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Culture System of Trees
Fruit Production Efficiency in Relation to Crown Forms

Valerian BALAN, Gheorghe CIMPOIES

Faculty of Horticulture, The Agrarian State University of Moldova,
MD-2049, 42 Mircesti St., Chisinau, Republic of Moldavia; cimpoies@uasm.md; v.balan@uasm.md

Abstract. Apple variety *Golden Delicious*, grafted on M 9 was studied at different distances and crown forms in ontogenesis. During the ontogenesis period the highest productivity was obtained at the plantations in the canopy with simple lines in a vertical and two oblique planes. The main role in absorption of solar energy lies in the way of all vegetative location in space. We present here a bibliographical review of some of the elements which constitute the ground of their conception such as light utilization, plant density, module placement rows and crowns.

Keywords: plant density, crown forms, light utilization, orchard system.

INTRODUCTION

Specific forms of crown to the extensive orchards, which require the formation of the skeleton elements, are sufficiently strong, progressively replaced by the forms in the iron system (palmetto) or spindle. Range of shapes has everywhere biological origins (variety, rootstocks etc.), climate (light, heat, rain etc.) and soil, but certainly responds also to the factors like tradition and a maximum and economic production potential (Cimpoies, 2000; Balan, 2007)

MATERIAL AND METHODS

The researches were carried out on the didactic field of the Department Fruit growing State Agrarian University of the Moldova. In ontogenesis there studied the following parameters of the plantings structure in different combination, as you could see in the Tab. 1.

Tab. 1

The scheme of planning the experiment.

Variant	Planting distance, m	Crown form	Module placement, crown	Module placement, rows
1	4x2,5	Palmetto	In a vertical plane	Simple
2	4x1,5	Slanke spill		
3	4x1	Palmetto	Two planes oblique	
4	4x1	Tatura		
5	4+1x1,5	Slanke spill	In a vertical plane	Double

The evidence and estimation of apple tree biological characters were done casing the method of constant research. The efficiency of solar energy (K) was calculated through ratio of accumulated energy in yearly phytomass (M) to the energy at a hectare in the vegetation period (m).

$$K = \frac{M}{m} 100,\%$$

For the calculation of energy quantity accumulated in phytomass were taken into account the fact that 1 kg of fruit dry mass constitutes – 5200 kcal. and phytomass – 4500 kcal. The mean multi-yearly value of active solar energy during the vegetation period in Moldova constitutes 3840 mln kcal.

The experiences were repeated three times. The direction of the rows from north to south. The number of registered trees in each variant are 24. At the basis of the studies are methodological indications for the establishment of orchards with high productive structures, the evidence and the control of the main indices of photosynthetic productivity, the study of the biological rotation in phytocenosis.

RESULTS AND DISCUSION

In the literature by speciality is mentioned that in the north orchards the number of trees per hectare is high to cover the orchard area with a maximum projection of the crown, which allows receiving better solar radiation. In the southern trees reach higher achievements photosynthetic, the light and heat contribute to the significant fructification (Jackson, 1978; Palmer et al., 1980).

Because of many combinations of varieties stocks, many of numerous planting distances as well as of modes of grouping of the trees from the existing diversity of biological material were imposed numerous researches on systems of management of trees. Among the experienced systems of leadership are mention apple iron forms (palmetto with oblique arms, palmetto with horizontal arms, free iron palmetto, vertical rim, etc.), free forms (Slanke spill, Super spindle system; Spindle Northern Netherlands etc.), and forms in two oblique plans (Tatura Trellis, "V system" or System Guttingen V) that show this great diversity (Jackson, et al., 1987; Mika, 1992; Ghena et al. 2004; Donica, et al., 2008).

The Republic of Moldova being situated geographically between these two scientific currents supported a set of influences on culture systems. Both the diversity of methods and technical possibilities and the climatic conditions in the area should be the object of study that will be at the basis of culture systems in the future. At the same time it is considered appropriately to identify the theoretical elements that contribute to the orchard productivity (yield, year entry into the fruit, fruit quality, frequency of fructification etc.) and examine the component elements that define the different culture systems, the mode of developing of the relations between these ones.

The crown volume associated with smaller planting distances have a small role in ensuring efficient use of solar energy, leading the production, labour productivity in the work manual high volume (cuts, harvesting), the degree of mechanization of technological work, etc. .

These considerations led to the approach of the research of a wide range of shapes crown. For example, the apple-variety combinations for the rootstock weak force are given the reduced crown volume: Slannke spill, Spindle bush, Solen, Vertical axis, Tatura Trellis, Super spindle, et. al. These types of crown were imposed both by local climatic conditions (light, rainfall, air drainage, etc.), the soil, and the diversity of species, varieties, rootstocks and a variety of mix-stock.

Slanke spill made in the Netherlands, Super spindle widespread in Germany and the Netherlands, the vertical axis, Solen, and Tesa made Solaxe France (Lespinasse, 1977), Palmeta free iron in Moldova (Babuc, 1985), Tatura Trellis developed Australia systems are

small crown of trees. These crowns allow the limitation of distance between rows to a strict minimum required by existing tractors.

To decipher a summary of the use of solar energy, where the direction of continuous canopy row in Tab. 2 is presented for illustration only 5 variations of the structure of fruit growing plantation of a series of experiments performed at the State Agricultural University of Moldova (Cimpoies, 2000).

Tab. 2

Photosynthetic absorbs radiation assets (RFA) of the variety *Golden Delicious* apple, grafted on M9 in the light of the crown, the location of the canopy and lines in space.

Module placement, rows	Module placement, crown	Planting distance, m	Crown form	Absorb R.F.A./day	
				$Jx10^8$ rous	$Jx10^8$/ha
Simple	In a vertical plane	4x2,5	Palmetto	35,3	883
		4x1,5	Slanke spill	34,9	871
	Two planes oblique	4x1	Palmetto	54,1	1352
		4x1	Tatura	53,3	1333
Double	In a vertical plane	4+1x1,5	Slanke spill	41,6	832

It was found that RFA, absorbed by a line or a band, increases with decreasing planting distance, reaching the value of 41.6 J x 10^8 in double rows with planting. It is obvious that in plantations located in simple lines, the greatest quantity of the RFA area occupied unit was absorbed by the crown in two oblique planes. This is due primarily to increased the value index Foliar Fi = 3.6 and volume production per unit area (25-26 thousand m3/ha). Also the increase the coverage of soil (68%).

These forms of conduct a wreath bioconversion top solar energy light (1,36-2,17%) in the tree of foliar and is confirmed by the production of fruit produced (Tab. 3). Fruit production has recorded the highest values in plantations with simple lines and canopy in two oblique planes.

Tab. 3

Production of fruit produced on the apple variety Golden Delicious, grafted on M9, according to the crown placement and the rows and canopy space, t / ha.

Variant	Vegetation year											
	4	5	6	7	8	9	10	11	12	13	14	Average
1	2,3	10,9	19,1	18,0	37,5	26,2	25,3	7,6	27,5	9,5	10,8	17,7
2	5,5	13,3	18,7	13,7	43,2	31,2	25,2	9,3	32,9	11,7	12,8	19,8
3	6,2	33,3	41,2	22,6	50,8	74,3	32,5	10,5	73,3	14,8	17,8	34,3
4	4,0	18,5	37,3	12,3	61,8	73,0	33,0	9,5	65,5	12,1	13,4	30,9
5	8,3	20,4	15,7	8,3	40,8	27,2	20,5	7,5	48,9	9,0	11,0	19,8

You deduce that the main role in absorption of solar energy lies in the way of all vegetative location in space.

Plantations in the canopy with simple lines in a vertical and two oblique planes are more rational in the economic and agrobiologic.

CONCLUSIONS

Apple tree due to a very large range of rootstocks and even different varieties of force enables the use of all of offers the possibility of the use of our systems of culture, allowing the adaptation of the orchard to soils less fertile or to different systems of management of tree crown.

For rising of the labour productivity systems they are chosen of simple management with a high degree of mechanization of work and culture of low stature of trees, which allow fully exploit the manual work (cut trees, and harvesting fruit space out). Such a system can be highlighted by the constantly relations between the species, rootstock, the management of crown, crown shape and distance of planting.

Modern fruit growing production involves the crown with simple lines in a vertical plane up to 2.5 m in height allowing the rationalization of work cutting, harvesting, maintenance of soil and orchard with lower costs. Adaptation of some forms of crown less bulky, more systematized, with a structure as to increase production of fruit.

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