

RESEARCHES CONCERNING THE YIELD CAPACITY OF SOME APPLE CULTIVARS IN DIFFERENT TECHNOLOGICAL SEQUENCES IN THE PEDOCLIMATICAL CONDITIONS OF BISTRITA

CERCETĂRI PRIVIND PRODUCTIVITATEA UNOR SOIURI DE MĂR, ÎN SECVENȚE TEHNOLOGICE DIFERITE ÎN CONDIȚIILE PEDOCLIMATICE DE LA BISTRITA

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Abstract. *The study of the characteristic features of growing and yielding at Auriu de Bistrita, Florina and Generos cultivars grafted on M26, in an experience in which there were pursued the influence of the planting density, the training system of the trees and the influence of the irrigation, searched to find technological solutions in order to improve the productivity of these cultivars. The obtained results proved that the increasing of tree number at surface unit was correlated positively with the yields obtained at every studied cultivar, but the yield per tree was decreased at the density of 2500 trees/hectare with 17% at the cultivar Auriu de Bistrita, 9.4% at Florina and 4% at Generos. The canopy did not influence significantly the productivity of these cultivars, but the water supply conducted to yield increment with 12% opposite the non irrigated variants.*

Key words: apple varieties, density, irrigation, vegetative growths, yield

Rezumat: *Studiul particularităților de creștere și fructificare ale soiurilor Auriu de Bistrița, Florina și Generos altoite pe M26, într-o experiență în care s-au urmărit influența densității de plantare, a sistemelor de conducere a pomilor și a regimului de irigare, a căutat să precizeze unele soluții tehnologice pentru creșterea productivității acestor soiuri. Rezultatele obținute au demonstrat că creșterea numărului de pomi la unitatea de suprafață s-a corelat pozitiv cu producțiile obținute la toate soiurile, însă producția pe pom a fost diminuată la densitatea de 2500 pomi/ha cu 17% la soiul Auriu de Bistrița, 9,4% la Florina și 4% la Generos. Forma de coroană nu a influențat semnificativ productivitatea acestor soiuri în schimb aportul suplimentar de apă a produs sporuri de producție cu 12% față de variantele neirigate.*

Cuvinte cheie: soiuri mere, densitate, irigare, creșteri vegetative, producție

INTRODUCTION

The establishment of growth and fructification characteristics in order to substantiate some technological sequences specific to apple varieties with genetic resistance to disease, to achieve high quantity and quality yield is of great actuality. In the case of high density orchards due to high cost of planting

material, the investment per unit area is large, so that the assessment of economic implications of the creation of high-density plantations requires the establishment of indicators and parameters that characterize this culture system.

The objective of the present paper is to present the results obtained regarding the characteristics of growth and fructification of the Auriu de Bistrita, Florina and Generos varieties and to specify the agro-phyto-technical elements which ensure the yield of fruit trees at a high potential.

MATERIAL AND METHOD

The researches were effectuated in a high density apple orchard, established in 2000 with the varieties Auriu de Bistrita, Florina and Generos grafted on M26 rootstock. The trees were planted at 4m between rows, and 1-1.5 m between the fruit trees.

The plantation was located in the middle third of the slope with southern exposition on brown clay iluvial soil with a humus content of 2.5%, 30% clay and the pH in water from 6 to 6.5.

For these varieties the used training system was the slender spindle and the "V" Güttingen corresponding to the globular and flattened training concepts. The plantation was equipped with a drip irrigation system, the trees being irrigated during the periods of water deficit and when the physiological requirements of the trees depending on the vegetative stage and phenologic phase requires its implementation.

The researches have been conducted between the years 2005 -2008, organized by the following experimental plan:

- the A factor: the variety with the graduations a^1 =Auriu de Bistrita, a_2 = Florina, a_3 =Generos;

- the B factor: the planting density with the graduations b_1 =2500 trees/ha, b_2 =1666 trees/ha.

-the C factor: the canopy with the graduations c_1 = slender spindle, c_2 = "V" Guttingen;

-the D factor: the irrigation scheme with the graduations d_1 = non irrigated, d_2 = irrigated

The experience was organized in randomized blocks with three repetitions, three trees per plot repetition. The experience setting up was polifactorial, resulting in 24 variants, so that the observations have covered 216trees. For statistical processing of the results was used the Duncan test and as reference was used the average of the experimental results.

RESULT AND DISCUSSIONS

1. The surface of the sectional area of the trunk

Comparing the average of SST (years 5 to 8 after planting), with the annual average of the experience it 's confirmed the greater vigor of the variety Auriu de Bistrita which in all the years of the study had higher values whatever was the training system or the planting distances (45.2 - 47.1 cm).

The variety Florina present values close to the average experience (38.3 to 41.3 cm²) while the variety Generos has the lowest SST values (30.3 to 32.8 cm²).

The canopy and the irrigation system does not influence significantly the SST values, instead the increased planting distances induce a slight increase in all cases, fact explained by increasing the nutrition space allotted to each tree.

Unlike the SST values, where the genotypic character plays a crucial role in quantifying this parameter, the annual growth increase of SST is significantly positive influenced by the planting density showing values with 6% higher at 1666 trees/ha.

2. The canopy volume

In relation to the graduations of the factor density, all varieties in all the years analyzed, respond favorably to the density of 1666 trees/ha, where the values are higher by 29% for Auriu de Bistrita, 10% for Florina and 4.6% for Generos compared to the density of 2500 trees/ha.

The shape of the canopy does not influence significantly the canopy volume, the two training systems of trees compensate each other, the slender spindle by the thickness of the orchard fence and the "V" Güttingen by the width at a height of 2.6 to 3.2 m, maintained by the repeated transfer of the growth axis on a lateral branch. Nor the irrigation rules applied had no significant influence on the canopy volume values.

3. The level of annual shoot growth

The level of the annual growths both in number and average length fits the studied varieties within the normal parameters. The number of annual growths has an annual average of 122.3 shoots per tree in Florina variety, followed by Generos variety with 106.4 shoots and Auriu de Bistrita with 102.6 shoots.

The average length of the annual growths ranged from 36.9 - 41.1 cm at Auriu de Bistrita, 29 - 35.6 cm in Florina and 32.1-37 cm in Generos, the higher values being constantly resulted in the variants where was applied the irrigation.

The planting density did not influence the average length of annual growths, in turn it's observed an increase tendency of the number of shoots formed at the density of 1666 trees/ha to 2500 trees / ha as follows: Auriu de Bistrita 107/96, Florina 127/117 and Generos 115/98 shoots.

The average number of shoots formed on the tree grew in the year 8 of planting compared to the year 5, from 73.8 to 123.6 for the variety Auriu de Bistrita, respectively 67.4%, to the variety Florina from 101.2 to 133,5 shoots (31.9%), and at the variety Generos from 78.8 to 131.6 (67%)shoots.

The multi-annual average sum of the growth ranged from 3336.8 to 4514.2 cm at Auriu de Bistrita, 3253.4 to 4684.6 cm at Florina and 2854.4 to 4456.3 cm at Generos variety.

4. Foliar surface dynamics

Of all the organs of the trees, the leaves control the most the growth and the fructification. The foliar device through its role on the formation of the fruit harvest of the current year and the process of fruit bud differentiation from which depends the next year's production is a defining element in the ensuring of a greater efficiency of the orchards.

Table 1

**Particularities of growth and yield of the varieties Auriu de Bistrița, Florina and Generos
(the average of the years V – VIII from planting)**

Variety	Density (trees/ha)	Training system	Irrigation scheme	Trunk diameter		Canopy volume (m ³ /tree) Semnification	Amount of annual growths (cm)	Foliar surface/tree (m ² /tree)	Product on per tree (kg)
				S.S.T. (cm ²)	Annual average growth increase(cm ²)				
Auriu de Bistrița	2500	Slender spindle	Non irrigated	45,24 bc	7,63	5,89 a	3691,1	7,84a-f	14,18 fg
			Irrigated	45,58 bc	7,87	5,80 ab	3960,6	8,19a-f	15,29 f
		V Guttingen	Non irrigated	46,21 ac	7,61	5,23 ab	3336,8	7,24c-g	13,94 g
			Irrigated	46,21 ac	7,85	5,56 ab	3764,3	7,80a-f	15,05 fg
	1666	Slender spindle	Non irrigated	46,56 ab	8,10	7,14 a-c	4202,8	8,91 ab	16,65 ef
			Irrigated	47,13 a	8,30	6,85 a-c	4514,2	9,07 a	19,16 d
V Guttingen	Non irrigated	46,81 ab	8,07	6,86 a-c	3802,0	7,94 a-f	15,44 f		
	Irrigated	47,08 a	8,16	6,81 a-c	4350,5	8,80 ab	17,27 e		
Florina	2500	Slender spindle	Non irrigated	40,49 e	7,30	4,89 a-c	3933,1	7,90 a-f	19,62 c-e
			Irrigated	40,98 de	7,48	5,09 b-d	4095,9	8,30 a-e	21,79 bc
		VGuttingen	Non irrigated	38,35 ef	7,25	5,10 b-d	3253,4	6,99 d-g	19,74 c-e
			Irrigated	38,65 ef	7,51	5,21 b-d	3893,2	8,03 a-f	22,95 h
	1666	Slender spindle	Non irrigated	41,33 de	7,50	5,26 b-d	4270,8	8,53 a-d	21,95 bc
			Irrigated	42,03 d	7,92	5,26 b-d	4684,6	9,12 a	22,94 b
V Guttingen	Non irrigated	40,13 d-f	7,77	5,79 b-d	3695,5	7,69 a-f	22,07 bc		
	Irrigated	40,46 e	7,99	5,79 c-e	4290,4	8,67 a-c	25,08 a		
Generos	2500	Slender spindle	Non irrigated	31,57 gi	5,95	3,32 d-f	3349,5	6,80 e-g	20,72 c
			Irrigated	31,68 gi	6,14	3,30 ef	3828,1	7,56 a-f	22,18 bc
		V Guttingen	Non irrigated	30,31 gh	5,84	2,93 ef	2855,4	5,83 g	18,71 de
			Irrigated	30,61 gh	6,12	3,02 ef	3366,8	6,68 fg	21,63 b-d
	1666	Slender spindle	Non irrigated	32,58 g	6,30	3,24 ef	4172,2	7,43 b-f	20,57 cd
			Irrigated	32,82 g	6,49	3,32 ef	4456,3	7,99 a-f	24,43 ab
V Guttingen	Non irrigated	32,04 gi	6,27	3,46 f	3665,8	6,94 e-g	20,57 cd		
	Irrigated	32,46 g	6,43	3,56 f	4057,8	7,59 a-f	22,99 b		

The average leaf surface calculated by the "Leaf Area Measurement" (software to calculate leaf surface) created at Univ. Sheffield is 37.81 cm² at Auriu de Bistrita variety, 33.16 cm² at Florina variety and 28.72 cm² at Generos variety. The distance between the internodes for Auriu de Bistrita is on average 2.86 cm, 2.3 cm at Florina and 2.48 cm at Generos.

The medium values of the foliar surface at the variety Auriu de Bistrita range from 7.2 to 8.9 m²/tree, at the variety Florina between 7.0 to 9.1 m²/tree and at the variety Generos 5.8 to 8.0 m²/tree according to the adopted technological version.

The combinations with the greatest foliar surface values are for the studied varieties, at the density of 1666 trees/ha under irrigation.

Although the shape of the canopy does not produce significant effects, it leads to higher values as the slender spindle training system.

The tree leaf area is significantly influenced by the size of the distance between the trees at a time (increasing the area of individual development of the tree and the area of nutrition) and very significant by the supplementation of the irrigation water (it generates higher values of the length of the annual shoots and even of the leaves).

5. Results regarding the fruit yield

The fruit production is affected by the process of fruit binding, the ratio/fruits, varietal characteristics, planting distances, applied agrotechnique, soil and climatic conditions etc.

The production levels achieved in the years V - VIII of planting in the polyfactorial experience from SCDP Bistrita were oscillating, but suggestive in respect to the productivity character of the studied varieties.

The average yields achieved by the variety Auriu de Bistrita was significantly distinct negative comparing to the level of production obtained from the varieties Florina and Generos. Thus the average yield per tree at Auriu de Bistrita was according to the analysed technological variant from 13.94-19.16 kg, while the same indicator presented values ranging from 19.62 to 25.08 kg at Florina variety. The averages of the yield obtained at Generous variety have ranged between 18.71 and 24.43 kg/tree, which was noted in year 8 of the planting with the highest production of the experience, from 32.06 to 36.63 kg/tree.

The influence of the experimental factors on the yield does not highlight significant differences in the training system used instead at planting density of 1666 trees / ha the values of this parameter are significant, also the influence of irrigation especially during 2006-2008 was very significant statistically registering increases of production by 12% over the non-irrigated variants.

CONCLUSIONS

1. The varieties Florina and Generos confirms the good yield results, being adapted to the variability of the pedo-climatic conditions, instead the variety

Auriu de Bistrita, although with a low production potential, may complete the local area assortment through the quality of the fruits.

2. Increasing the planting density at 2500 trees/ha is recommended for the variety Generos, accepted for the variety Florina and totally non indicated for the variety Auriu de Bistrita in the conditions of grafting on M26, this variety being very difficult to control in terms of limiting the space of development.

3. The training system slender spindle induces a larger number of annual growths, respectively an increased leaf area which, through the intensity and the photosynthetic efficiency positively affects the productivity of trees, instead the "V" Guttingen training system through the inclined panels of vegetation, provides a top recovery of natural light and ventilation of the fruit bearing formations, leading finally to the high quality parameters of fruits.

4. The influence of irrigation, even if it has not produced large increases of yield, was obviously that the additional intake of water when the physiological needs of the plantation requires this measure is compensated by the higher levels of the achieved yield.

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