c_4$	42210.00	100.0	0.00	Mt.
$a_2b_2c_4$	52220.00	123.7	10010.00	***
$a_1b_2c_5$	34070.00	100.0	0.00	Mt.
$a_2b_2c_5$	36800.00	108.0	2730.00	**
$a_1b_2c_6$	37080.00	100.0	0.00	Mt.
$a_2b_2c_6$	42410.00	114.4	5330.00	***
$a_1b_2c_7$	33900.00	100.0	0.00	Mt.
$a_2b_2c_7$	36800.00	108.6	2900.00	**
			LSL (p 5%)	1457.56
			LSL (p 1%)	2046.50
			LSL (p 0,1%)	3033.90

Table 10

Influence of the A factor- *irrigation regime* on the apple production, Iara – Turda, 2014

Variant	Average yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
a_1 - non irrigated	13897.86	100.0	0.00	Mt.
a_2 – irrigated at 50 %AHI	15736.43	113.2	1838.57	**
			LSL (p 5%) 476.47	
			LSL (p 1%) 1100.32	
			LSL (p 0,1%) 3501.51	

Analysis of the effect of the irrigation regime on apple tree production in the conditions of Iara - Turda, during 2014, showed higher yields on irrigated variants, than the non-irrigated variants. Registered production growth due to irrigation was 1838.57kg/ha (13.2%), statistically distinct difference (p 0.1% = 3501.51), as presented above, in Table 10.

Table 11

Influence of interractions of A factor and B factor – *irrigation regime fertilization* on the production of apples, Iara – Turda, 2014

Variant	Average yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
$a_1 b_1$	13614.29	100.0	0.00	Mt.
$a_2 b_1$	15174.29	111.5	1560.00	**
$a_1 b_2$	14181.43	100.0	0.00	Mt.
$a_2 b_2$	16298.57	114.9	2117.14	**
			LSL (p 5%)	480.74
			LSL (p 1%)	1098.43
			LSL (p 0,1%)	3456.60

Table 12

Influence of interraction of A factor to C factor – *irrigation regime* to *biological material (cultivated variety)* on the production of apples, Iara - Turda, 2014

Variant	Medium yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
$a_1 c_1$	10895.00	100.0	0.00	Mt
$a_2 c_1$	12530.00	115.0	1635.00	**
$a_1 c_2$	16670.00	100.0	0.00	Mt
$a_2 c_2$	19165.00	115.0	2495.00	***
$a_1 c_3$	19525.00	100.0	0.00	Mt
$a_2 c_3$	22110.00	113.2	2585.00	***
$a_1 c_4$	20850.00	100.0	0.00	Mt
$a_2 c_4$	22330.00	107.1	1480.00	**
$a_1 c_5$	7115.00	100.0	0.00	Mt
$a_2 c_5$	8335.00	117.1	1220.00	**
$a_1 c_6$	12460.00	100.0	0.00	Mt
$a_2 c_6$	13755.00	110.4	1295.00	**
$a_1 c_7$	9770.00	100.0	0.00	Mt
$a_2 c_7$	11930.00	122.1	2160.00	**
			LSL (p 5%)	595.82
			LSL (p 1%)	1012.09
			LSL (p 0,1%)	2284.24

The irrigarion regime influenced the yield of apple trees, differentiated, in relation to B factor, fertilisation, the best results being registered in 2014, at the irrigated variant where extra radicular fertilizer was added to the radicular treatment (14,9% higher then the

non-irrigated version). The influence of the irrigation regime shows distinct statistically significant difference, for both of the fertilisation schemes: 1560 kg/ha higher, (11.5%) for the irrigated raducular fertilised variants and 2117 kg/ha greater (14.9%,), for the irrigated radicular and extra radicular fertilised variants, as presented in the table above.

The influence of interraction of the A factor – *irrigation,* correlated to C factor – *biological material (variety)* on the production of apples, as presented above, shows statistically distinct significance for the most of thevariants, except a_2c_2 and a_2c_3 variants, which showed highly statistically significant difference (Florina and Generous varieties). In 2014, Florina and Generous varieties registered very high values for diameter and fruit weight.

Table 13

Influence of interraction of A factor to B and C factor – *irrigation regime* to *fertilisation regime* to *biological material (cultivated variety)* on the production of apples, Iara - Turda, 2014

Variant	Medium yield (kg/ha)	Relative yield (%)	Difference ± d (kg/ha)	Significance of the difference
$a_1b_1c_1$	10870.00	100.0	0.00	Mt.
$a_2b_1c_1$	12040.00	110.8	1170.00	**
$a_1b_1c_2$	16630.00	100.0	0.00	Mt.
$a_2b_1c_2$	18820.00	113.2	2190.00	**
$a_1b_1c_3$	18820.00	100.0	0.00	Mt.
$a_2b_1c_3$	20900.00	111.1	2080.00	**
$a_1b_1c_4$	20720.00	100.0	0.00	Mt.
$a_2b_1c_4$	21590.00	104.2	870.00	*
$a_1b_1c_5$	6920.00	100.0	0.00	Mt.
$a_2b_1c_5$	7760.00	112.1	840.00	*
$a1b_1c_6$	12120.00	100.0	0.00	Mt.
$a_2b_1c_6$	13600.00	112.2	1480.00	**
$a_1b_1c_7$	9220.00	100.0	0.00	Mt.
$a_2b_1c_7$	11510.00	124.8	2290.00	***
$a_1b_2c_1$	10920.00	100.0	0.00	Mt.
$a_2b_2c_1$	13020.00	119.2	2100.00	**
$a_1b_2c_2$	16710.00	100.0	0.00	Mt.
$a_2b_2c_2$	19510.00	116.8	2800.00	***
$a_1b_2c_3$	20230.00	100.0	0.00	Mt.
$a_2b_2c_3$	23320.00	115.3	3090.00	***
$a_1b_2c_4$	20980.00	100.0	0.00	Mt.
$a_2b_2c_4$	23070.00	110.0	2090.00	**
$a_1b_2c_5$	7310.00	100.0	0.00	Mt.
$a_2b_2c_5$	8910.00	121.9	1600.00	**
$a_1b_2c_6$	12800.00	100.0	0.00	Mt.
$a_2b_2c_6$	13910.00	108.7	1110.00	*
$a_1b_2c_7$	10320.00	100.0	0.00	Mt.
$a_2b_2c_7$	12350.00	119.7	2030.00	**
			LSL (p 5%)	729.87
			LSL (p 1%)	1138.23
			LSL (p 0,1%)	2210.36

In 2014, the influence of interractions of the irrigation regime to the B and C factors, fertilisation and biological material, reported for fruit yield, showed significant positive difference for $a_2b_2c_6$, $a_2b_1c_5$ and $a_2b_1c_4$ variants (Granny Smith, Jonathan and Idared varieties). The $a_2b_1c_7$, $a_2b_2c_2$ and $a_2b_2c_3$ (Golden Delicious, Florina and Generous

varieties) presented statistically distinct significance, the rest of the varisnts presented highly statistically significant difference. The results are presented in the table above.

CONCLUSIONS

Following the experiences vonducted in Cacova Ierii, Iara-Turda region, in 2012, 2013 and 2014, the observations lead to the following conclusions:

In 2012 the yield for the irrigated variant has overcome the non-irrigated variant, the difference being distinctly significant, 4446.43 kg/ha (respectively by 17.1%), in 2013,the difference between the the two variants registered a very significant difference (5980.72 kg/ha, respectively 18,3% higher); in 2014 the registered difference is distinctly significant for the irrigated variant (1838,57 kg/ha, respectively 13,2% higher).The influence of the interraction of A x B factor on apple yield, determined in 2012, a recorded value of the highest yield rate for the irrigated and extra-fertilised versions, the differences being distinctly significant in 2012 and 2014; in 2013 a very significant difference was registered correlated with highest apple yield. The influence of the interractions of A x C factors on apple yield showed that the highest yield was recorded in 2012 by variant a_2c_2 (irrigated variant x Florina variety) – 37440 kg/ha, in 2013 the highest yield was regorded for a_2c_4 variant (irrigated variant x Idared vatiety) -51845 kg/ha and in 2014 the highest yield was regorded also by a_2c_4 variant (irrigated variant x Idared vatiety) – 22330 kg/ha. The influence of the interractions of A x B x C factors recorded the highest yield in 2012 at $a_2b_2c_2$ variant (irrigated x extra-fertilisation x Florina variety) – 38910 kg/ha; in 2013 the $a_2b_2c_4$ variant (irrigated x extra-fertilisation x Idared variety) registered the highest yield rate of all – 52220kg/ha; in 2014 the highest yield rate was registered also, as in 2014, by the $a_2b_2c_4$ variant (irrigated x extra-fertilisation x Idared variety)- 23070kg/ha. In 2012 the influence of the interractions of the irrigation regime on the B and C factors, fertilisation and biological material, reported for fruit yield, showed very significant differences for $a_2b_1c_1$ and $a_2b_2c_2$ variants; in 2013, correlated with the highest yield, very significant differences were reported for more variants: $a_2b_1c_1$, $a_2b_1c_2$, $a_2b_1c_4$, $a_2b_1c_5$, $a_2b_1c_5$, $a_2b_1c_6$, $a_2b_1c_7$, $a_2b_2c_1$, $a_2b_2c_2$ and $a_2b_2c_4$; in 2014, correlated with a lower yield, the only very significant differences were recorded at $a_2b_1c_7$, $a_2b_2c_2$ and $a_2b_2c_3$.

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