INTERACTIONS BETWEEN PYRUS PYRASTER TREES (WILD PEAR) AND GRASSLAND IN AN AGROSILVOPASTORAL SYSTEM

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Abstract. *The research is carried out on the Pyrus pyraster grasslands from Jimbor village commune Homorod, on the floor of the oak forests. Our study makes an analysis of the connections that exist between Pyrus pyraster trees and grasslands in terms of floral composition, nutritional and pastoral quality of herbaceous layer, analyzes the amount of nutrients in the soil and necessary for plant development and it also evaluates the production of nutrients per hectare, both under the canopy of Pyrus pyraster trees, as well as in the open field. The number of species found in the herbaceous layer of shady ground is with 22 % larger than in the open field, and the participation of fodder species is 24 % higher under the canopy of trees than in the land in full sun. The most found species under trees is Lolium perenne, it's participation percentaje being almost 4 times higher than in the open field, this influencing the green mass production which is 14 t/ha. The nutritional value of the feed consumed by the animals grazed is very good being supplemented in the autumn months with ripe forest pear fruits.*

Keywords: agrosilvopastoral system, *Pyrus pyraster*, productivity, biodiversity

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1. Introduction

Agroforestry systems include all land uses in which forest species are deliberately maintained or introduced into agricultural production to benefit from the result of their ecological and economic interaction. It is, therefore, a broad concept, which includes all forms of association between trees and/or shrubs, on the one hand, and agricultural crops, grasslands and/or animals, on the other hand [6].

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The main feature of agroforestry systems is that the association of the components that make up their composition (trees, grasslands, animals), is done at the same time and on the same land [2].

Agroforestry and pastoral systems must always be analyzed in two ways. Firstly, in order to obtain additional, diversified and high-quality grass production, in order to ensure ecological stability and secondly, the high economic aspects that these systems can create are taken into account.

Capitalizing on the benefits offered by agroforestry systems can be one of the ways to improve the quality of the environment and conserve natural resources. These systems can maintain the balance and functionality of ecosystems, increase their diversity, reduce the action of greenhouse gases (by storing carbon) and create the most suitable environment for the production of high quality feed, with grazing being carried out in the most efficient way.

For this, we need extensive research on agroforestry systems that still exist in our country, the grassland being the most important component of an agroforestry system, its quality and productivity being directly related to obtaining high quality ecosanogenic animal products.

The trees in the agro-forestry-pastoral systems come from species resistant to frost and drought, to various anthropogenic actions and able to exploit the productive potential of the soil, such as: oaks, sessile oak, beech, cherry, wild pears, etc. [6].

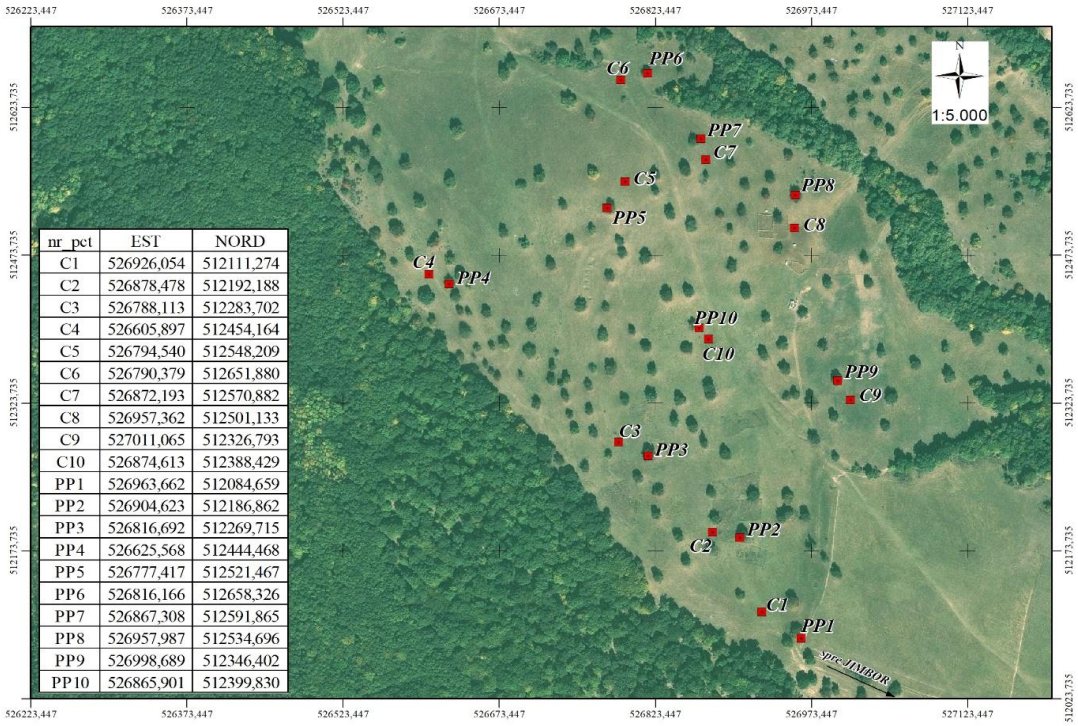
This paper analyzes the interactions between wild pear trees (*Pyrus pyraster*) and grassland, in an agro-silvo-pastoral system, based on the premise that trees in agricultural systems ensure a much more efficient use of light, water and of nutrients, than in general, on grasslands devoid of forest vegetation (Figure 1).

2. Materials and Methods

The researches were carried out in Jimbor village, Homorod commune, Brașov county, on the grasslands grazed with sheep and cows, according to the current pastoral arrangement, Oak Forest, in the altitudinal floor of oaks.

From the point of view of the physical and geographical reasoning, the studied territory falls within the Transylvanian Plateau Land, Homoroadelor Hills district, with small slopes and an average altitude of 620 m.

The field works consisted in delimiting the research perimeter from which a number of 10 woody hairy trees (*Pyrus pyraster*) and 10 open field areas located at approx. two tree heights were chosen (Figure 1).



nr_pct	EST	NORD
C1	526926,054	512111,274
C2	526878,478	512192,188
C3	526788,113	512283,702
C4	526605,897	512454,164
C5	526794,540	512548,209
C6	526790,379	512651,880
C7	526872,193	512570,882
C8	526957,362	512501,133
C9	527011,065	512326,793
C10	526874,613	512388,429
PP1	526963,662	512084,659
PP2	526904,623	512186,862
PP3	526816,692	512269,715
PP4	526625,568	512444,468
PP5	526777,417	512521,467
PP6	526816,166	512658,326
PP7	526867,308	512591,865
PP8	526957,987	512534,696
PP9	526998,689	512346,402
PP10	526865,901	512399,830

Fig. 1 Satellite image with the projection of the analyzed surveys (Google Earth Pro 2019)

Floristic surveys were carried out under the canopy of forest brushes and in the open field on surfaces of 100 sqm each (Figure 2, 3).

Fig. 2

Fig. 3

Images from the realization of the floristic surveys

Halfway between the edge of the canopy and the trunk of the trees in a circle and on the diagonal of the sample surface (10 x 10 m) of the surveys, soil samples were taken at a depth of 0-10 cm, with an agrochemical probe. Also, in order to determine the quality of the feed consumed by the grazing animals, grass samples were taken.

The soil analyzes were performed by the Office of Pedological and Agrochemical Studies Brașov, and the analyzes of the grass samples, by the quality laboratory of the fodder quality from the Research - Development Institute for Grasslands, Brașov.

Based on the floristic surveys, the productivity of the grass carpet (pastoral value and green mass production), was evaluated according to a new method [4]. In this sense, the floristic surveys were carried out by appreciating directly in percentages the participation of the species (P%) in the grass carpet (Klapp - Ellenberg) in order to be able to continue to perform the calculations on pastoral value (PV), production indices of the species (IM), and consumable green mass (GM t/ha).

The pastoral value (PV) was calculated using the formula: $PV = \Sigma P$ (%) x F/9, where F is the feed quality index according to Kovacs (1979), Păcurar and Rotar (2014), and Marușca (2019), [3, 7, 4].

The production of useful phytomass or green mass production (GM) was estimated considering only the species with F4 to F9, by multiplying the P% value with a plant habitus coefficient (M), having values from 1 (very small) to 9 (very high), thus establishing a weighted IM index value [4].

The final evaluation of the GM is made by multiplying the IM habitus index value with other indices values established in grassland experiments [4].

3. Results and Discussions

The soil supply degree with nutrients directly influences the floristic composition of the grasslands studied. Thus, the soil samples analyzed show differences in terms of higher trophicity under trees (shaded ground) than in open field (Table 1).

The results of the analyzed soil samples show that its supply with nutrients necessary for the development of plants (nitrogen, phosphorus, potassium) is 14 to 67% higher in the soil under the canopy of *Pyrus pyraster* trees than in open field soil.

The nutrient richness of the soil in the shaded ground is mainly due to the manure left by the animals that stand in the shade for rest, sawdust or scratched by the tree trunk.

Table 1. Agrochemical values of open field grassland soil and from shady ground

Specification	Unit	1. Open field	2. Shady ground	Diff. 2-1 (+, -)	%
pH in H2O	ind.	5.45	5.95	+0.50	109
Humus	%	6.96	6.96	0	100
Nitrogen index	%	5.08	5.79	+0.71	114
Mobile phosphorus	ppm	5.08	7.5	+2.42	148
Mobile potassium	ppm	240	> 400	> 160	> 167
Amount of exchangeable bases	me/100g	19.0	24.4	+5.4	128
Hydrolytic acidity	me/100g	7.0	4.9	-2.1	70
Cation exchange capacity	me/100g	26.0	29.3	+3.3	113
Base saturation degree	%	73.1	83.3	+10.2	114
Interchangeable aluminum	me/100g	0.067	0	x	x

In addition to this naturally obtained positive aspect, the cattle that stay in the shade of the trees consume the ripe forest pears, later helping to spread the hair seeds through the manure left on the grassland. This later leads to the natural regeneration of grassland with forest pears, the old trees can be removed in favor of the young generation [1].

Quantitative differences between the percentage of participation of each herbaceous species encountered in the analyzed surveys, respectively forage value indices (F) and useful phytomass index (M), used for the calculation of productivity (both qualitative and quantitative) of grassland in the shade of trees of *Pyrus pyraster* and open field, are shown in Table 3.

All the changes that take place in the soil and on its surface, obviously influence the development of plants in the herbaceous layer. Thus, we notice that the percentage of participation for the very valuable fodder species, *Lolium perenne*, exceeds in the analyzed surveys under the trees, by approximately 4 times more (390%) the percentage of participation in the open field. Also under trees and with a higher percentage than in the land in full sun, there are other valuable species such as: *Festuca pratensis, Phleum pratense, Poa pratensis, Alopecurus pratensis*, and decreasing by 80-94% compared to open field *Agrostis capillaris* and *Festuca rupicola*.

A very important aspect to emphasize is the presence of nitrophilous species in the composition of the herbaceous layer under the trees, namely: Urtica dioica (6.0%), *Sisymbrium officinale* (4.3%), *Erodium cicutarium* (0.7%), *Xanthium spinosum* (0.6%) and others, as a result of overstaying with sheep (Figure 3).

Table 3. Floristic composition and productivity of grasslands from open field (OF) and shaded grasslands (SG) of the 20 surveys

Species	Presence class		Participation %				Indices	
	OF	SG	OF	SG	Diff.+ -	%	F*	M**
Acoperire	x	x	100	97.3	-2.7	97	x	x
Poaceae			**63.2**	**51.9**				
Agrostis capillaris	V	IV	15.1	3.2	-11.9	21	7	5
Festuca rupicola	V	I	32.5	1.8	-30.7	6	5	5
Lolium perenne	IV	V	10.6	41.1	+30.5	388	9	8
Cynosurus cristatus	III	III	1.3	1.3	x	100	7	4
Festuca pratensis	III	II	1.1	1.2	+0.1	109	8	9
Deschampsia caespitosa	II	II	0.8	0.8	x	100	3	0
Festuca valesiaca	II	-	1.6	-	x	x	5	3
Anthoxanthum odoratum	I	I	0.1	0.3	+0.2	300	5	3
Phleum pratense	I	I	0.1	0.3	+0.2	300	9	8
Bromus hordeaceus	-	III	-	0.7	x	x	3	0
Poa pratensis	-	II	-	1.1	x	x	8	6
Alopecurus pratensis	-	I	-	0.1	x	x	8	7
Fabaceae			**19.6**	**18.3**				
Trifolium repens	V	V	15.3	16.1	+0.8	105	8	5
Trifolium pratense	V	IV	3.4	2.1	-1.3	62	8	7
Lotus corniculatus	III	-	0.9	-	x	x	8	6
Trifolium arvense	-	I	-	0.1	x	x	4	2
Alte familii			**17.2**	**27.1**				
Leontodon autumnalis	V	IV	1.8	1.4	-0.4	78	5	3
Achillea millefolium	V	III	2.7	0.6	-2.1	22	6	4
Plantago lanceolata	V	III	1.9	0.8	-1.1	42	6	1
Agrimonia eupatoria	V	II	1.5	0.4	-1.1	27	3	0
Carduus acanthoides	IV	IV	1.4	1.2	-0.2	86	2	0
Fragaria viridis	IV	I	2.3	0.3	-2.0	13	4	1
Daucus carota	III	III	0.5	0.6	+0.1	120	6	5
Potentilla reptans	III	I	0.7	0.2	-0.5	29	3	0
Taraxacum officinale	II	V	0.6	1.8	+1.2	300	7	3
Prunella vulgaris	II	III	0.6	0.7	+0.1	117	4	2
Juncus conglomeratus	II	I	0.5	0.3	-0.2	60	3	0
Alchemilla vulgaris	I	I	0.1	0.2	+0.1	200	6	4
Filago arvensis	I	I	0.2	0.2	x	100	3	0
Cichorium intybus	I	I	0.2	0.1	-0.1	50	5	6
Juncus tenuis	I	I	0.1	0.3	+0.2	300	3	0
Ranunculus repens	I	I	0.1	0.2	+0.1	200	1	0
Mentha longifolia	I	I	0.1	0.1	x	100	4	6
Carex pallescens	II	-	0.5	-	x	x	4	3
Centaurea phrygia	II	-	0.6	-	x	x	4	6
Cirsium vulgaris	I	-	0.2	-	x	x	2	0
Eryngium campestre	I	-	0.1	-	x	x	3	0
Galium verum	I	-	0.1	-	x	x	5	4
Gypsophila muralis	I	-	0.1	-	x	x	3	0

Species	Presence class		Participation %				Indices	
	OF	SG	OF	SG	Diff.+ -	%	F*	M**
Lysimachia nummuaria	I	-	0.1	-	x	x	3	0
Verbena officinalis	I	-	0.2	-	x	x	4	4
Urtica dioica	-	V	-	6.0	x	x	3	0
Polygonum aviculare	-	IV	-	2.4	x	x	5	3
Sisymbrium officinale	-	IV	-	4.2	x	x	3	0
Erodium cicutarium	-	III	-	0.7	x	x	3	0
Plantago major	-	III	-	0.9	x	x	4	5
Stellaria media	-	II	-	0.6	x	x	1	0
Arctium lapa	-	I	-	0.1	x	x	2	0
Crataegus monogyna	-	I	-	0.1	x	x	3	0
Eleocharis palustris	-	I	-	0.1	x	x	3	0
Geranium pratense	-	I	-	0.1	x	x	3	0
Glecoma hederacea	-	I	-	1.5	x	x	3	0
Malva sylvestris	-	I	-	0.3	x	x	3	0
Rosa canina	-	I	-	0.1	x	x	3	0
Xanthium spinosum	-	I	-	0.6	x	x	2	0
Total specii (nr.)			**37**	**45**	**+8**	**122**	**x**	**x**
din care: - furajere			**25**	**24**	**-1**	**96**	**x**	**x**
- nefurajere			**12**	**21**	**+9**	**175**	**x**	**x**
Participare specii furajere			**61.7**	**76.8**	**-15.1**	**124**	**x**	**x**
Participare specii dăunătoare			**38.3**	**20.5**	**-17.8**	**54**	**x**	**x**
Goluri în vegetație			**0**	**2.7**	**x**	**x**	**x**	**x**
Valoarea pastorală (VP)			**67.9**	**70.3**	**+2.4**	**104**	**x**	**x**
Indice fitomasă utilă (IM)			**4.84**	**5.07**	**-0.23**	**105**	**x**	**x**
Producția de furaj (MV t/ha)			**13.07**	**14.20**	**-1.13**	**109**	**x**	**x**

F* = feed value indices

M** = useful phytomass value indices

Fig. 3. Surface invaded with nitrophilous species

The percentage of participation of forage species is 24% higher iunder three shade than in open field, and the percentage of harmful species is 46% lower under the protection of the canopy of trees against the ground in full sun.

Given the large number of forage species as a presence (25 in open field and 24 under three shade) of the two types of surveys, there is a very good pastoral value, with values between 67.9 and 70.3. This is also reflected in the continuity of the grass cover, in both situations, the percentage of gaps being very small, even zero in the open field and 2.7% in shady ground, so the grass cover is almost complete.

Green mass production is 13.07 t / ha in open field and 14.20 t / ha in shaded land, about 9% higher in the second case.

Finally, we can talk about the quality of grass under threes shade and in open field, analyzing its main chemical parameters: crude protein (PB), fibrous fractions (NDF, ADF and ADL) and digestibility (DSU, BMD). All these elements determine the nutritional value of the fodder consumed by the animals grazed in the agrosilvopastoral system with wild pears (Table 4).

The crude protein (CP) of the treeless grassland reaches 17.7% and grows slightly over 22% under the wild pears. Likewise, the digestibility of dry matter (DDM) and organic matter (DOM) increases under trees by 12-13% due to the superior quality of the grass.

Thus, it turns out that the production and forage quality of the grasslands under the wild pears is obviously better than the one in the open field. To these is added the production of wild pears of approximately 30-50 kg / tree, which is used by cattle and other animals, whether domestic or wild [8].

Table 4. The differences between the chemical quality parameters of the grass, from open field (OF) and shaded ground (SG)

Chemical parameters for feed quality	Participation in dry matter %		Diff. + -	%
	OG	SG		
CP	17.7	22.3	+4.6	126
ASH	10.8	12.0	+1.3	112
FB	29.0	27.5	-1.5	95
ADF	33.2	32.0	-1.2	96
ADL	3.2	2.2	-1.0	69
NDF	55.8	56.0	+0.2	100
DDM	63.9	71.4	+7.6	112
DOM	60.2	68.0	+7.8	113

Conclusions

(1) The high fodder production of about 14 t / ha of green mass, obtained in shaded land, the very good pastoral and nutritional value, are valuable data regarding the food consumed by the animals grazing in the "groves" in Jimbor locality.

(2) The very good values of the nutrients from the soil in the shade of the wild pear trees, produce major changes in the composition of the grassland carpet, favoring, under the canopy of the trees, the development in proportion of 76.8% of the forage species.

(3) All the aspects analyzed in this paper are the first arguments regarding the advantages of maintaining and promoting agroforestry systems with wild pears.

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