

STUDIES REGARDING THE INFLUENCE OF IRRIGATION REGIME ON FRUIT WEIGHT AND VOLUME AT APPLE FRUITS 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-vigorous M106 rootstock. Fruit weight and volume are very important factors in assessing the quality of fruits and their marketing value. The irrigation regime is also a very important factor for fruit growing, as it can influence the yield, the quality and also the price for fresh fruits. Therefore, the interactions of these factors are studied, in order to observe the effects they have on growth and fructification parameters of the apple fruit varieties in the pedoclimatic context of the studied area.

Keywords: apple fruits, apple variety, irrigation regime, fruit volume, fruit weight.

INTRODUCTION

Apple trees are considered a species with high demands regarding soil moisture, which should represent 70-75% of the field capacity, and regarding relative air humidity (Cimpoieș, 2012.). Apple tree varieties have different resistance to drought conditions, so some varieties are more drought-tolerant as Idared and Golden Delicious, having a greater resistance to low levels of soil moisture and air humidity (Cimpoieș, 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, 1999). 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), while 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 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. During the investigations, for the experimental field, a drip irrigation system was used, supplied with groundwater.

For irrigation regime factor, two variants were tested: non-irrigated and irrigated at 50% of Active Humidity Interval (A.H.I.), the non-irrigated version being the control variant. The fruits were harvested at optimum maturity, determined by means of starch index, flesh firmness, juice sugar and acid content, seed color, flesh color, presence of watercore, background color etc. All the fruits of ten representative fruit trees of each studied variant were harvested and then each fruit was weighed using a precision scale and measured using a digital calliper.

Table 1.

Summary of the experimental factors

Studied factors	Factor graduations
Factor A Irrigation regime	a ₁ –non-irrigated
	a ₂ – irrigated at 50 % IUA
Factor B Variety	b ₁ – Jonagold
	b ₂ – Florina
	b ₃ – Generos
	b ₄ – Idared
	b ₅ – Jonathan
	b ₆ – Granny Smith
	b ₇ – Golden Delicious

RESULTS AND DISCUSSION

The average value that was recorded for apple fruit volume at irrigated variants, during the experimental period, was 236,51cm³, which compared to the average value recorded at non-irrigated variants of 201,46 cm³, showed an important increase in fruit volume, of 35,05 cm³, influenced by the extra water intake, during the vegetation period. The apple fruit cultivar that registered the highest value for fruit volume is Generos variety, for both irrigated and non-irrigated variants, this variety also registered the best response regarding fruit weight increase influenced by the irrigation regime.

The volume of apple fruit was calculated by using the formula $V=4\pi/3*r_1*r_2*r_3$, using the three diameters that were measured for each fruit after harvest. As seen in table 2, the lowest values recorded for fruit volume were registered at jonathan and Granny Smith varieties, for both irrigated and non-irrigated variants, similar to the recordings regarding apple fruit average weight. The influence of the irrigation regime applied to the apple crops during the vegetation period showed a general increase in apple fruit volume, at harvest.

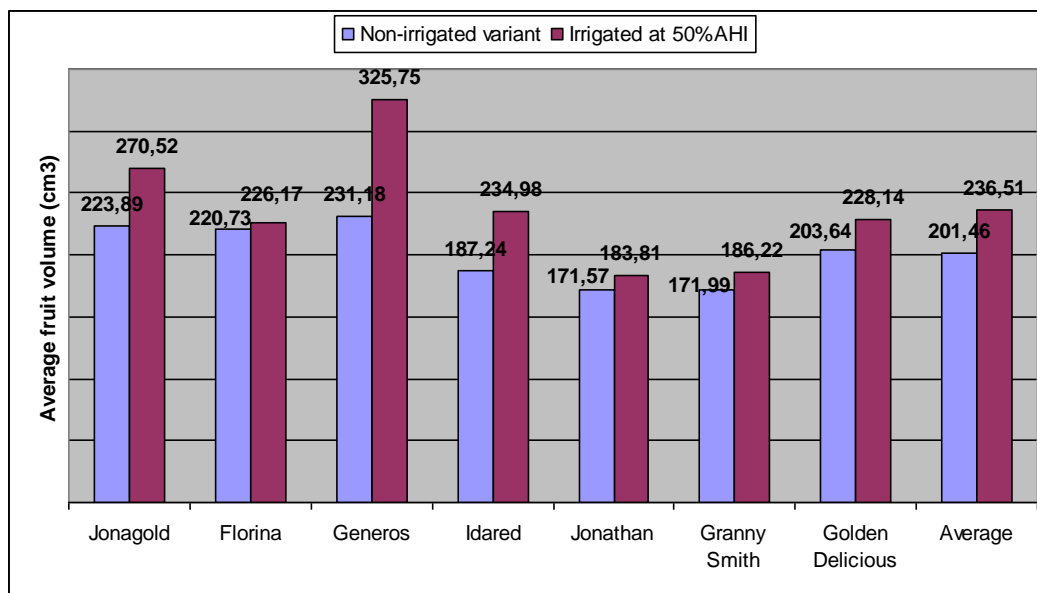


Fig. 1. Average volume of apple fruits, 2012-2014, Iara-Turda region

Table 2.

Average apple volume, 2012-2014, Iara – Turda area

Variety	Non-irrigated variant				Irrigated at 50% AHI variant			
	Average	Year I	Year II	Year III	Average	Year I	Year II	Year III
Jonagold	223,89	216,16	229,20	226,31	270,52	248,94	276,99	285,62
Florina	220,73	228,54	209,85	223,8	226,17	232,01	214,13	232,37
Generos	231,18	227,40	245,15	220,99	325,75	334,35	384,06	339,84
Idared	187,24	180,62	191,45	189,65	234,98	250,96	239,24	214,75
Jonathan	171,57	182,25	165,96	167,76	183,81	193,54	181,00	176,88
Granny Smith	171,99	180,33	170,24	165,40	186,22	181,34	190,99	186,33
Golden Delicious	203,64	212,81	189,45	208,66	228,14	214,82	244,50	225,1

The average value recorded for fruit weight for each of the seven apple varieties that were irrigated is 201,02 grams, which compared to the average value recorded at the non-irrigated variants, 168,11 grams, shows a consistent difference between the experimental variants, of 32,91 grams.

The apple fruit variety that registered the highest values for fruit weight, for both irrigated and non-irrigated variants is Generos variety, as well as for the recordings regarding fruit volume, the weight increase of apple fruits being also influenced by irrigation water input during the vegetation period, correlated to fruit volume increase.

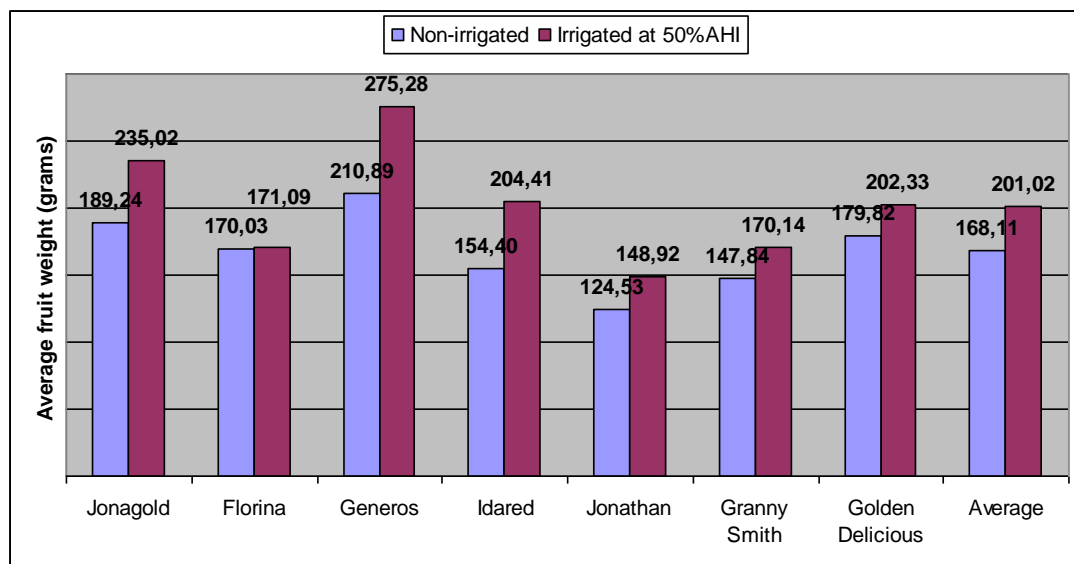


Fig. 2. Average weight of apple fruits, 2012-2014, Iara-Turda region

The apple fruit variety that has the lowest response to the irrigation regime, regarding apple fruit weight is Florina variety, that showed an insignificant increase in fruit weight at the irrigated variants, consisting in only 1,06 grams. The varieties that were most sensitive to drip-irrigation were Jonagold and Generos, the fruits that were harvested from the irrigated variants being larger and heavier, resulting in an increase in productivity and yield.

Table 3

Apple fruit weight, 2012-2014 average, Iara – Turda area

Variety	Non-irrigated				Irrigated at 50% AHI			
	Average	Year I	YearII	YearIII	Average	Year I	YearII	YearIII
Jonagold	189,24	176,47	195,66	195,59	235,02	227,77	221,59	270,89
Florina	170,03	165,26	178,20	166,63	171,09	189,77	133,43	176,76
Generos	210,89	209,32	207,13	216,24	275,28	270,84	276,72	311,77
Idared	154,40	130,35	164,59	168,26	204,41	214,16	208,34	190,01
Jonathan	124,53	119,80	133,20	120,59	148,92	152,32	143,20	161,21
Granny Smith	147,84	141,79	157,10	144,63	170,14	184,31	163,44	162,67
Golden Delicious	179,82	181,66	160,35	197,45	202,33	218,33	198,47	190,19

Quality classification of apple fruits was assessed immediately after harvest, according to the average of the values recorded for height and width of apple fruits, in order to obtain homogenous values for all varieties, due to the fact that some of the apple cultivars have higher values for width of the fruit and some have specific traits such as taller fruits. The apple fruits were classified in four categories, Extra quality: apples with average diameter higher than 75mm; first quality, fruits with diameter values between 68-75mm;

second quality, 60-68 mm diameter fruits and third quality, fruits with an average diameter value lower than 60 mm.

Table 4

Apple fruit classification, according to dimension, 2012 - 2014, Iara – Turda area

Variety		Irrigated variant	Non-irrigated variant
		Average %	Average %
Jonagold	Extra	71,66	41,67
	1 st Quality	18,33	21,67
	2 nd Quality	10	23,33
	3 rd Quality	0	13,33
Florina	Extra	41,66	41,67
	1 st Quality	48,33	36,67
	2 nd Quality	10	18,33
	3 rd Quality	0	3,33
Generos	Extra	96,66	46,67
	1 st Quality	3,33	36,67
	2 nd Quality	0	13,33
	3 rd Quality	0	3,33
Idared	Extra	48,33	26,67
	1 st Quality	38,33	31,67
	2 nd Quality	13,33	15,00
	3 rd Quality	0	26,67
Jonathan	Extra	6,66	13,33
	1 st Quality	46,66	30,00
	2 nd Quality	45	40,00
	3 rd Quality	1,66	16,67
Granny Smith	Extra	40	16,67
	1 st Quality	43,33	30,00
	2 nd Quality	16,66	35,00
	3 rd Quality	0	18,33
Golden Delicious	Extra	41,66	31,67
	1 st Quality	48,33	30,00
	2 nd Quality	10	33,33
	3 rd Quality	0	5,00

As seen in table 4, the quality of apple fruits, according to their dimensions, was influenced by the irrigation regime, for all of the seven apple varieties, where a general tendency was observed at the irrigated variants to grow bigger fruits and record a very low percent of third quality fruits. For the irrigated variants, only the Jonathan variety produced fruits that were classified as third quality, but the percentage was very low (1,66%), compared to non-irrigated variant which recorded 16.67% of third quality fruits.

CONCLUSIONS

During the vegetation period, some stages such as budburst and flowering, shoot growth, fruit fill or harvest, when the fruit cells multiply or get filled with water and sugar, are considered critical, when soil moisture should be readily available, in order to

obtain high yields of good quality apple fruits. Regarding fruit dimension and weight, by irrigating apple orchards at 50% AHI, a constant crop of good quality apple fruits can be achieved yearly, resulting in high productivity and income, correlated with increased yield levels and lower offset periods.

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