CONTRIBUTIONS TO THE EVALUATION OF THE PRODUCTIVITY OF GRASSLANDS FROM THE SILVOPASTORAL SYSTEM WITH ORIENTAL HORNBEAM (*Carpinus orientalis*) FROM DOBROGEA

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Abstract

Mitigation of the effects of global climate change can also be achieved by using simple methods of exploitation of permanent grasslands such as silvopastoral systems. With a good representation in Dobrogea, the silvopastoral system with oriental hornbeam is superior to treeless grasslands both in terms of nutrients content of soil and productivity. For the studied area, in the pastoral system with oriental hornbeam the pastoral value is twice higher, and the value of the fodder production is three times higher than for the open field grasslands. Also, the digestibility of fodder from grasslands under oriental hornbeam is 33% higher than that of fodder obtained from treeless grasslands, emphasizing the importance of maintaining and expanding these exploitation systems.

Keywords: silvopastoral system, Oriental Hornbeam, Dobrogea, grassland productivity.

INTRODUCTION

The importance and necessity of maintaining and implementing new agroforestry systems (Papanastasis *et al*. 2009, Jose 2012, Mosquera-Losada *et al*. 2012, Kay *et al*. 2019, Marsden *et al*. 2020) is a topic of growing interest in the context of global climate change (Rao *et al*. 2007, Luedeling *et al*. 2014, Gomes *et al*. 2020, Raj *et al*. 2020, Santoro *et al*. 2020).

Both nationally and european level, Dobrogea is one of the areas exposed to drought and desertification (Vorovencii 2015, Arghiuş *et al*. 2016, eca.europa.eu). Having a rather rugged terrain (Popescu & Ielenicz 2003), with areas where the superficial soil did not allow their transformation into arable land, in Dobrogea, especially in the northern half of the province, a series of silvopastoral systems is maintained. (Marușca *et al*. 2020, Marușca & Memedemin 2020).

Being totally forested in the past (Drăcea 1928) the hills from the north of Dobrogea present today large, cleared areas. Thus, these secondary meadows together with windbreak tree rows, clumps of trees, clearings and the ecotone areas are used by the locals for grazing.

Of these silvopastoral systems, the one with *Carpinus orientalis* is one of the best represented as the extent, oriental hornbeam being a thermophilic, xerophilous species, resistant to drought and adapted to live on poor and superficial soils (Sikkema & Caudullo 2016), therefore very well adapted to the environmental conditions in the studied area.

Increasing temperatures and the deficit of precipitation in recent years (tutiempo.net) require the evaluation of the viability and productivity of silvopastoral systems to promote their use in counteracting the effects of aridification.

MATERIAL AND METHOD

The research on the silvopastoral system with oriental hornbeam were carried out in the central-northern Dobrogea area, in Tulcea county, on the territory of Izvoarele commune, west of Alba village.

As in the case of other evaluated silvopastoral systems (Marușca & Memedemin 2020), 10 sample plots with an area of 100 sqm (10 x 10 m) were analyzed, 5 of these surfaces being represented by areas grazed under oriental hornbeam trees. To make a comparative evaluation for each of these 5 surfaces, a same size test plot was analyzed on a treeless grassland located in the immediate vicinity.

For each of the test surfaces, the analysis of the vegetal layer was performed using the floristic survey method, the specific participation being expressed in percentages according to the Klapp - Ellenberg method. The data obtained were used to assess the productivity of treeless grassland and of the silvopastoral system with Oriental hornbeam, according to the method proposed by Marușca (2019).

In order to evaluate the differences between the productivity values for the 10 test plots, 4 soil samples were collected from each analyzed surface. Soil samples were collected at a depth of 0-10 cm using a soil corer with an inner diameter of 25 mm. For the grassland with oriental hornbeam trees, the soil samples were collected from half the distance between the projection of the edge of the leaf canopy and the trunk, as well as from the edge of the projection of the canopy, on a circular surface around the tree. For treeless grassland surfaces, the 4 soil samples were collected on the diagonals of the sample surface. The collected samples were analyzed at the Office of Pedological and Agrochemical Studies (OSPA) Brașov using the standard methodology for soil agrochemical analyzes.

The evaluation of the quality of the feed material involved the collection from each plot of grass samples that were analyzed according to the Near Infrared Reflectance Spectroscopy (NIRS) method. The following chemical parameters of fodder quality were evaluated: crude protein (CP); crude fiber (CF); ash (ASH); fibrous fractions: acid detergent fiber

(ADF), lignin detergent acid (LDA) and neutral detergent fiber (NDF); dry matter digestibility (DDM); digestibility of organic matter (OMD).

RESULTS AND DISCUSSION

The values obtained from the soil analyzes (table 1) reveal a higher content of nutrients under trees than in the open field grasslands, a situation highlighted also by previous studies on agrosilvopastoral systems in Dobrogea (Marușca & Memedemin 2020).

Thus, the humus content and the nitrogen index are 17% higher, while the phosphorus and potassium have values between 1-6% higher on the surfaces under the trees than on the open field grasslands.

Vegetation conditions and higher nutrient content sustain the better production and quality of forages from the silvopastoral system with oriental hornbeam compared to classic treeless grasslands system (table 2).

Table 1

Average agrochemical values of the soils of open field grasslands and from under the oriental hornbeam, for the range 0-10 cm depth

Specification	Unit	1.Open field	2. Under trees	Diff. +; -	%
pH in H_2O	ind	6,7	6,7	0	100
Base saturation (V)	%	97,5	98,0	+ 0,5	101
Humus	%	5,58	6,51	+ 0,93	117
Total nitrogen (N)	%	0,278	0,326	+ 0,048	117
Mobile Phosphorus (P)	ppm	14,9	15,0	+ 0,1	101
Mobile Potassium (K)	ppm	378	> 400	> + 22	> 106

Table 2

Floristic composition and productivity of open field (OF) and under trees (UT) grassland

Specification	OF	UT	Diff. +;-	IF	IM
Cover	**90,8**	**88,3**	**- 2,5**	**X**	**X**
POACEAE	(48,6)	(59,1)	(+ 10,5)	X	X
Botriochloa ischaemum	24,0	1,2	- 22,8	3	0
Festuca valesiaca	10,0	19,2	+ 9,2	5	3
Stipa capillata	8,8	1,7	- 7,1	3	0
Chrysopogon gryllus	3,6	2,0	- 1,6	4	7
Agropyron cristatus	0,6	-	X	7	5
Bromus hordeacens	0,6	-	X		5
Bromus tectorum	0,6	0,4	- 0,2	5	2
Melica ciliata	0,2	1,2	+ 1,0	5	2
Poa angustifolia	0,2	26,4	+ 26,2	4	5
Elymus repens	-	2,0	X	5	7
Brachypodium pinnatum	-	1,4	X	7	7
Dactylis polygama	-	1,4	X	5	7

Table 2 - continuation

Bromus sterilis	-	0,8	X	7	0
Poa bulbosa	-	0,8	X	3	1
Koeleria macrantha	-	0,6	X	6	3
FABACEAE	(12,0)	(9,4)	(- 2,6)	X	X
Trifolium campestre	6,4	5,6	- 0,8	7	2
Trifolium arvense	3,2	2,0	- 1,2	4	2
Medicago falcata	1,3	1,4	- 0,4	7	6
Coronilla varia	0,6	0,4	- 0,2	1	0
Other families	(30,2)	(19,8)	(-10,3)	X	X
Teucrium polium	6,2	0,8	- 5,4	3	0
Teucrium chamaedrys	2,8	2,0	- 0,8	3	0
Eryngium campestre	2,2	0,8	- 1,4	3	0
Achillea millefolium	1,4	1,9	+ 0,5	6	4
Orlaya grandiflora	1,1	1,4	+ 0,3	3	0
Artemisia austriaca	1,0	2,0	+ 1,0	3	0
Thymus pannonicus	1,0	-	X	4	2
Thymus zygioides	1,0	-	X	4	1
Helichrysum arenarium	0,8	-	X	3	0
Petrorhagia illyrica	0,6	0,6	- 0,2	3	0
Sideritis montana	0,8	-	X	3	0
Agrimonia eupatoria	0,6	0,4	0,2	3	0
Erodium cicutarium	0,6	-	X	3	0
Erysimum virgatum	0,6	-	X	3	0
Filago arvensis	0,6	-	X	3	0
Fragaria vesca	0,6	0,7	+ 0,1	5	1
Marrubium peregrinum	0,6	1,4	+ 0,8	3	0
Plantago lanceolata	0,6	-	X	6	1
Sanguisorba officinalis	0,6	-	X	7	5
Crataegus monogyna	0,5	0,2	- 0,3	3	0
Potentilla recta	0,5	-	X	3	0
Allium flavum	0,4	-	X	2	0
Cynanchum acutum	0,4	-	X	1	0
Nepeta cataria	0,4	-	X	3	0
Xeranthemum annuum	0,4	-	X	3	0
Carduus nutans	0,3	-	X	2	0
Convolvulus arvensis	0,3	0,3	0	7	6
Inula oculus-christi	0,3	-	X	3	0
Achillea coarctata	0,2	-	X	3	0
Centaurea diffusa	0,2	-	X	3	0
Cichorium intybus	0,2	-	X	5	6
Dianthus nardiformis	0,2	-	X	3	0
Euphorbia sequeriana	0,2	-	X	1	0
Linum austriacum	0,2	-	X	3	0
Potentilla pedata	0,2	0,1	- 0,1	3	0
Salvia nemorosa	0,2	-	X	4	4
Allium scorodoprasum	0,2	-	X	2	0
Alyssum alyssoides	0,2	0,9	+ 0,8	3	0
Carthamus lanatus	0,1	0,3	+ 0,2	3	0
Filago germanica	0,1	-	X	3	0
Hypericum perforatum	0,1	-	X	3	0

Table 2 - continuation

Jurinea mollis	0,1	-	X	3	0
Minuartia setacea	0,1	-	X	3	0
Potentilla argentea	0,1	0,4	+ 0,3	4	2
Sedum urvillei	0,1	-	X	3	0
Taraxacum serotinum	0,1	-	X	5	2
Torillis arvensis	0,1	-	X	3	0
Tragopogon dubius	0,1	-	X	5	5
Verbascum thapsus	0,1	-	X	3	0
Carpinus orientalis (juv)	-	4,1	X	3	0
Quercus pubescens (juv)	-	0,6	X	3	0
Chondrilla juncea	-	0,2	X	3	0
Scleranthus annuus	-	0,2	X	3	0
Acer campestre (juv)	-	0,1	X	3	0
Alyssum hirsutum	-	0,1	X	3	0
Galium verum	-	0,1	X	5	4
Fraxinus ornus	-	0,1	X	3	0
Senecio vernalis	-	0,1	X	3	0
Total species (nr)	**62**	**42**	**- 20**	**X**	**X**
Participation of fodder species	**33,9**	**68,2**	**+ 35,3**	**X**	**X**
Participation of harmful species	**56,9**	**20,1**	**- 36,8**	**X**	**X**
Pastoral value (PV)	**20,0**	**45,4**	**+ 25,4**	**X**	**X**
Relative value for PV	**100**	**227**	**X**	**X**	**X**
Phytomass index	**1,11**	**2,78**	**+ 1,67**	**X**	**X**
Fodder production (GM t/ha)	**2,22**	**6,39**	**+ 4,17**	**X**	**X**
Relative value (fodder production)	**100**	**288**	**X**	**X**	**X**

The data analysis shows that the dominant species in the treeless grasslands, *Botriochloa ischaemum*, with a participation of 24%, is a species without fodder value (Păcurar 2020). The situation is different in the grasslands under the oriental hornbeam where *Poa angustifolia* and *Festuca valesiaca* are dominant, with a participation of 26%, respectively 19%, species with high forage value. Also, the participation of species with forage value in the silvopastoral system with oriental hornbeam exceeds twice the value calculated for grasslands without trees.

In terms of productivity indices the situation is similar, in the pastoral system with oriental hornbeam the pastoral value is twice higher and the value of fodder production is three times higher than for open field grasslands.

The results of the analyzes for the grass samples are presented as an average value for each of the two variants - grasslands under oriental hornbeam trees (UT) and open field grasslands (OF) (table 3).

The results emphasize once again the higher qualitative value of the fodder obtained in the silvopastoral system with oriental hornbeam. Thus, the crude protein content is 34% higher, the crude fiber is almost 10% lower, these parameters leading to a 33% higher digestibility for the fodder in the grasslands under the oriental hornbeam compared to the grasslands in the open field.

Table 3

Differences between chemical quality parameters
of the grass from open field grasslands (OF) and from under trees (UT)

Feed quality parameters	Value (%)		Diff. +; -	%
	CD	SA		
CP	8,2	11,0	+ 2,8	134
ASH	4,8	6,6	+ 2,2	138
CF	44,8	40,9	- 3,9	91
ADF	49,7	45,2	- 4,5	91
LDA	8,2	6,7	- 1,5	82
NDF	79,6	72,9	- 6,7	92
DDM	28,8	38,2	+ 9,4	133
OMD	25,5	34,2	+ 8,7	134

CONCLUSIONS

The effects of global warming can be mitigated by implementing simple and effective measures such as the use of agroforestry systems.

The present paper demonstrates the superiority of the silvopastoral system with oriental hornbeam over the treeless grasslands in North Dobrogea, the area on which phenomena such as drought and aridification are already manifested.

Maintaining and expanding such grassland exploitation systems can bring benefits both in terms of grassland quality and productivity and in terms of biodiversity conservation in the context of climate change.

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