

STUDY OF A SILVOPASTORAL SYSTEM WITH TURKEY OAK (*QUERCUS CERRIS* L.) IN DOBROGEA

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Abstract

Changing climate and global warming are a major challenge for livestock farming especially during the grazing season. Silvopastoral systems are a viable solution to mitigate the negative effects of drought on the grassland and livestock. The research was carried out in Visterna, Dobrogea province, on existing grasslands under a 35-40 year old Turkey oak plantation, with an average density of 867 trees per hectare. The green mass production was evaluated at 3.4 t/ha, which can ensure an optimal load of 0.4 LU/ha in 130 days of grazing season. The calculated pastoral value is 16.3 and the estimated milk production can reach 1,300 liters/ha. This system with grass and planted trees can be a solution for the seasonal conditions with moisture deficit and higher temperatures from the future.

Keywords: silvopastoral system, *Quercus cerris* plantation, tree features, grassland productivity.

INTRODUCTION

Agroforestry is a different way of using land compared to agriculture, forestry or animal husbandry taken singly, which combines either trees with cultivated plants, trees with livestock or trees, cultivated plants and livestock. (MCADAM et al. 2009, MIHĂILĂ et al. 2010, MOSQUERA-LOSADA et al. 2012).

The objective of agroforestry is to reduce the possibility of certain natural risks such as desertification, land degradation, etc. and to create the

highest possible yields for farmers. The presence of trees in the agricultural land increases land productivity, offering multiple ecological, economic and social services at local and regional levels, ensuring through wood production a constant additional income for land owners who use agroforestry systems, increasing thus their financial stability (RIGUEIRO-RODRÍGUEZ et al. 2009).

The way in which the components of agroforestry systems (trees/shrubs, crops, animals) are arranged in space and time, making

the difference between these activities, is done in accordance with the role of the trees and the functions they perform. Intercroppings, perimetral tree fences, windbreak forest belts, planting of forest shrub species for soil conservation, clump of trees on agricultural land, etc. are agroforestry practices within these systems. Any of these practices turn into a functional system when it

reaches a certain stage of development for a specific area, representing the usual way of using the land in the region. (MIHĂILĂ et al. 2010).

The silvopastoral system with *Quercus cerris* (SsQc) represents a category of agroforestry system with a long tradition, especially in the arid and semi-arid areas of our country..

MATERIAL AND METHOD

To study the influence of trees on the vegetation layer and directly or indirectly on grazing livestock in a silvopastoral system, we made measurements of forest and herbaceous vegetation, analyzed the agrochemical characteristics of the soil and studied the relationships that exist between the component elements of the system.

The research were carried out in Visterna village, Sarighioi commune, Tulcea county (Fig. 1), in a Turkish oak plantation (*Quercus cerris*, L.), grazed during the summer with sheep and goats, the main role of the trees within this silvopastoral system being to provide shade for the livestock.



Fig. 1 Geographical position and location of Visterna on the map of Tulcea county
(https://ro.wikipedia.org/wiki/Visterna,_Tulcea)

The fieldwork consisted of delimiting the research perimeter into 3 sample areas of 100 sq m each (Fig. 2), areas on which floristic surveys were carried out, soil samples were taken at a depth of 0 - 10 cm with an agrochemical sampler and biometric

measurements of the trees were made, for each specimen being assigned a number. The trunk diameter was measured with a tree caliper at a height of 1.30 m and the tree height up to the terminal bud was measured with a dendrometer (Fig. 3,4).



Fig. 2 Location of sample surfaces and inventory of Stereo 70 coordinates for the corners of each analyzed plot



Fig. 3



Fig. 4

Silvopastoral system with *Quercus cerris*

Soil analyses were carried out by the Braşov Pedological and Agrochemical Studies Office. The determinations regarding the productivity of the vegetation layer (qualitative and quantitative) from the silvopastoral system with Turkey oak, were made using the method proposed by Maruşca in 2019. In this regard, floristic surveys were carried out assessing directly the percentage participation of species (P %) in the vegetal layer

in order to be able to further perform calculations regarding the pastoral value (PV), the production index (IP) and the net production of green fodder (GF t/ha). To evaluate the results, data from the specialized literature on the agrochemical characteristics of the soil, the silvopastoral management guidelines, the forestry code and the technical norms for forest management were used.

RESULTS AND DISCUSSIONS

The degree of soil supply with nutrients directly influences the floristic composition of the studied system. The results of the analyzed soil samples highlight the trophicity

of the silvopastoral system with Turkey oak compared to the optimum in the specialized literature (Table 1).

Table 1

Agrochemical values of open field and shaded meadow soil

Specification	Unit	*Optimal values	SsQc	Diff. 2-1 (+, -)	%
pH in H ₂ O	ind.	6,60	7,00	+0,40	106
Soil humus	%	6,16	5,00	-1,16	81
Nitrogen Index	%	5,79	0,20	-5,59	3
Mobile Phosphorus	ppm	6,00	108	+102	18
Mobile Potassium	ppm	230	265	+35	115
Base saturation (BS)	%	94	60,00	-34	64

* according to the methodology of the National Research and Development Institute for Pedology and Agrochemistry 1981 and 1987.

The supply of soil nutrients (nitrogen, phosphorus, potassium) from the silvopastoral system with Turkey oak, necessary for the development of forage plants, does not register optimal values for obtaining a vegetal layer with high pastoral value. The presence of trees on grasslands, whether planted or from natural regeneration, produces

changes in the floristic composition of the vegetal layer, in the structure and spatial distribution of herbaceous plant communities, leading to the birth of micro-ecosystems with different species that are not found on grasslands without trees (LÓPEZ-SÁNCHEZ et al. 2016). The dominance of the species *Bromus* sp. (table 2), whose

forage quality indicator and useful forage phytomass indicator is low (value 5-6 according to Marușca,

2019), reflects the soil's poverty in nutrients.

Table 2

Floristic composition and productivity of grasslands in the silvopastoral system with Turkey oak from Visterna

Nr.sp.	Species	Survey no.			Average %
		1	2	3	
	Acoperire vegetație(%)	100	100	100	100
	Species from Poaceae family				
1	<i>Bromus arvensis</i>	40.0	45.0	15.0	33.3
2	<i>Bromus sterilis</i>	24.0	25.0	65.0	38.0
3	<i>Brachypodium sylvaticum</i>	5.0	10.0	5.0	6.7
4	<i>Dactylis glomerata</i>	3.0	2.0	1.0	2.0
5	<i>Festuca valesiaca</i>	1.0	7.0	1.0	3.0
6	<i>Poa angustifolia</i>		1.0	5.0	2.0
7	<i>Melica ciliata</i>		1.0		0.3
8	<i>Triticum aestivum</i>		1.0		0.3
	Other plant families				
9	<i>Quercus cerris</i>	80.0	70.0	90.0	80.0
10	<i>Carpinus orientalis</i>	2.0	5.0	0.1	2.4
11	<i>Teucrium chamaedrys</i>	2.0	2.0	0.1	1.4
12	<i>Agrimonia eupatoria</i>	1.0	1.0	1.0	1.0
13	<i>Torilis arvensis</i>	1.0	0.1	0.1	0.4
14	<i>Fragaria vesca</i>	1.0	3.0	2.0	2.0
15	<i>Ballota nigra</i>	1.0			0.3
16	<i>Cynanchum acutum</i>	0.1	0.1	1.0	0.4
17	<i>Marrubium vulgare</i>	0.1	1.0		0.4
18	<i>Cirsium vulgare</i>	0.1			0.1
19	<i>Rosa canina</i>	0.1	0.1		0.1
20	<i>Allium flavum</i>	0.1	0.1	0.1	0.1
21	<i>Chenopodium album</i>	0.1			0.1
22	<i>Achillea setacea</i>	0.1	1.0		0.4
23	<i>Potentilla reptans</i>	0.1	0.1		0.1
24	<i>Crataegus monogyna</i>		5.0	0.1	1.7
25	<i>Lepidium draba</i>		1.0		0.3
26	<i>Muscari racemosum</i>		0.1	0.1	0.1
27	<i>Viola odorata</i>		0.1	0.1	0.1
28	<i>Silene vulgaris</i>		0.1		0.1
29	<i>Caucalis platycarpus</i>		0.1		0.1
30	<i>Geum urbanum</i>		0.1		0.1
31	<i>Pirus piraster</i>		0.1		0.1
32	<i>Ligustrum vulgare</i>		0.1		0.1
33	<i>Fraxinus ornus</i>		0.1	0.1	0.1
34	<i>Ulmus campestris</i>		0.1		0.1
35	<i>Potentilla argentea</i>		0.1		0.1
36	<i>Myrrhoides nodosa</i>			1.0	0.1
37	<i>Buglossoides purpureocaerulea</i>			0.1	0.1

Applying the method proposed by Marușca in 2019 to determine the productivity of the vegetation cover in the silvopastoral system with Turkey oak, the following results were obtained:

- Number of species 37
- Fodder plant species: 28%
- Harmful plant species: 72%
- Green fodder production: 3,4t/ha
- Optimal loading with livestock: 0,40 LU/ha
- Optimal grazing period: 130 zile
- Pastoral value: 16,3 (weak)
- Milk production: 1300 liters/ha.

At an optimal density of trees on the grassland, their shade and the

moisture they can retain in the soil due to their root system and wide canopy are very important aspects for the development of a diverse, rich vegetation cover and also beneficial for obtaining very good quality fodder (LÓPEZ-CARRASCO *et al.* 2015, LÓPEZ-SÁNCHEZ *et al.* 2016).

Upon inventorying all the trees in the three experimental plots of silvopastoral system with Turkey oak under study, a total number of 26 trees with an average diameter of approximately 20 cm and an average height of 10 m resulted (Table 3).

Table 3

General information of (*Quercus cerris*) trees inventoried in the silvopastoral system

<i>Quercus cerris</i>	Nr. of individuals	Min.	Max.	Av.	Standard error	Variant	Standard deviation	Coefficient of variation
Diameter	26	6,37	25,73	18,88	0,89	20,93	4,58	24,24
Height	26	5,00	12,10	10,36	0,29	2,22	1,49	14,38

Graphical distribution for diameter and height of inventoried specimens

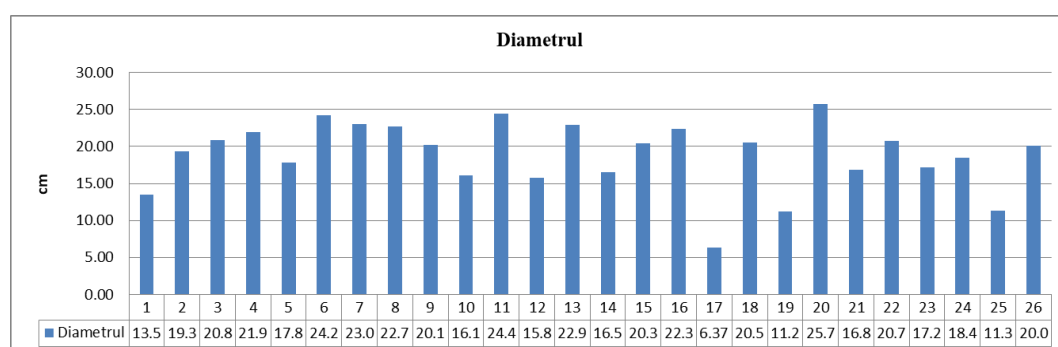


Fig. 5 Graphic representation of the diameters of each specimen

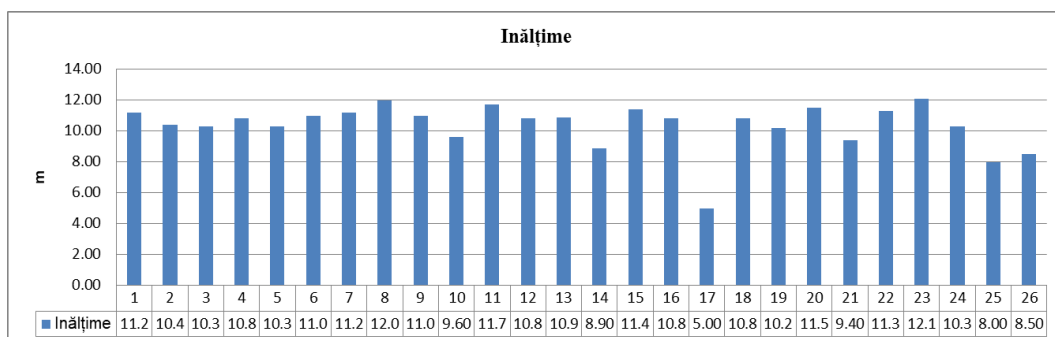


Fig. 6 Graphical representation of the heights of each specimen

According to the Technical Norms for Forest Management (2022), the average age of the spruce plantation that forms the silvopastoral system under study is 35-40 years.

The calculations resulted in a density of 867 trees/ha and therefore a coverage of 80% of the system surface. The canopy density provided by the foliage effectively distributes light and heat at ground level, not being identified surfaces devoid of herbaceous vegetation in the studied area. However, it is known that in our country, areas of regenerated pastures or planted with trees with a consistency equal to or greater than 0.4 are included in the forestry systems, grazing being prohibited in them. The exception is these areas, bordering the compact forest, which in the past were part of the agricultural field but which, due to the need to restore some ecosystems or to stabilize soils, were replanted. These plantations in the Dobrogea area, due to long periods of drought, lack of water and dryness, are frequently

exploited by livestock farms in their vicinity.

Trees and also the loading with grazing livestock are very important factors in maintaining grassland diversity. Exceeding the optimum number of grazing cattle and/or sheep can lead to the emergence of plant associations dominated by nitrophilic species (MORENO *et al.* 2016), which is undesirable for obtaining high-quality forage.

The field assessment showed that the phytosanitary condition of the trees in the studied silvopastoral system with Turkey oak is generally good, with specific forestry works observed across the entire area.

For the sustainability of silvopastoral systems, it is necessary to respect all the technical solutions provided by silvopastoral or forestry systems, especially by performing maintenance works on time, and grazing being carried out in accordance with the optimal support capacity of the system.

Under the conditions of rational management of the silvopastoral system with *Quercus*

cerris from Visterna (and beyond), less labor could be used and less money invested for both wood and

livestock production than in the case of each crop separately.

CONCLUSIONS

Silvopastoral systems are a viable solution in the context of global climate change.

The biometric characteristics of *Quercus cerris* trees, aged 35-40 years, are an average height of 10 m and an average diameter of 20 cm, not very wide canopy, but which, at a density of 867 specimens per hectare, cover the ground with shade in a proportion of 80%.

The productivity of the grassland under *Quercus cerris* trees is lower, namely 3.4 t/ha green fodder and 16.3 pastoral value, ensuring 1,300 liters of milk per hectare in 130 days of grazing

season, with an optimal load of 0.4 LU/ha.

Although the results obtained regarding the forage productivity of the silvopastoral system with Turkish oak from Visterna are not spectacular compared to the dry grasslands without forest vegetation in Dobrogea, the research recommends capitalizing on forested or planted pastures bordering the compact forests and promoting these exploitation systems as a priority in the context of the constant increase in temperatures and the danger of aridization in the future.

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