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INFLUENCE OF *NON-SACCHAROMYCES* YEASTS ON WHITE DRY WINES

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Abstract. *It was demonstrated a positive action ofthenon-Saccharomyces yeasts on the organoleptic properties of wines. Also, their participation in fermentation process did not involve an excessive accumulation of volatile acidity or other taste and aroma defects. The involvement of the non-Saccharomyces yeasts in practical oenology that keeps on recent achievements in oenological biotechnologies allow an increase of aromatic intensity (floral, fruitful etc.) in varietal wines and preserve the varietal identity of obtained wines.*

Keywords: yeasts, *non-Saccharomyces, Saccharomyces cerevisiae,* alcoholic fermentation, kinetics of alcoholic fermentation, white dry wines.

Introduction

Yeasts are microscopic fungi that transform naturally the sugar from grapes into ethylic alcohol. These microorganisms have an extremely simplified anatomy. They are the basic agent in wine production because they are responsible of alcoholic fermentation mentioned above. These yeasts are retained by berries skin by the pruine. Their dispersion across plantation is realized by insects, named drosophila, also by the wind etc.

Nowadays, the world market offers to winemakers a wide spectrum of products that ensure a good alcoholic fermentation. The enzymes of selected *Saccharomyces* strains prevalent the fermentation environment and thereby provide a rapid and reliable fermentation, ensuring wines with a constant quality. On the other part, the wines that are produced by mono-seeding are recognized as being less complexes and too “standardized”. However, once in the alcoholic fermentation process the *non-Saccharomyces* yeasts are involved, it can be obtained a positive influence on the organoleptic characteristics of wines. At the same time natural microflora fermentations risk to stop because of the sensibility of these yeasts to the environmental conditions (alcohol, pH and others. From these reasons it is proposed to use a multi-starter culture that contains both strains *Saccharomyces* and *non-Saccharomyces*. This seeding technique

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allowsmimicking a natural fermentation at the beginning to increase wine complexity and at the same time to avoid the risk of stagnation of fermentation. During the alcoholic fermentation with different yeasts pairs different interactions between these are noticeable [1].The last years the *non-Saccharomyces* yeasts have become increasingly studied dues to those technological proprieties. Many works refer to those benefic influences on the white dry wines [2, 3, 4, 5, 7].
In view of the above, several *non-Saccharomyces* strains were proposed for co-fermentation process in association with *Saccharomyces cerevisiae.* French Institute of Vine and Wine (Nantes) last ten years were studied the fermentation process, its kinetics and also organoleptic and physic-chemical characteristics of produced wines from Melon B and Sauvignon varieties.

Materials and methods

T he research objective supposes the association of non-*Saccharomyces* yeasts with *Saccharomyces cerevisiae* in sequential seeding to prove the positive changes involved by these strains.
Non-*Saccharomyces*strains targeted in this study are:
- ✓ *Candida pyralidae,*
- ✓ *Metschnikowiapulcherrima,*
- ✓ *Torulasporadelbrueckii.*

Candida pyralidae is a selected strain that was studied earlier at the French Institute of Vine and Wine (Nantes). It has an oenological interest in enriching wine with aroma. The other two tested strains (*Metschnikowiapulcherrima* and *Torulasporadelbrueckii*) are already recommended to be produced and marketed. During this study were used three Lots of different varieties and geographical provenience:
- ✓ LOT 1 : Melon de Bourgogne
- ✓ LOT 2 : Sauvignon de Poitou
- ✓ LOT 3 : Sauvignon de Touraine

Given the trends of last years of substitution of manual harvest with mechanical, in all three Lots the harvest was perform using the combine and received as marc (Melon B) and must (Sauvignon).

The success of implantation of the strains was verified by performing an implantation control when the density of musts was ranged between 1,020 and 1,030 g/dm^3. Biomass analysis was realized by amplification Polymerase Chain Reaction (PCR). The genetic profile of biomass recovered from must, compared with referential strain allow the validation of successful yeast implantation. In order to determine the basic physical and chemical indexes were used recommended a standardized methods proposed by OIV [6].

Results and discussions

The analytical composition of every lots is different and especially in assimilable nitrogen. In order to ensure a reliability of alcoholic fermentation, in this study it was proceed to an increase of nitrogen content by using acloholic fermentation activators „Go Ferm„ and „Fermaid E„ in two halves. Table 1 presents an analytical composition of 3 lots of must.

Table 1. Analytical composition of musts

Indexes	Melon B	Sauvignon de Poitou	Sauvignon de Touraine
Total acidity, g/l H_2SO_4	4.0 (82 me/l)	6.42 (131 me/l)	5.0 (102 me/l)
pH	3.20	3.08	3.17
Assimilated nitrogen, mg/l	66	190	55
Tartric acid, g/l	2.9 (38 me/l)	3.9 (52 me/l)	4.1 (54 me/l)
L-malic acid, g/l	5.7 (85 me/l)	8.8 (131 me/l)	7.0 (104 me/l)
Turbidity,NTU	100	50	110
Potential alcohol concentration, % vol	10.0	10.0	12.0
Carbohydrates concentration, g/l	166	166	195

Table 2. Comparative characteristics of fermentative activity of yeasts

Yeasts Strains	Melon B			Sauvignon de Poitou			Sauvignon de Tourraine		
	Alcoholic Fermention, days		Residual sugar before sulfitage, g/l	Alcoholic Fermention, days		Residual sugar before sulfitage, g/l	Alcoholic Fermention, days		Residual sugar before sulfitage, g/l
	Latency	Duration		Latency	Duration		Latency	Duration	
1	2	3	4	5	6	7	8	9	10
Saccharomyces cerevisiae	1	20	1.8	2	16	2.0	3	10	1.9
Torulaspora delbrueckii	2	28	1.9	2	25	2.5	4	35	2.0
Candida pyralidae 2%	3	20	1.9	2	23	1.9	3	24	1.9
Candida pyralidae 3%	3	20	1.8	2	23	2.0	3	24	1.9
Candida pyralidae 5%	3	20	1.9	2	25	2.5	3	10	2.1
Metschnikowia pulcherrima	3	22	1.9	2	16	1.5	3	10	1.8
Metschnikowia pulcherrima IFV	4	20	1.8	2	11	1.25	3	10	1.5

Analysis results show a fundamental difference in assimilable nitrogen concentration, ranging from 55 to 66 g/l for Touraine Sauvignon and Melon B but up to 190 g/l for Poitou Sauvignon.

Also, the total acidity range from 4,0 g/l in Melon B must up to 6,42 g/l in those obtained from Poitou Sauvignon.

Chemical composition of must, as well as the interactions that occur between pairs of strains involved in every fermentative process influence first of all the duration of the fermentation (Table 2).

Table 2 results shows a difference in duration (days) of alcoholic fermentation carried out with *Saccharomyces cerevisiae* strain in 24 hours, while, under the same experimental conditions, this characteristic for *Torulasporadelbrueckii*and *Candida pyralidae* strains was respectively 48 and 72 hours. In terms of the duration of fermentation of must, it is observed only small deviations for experimented varieties, being higher in Melon B and quasi identical in the two lots of Sauvignon.

Also, the interactions between strains and the fermentation kinetics will alter (Fig. 1, 2, 3).

The curves of each series had a similar shape to that of the reference sample (seeded with *Saccharomyces cerevisiae*), but the using of *non-Sachharomyces* yeasts increase the latency period because of the concurrence between the strains. *Torulasporadelbrueckii* provides a quick beginning of alcoholic fermentation but towards the end the sugar consumption decrease and the fermentation slows compared to the previous steps.

This can be seen in all launched lots. *Metschnikowiapulcherrima*, didn’t involve fermentation difficulties in any sample, also its competition with *Saccharomyces* is less noticeable.

Regarding to *Candida pyralidae* strain, the graphs are quasi identic, showing that the initial number of microorganisms doesn’t involve changes in duration and speed of alcoholic fermentation of the musts.

The alcoholic fermentation of Lot No. 2 (Poitou Sauvignon) took place in a higher speed than the other two lots but the curves of lot No.3 (Touraine Sauvignon) have greater slopes at the beginning, showing that the fermentation speed decrease with the decrease of the content of sugar and increase of the content of alcohol.

Legend:
LT1-TD-*Torulaspora delbrueckii*
LT1-RnMO2-*Candida pyralidae 2%*
LT1-RnMO3-*Candida pyralidae 3%*
LT1-RnMO5-*Candida pyralidae 5%*
LT1-SC-*Saccharomyces cerevisiae*
LT1-MP- *Metschnikowia pulcherrima*
LT1-MPL8- *Metschnikowia pulcherrima*
selected from IFV

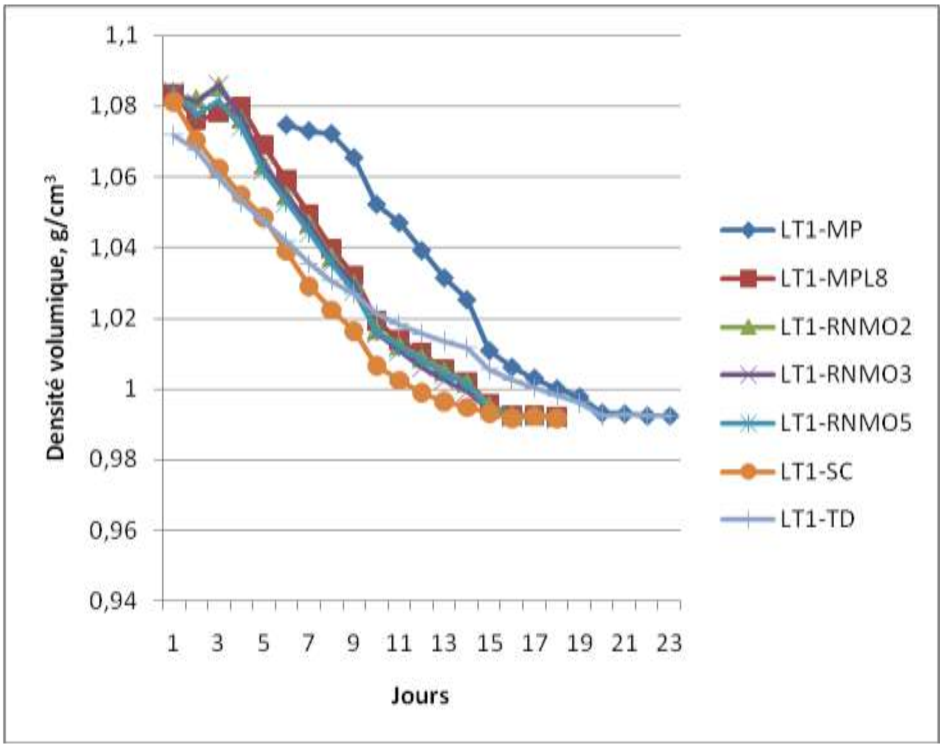

Fig. 1. Alcoholic fermentation kinetics of Lot Nr1 (variety Melon B)

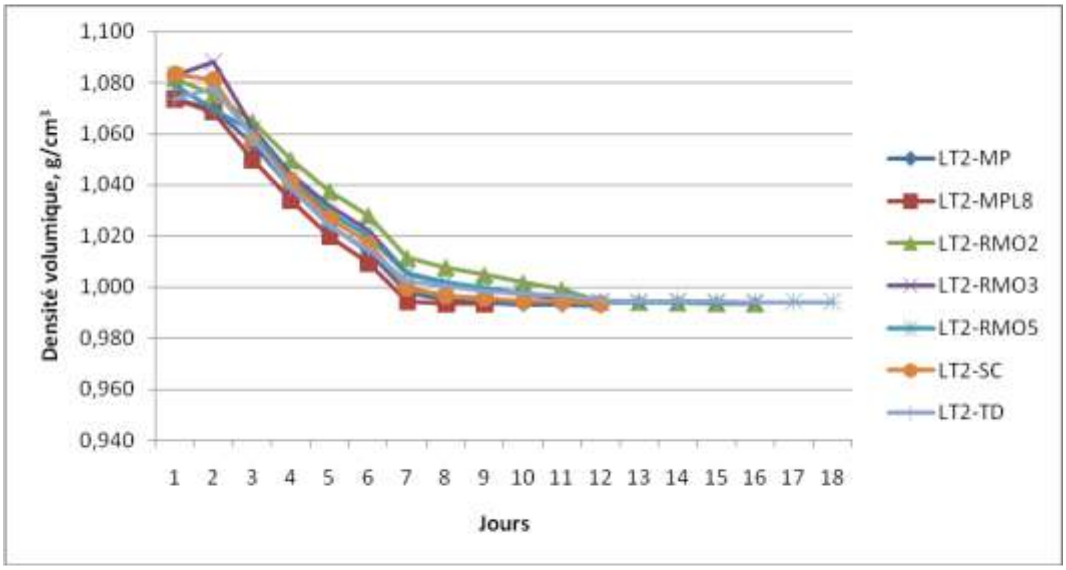

Fig. 2. Alcoholic fermentation kinetics of Lot Nr2 (variety Poitou Sauvignon)

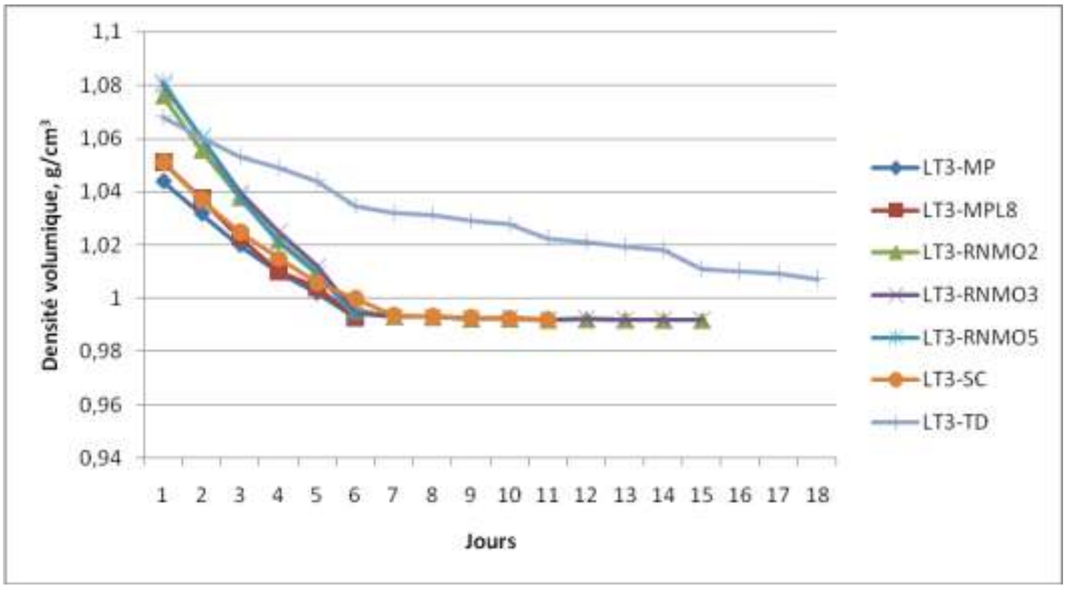

Fig. 3. Alcoholic fermentation kinetics of Lot Nr3 (varietyTouraine Sauvignon)

Tables 3, 4 and 5 summarize the analytical composition of produced wines

Table 3. Analytical composition of obtained wine from variety Melon B (Lot 1)

Indexes	Melon B						
	Saccharomyces cerevisiae	Torulaspora delbrueckii	Candida pyralidae 2%	Candida pyralidae 3%	Candida pyralidae 5%	Metschnikowia pulcherrima	Metschnikowia pulcherrima IFV
Alcohol concen-tration, % vol	12.48	12.37	12.43	12.43	12.32	12.79	12.35
Glucose +Fructose, g/l	1.3	0.6	1.2	0.9	1.3	<0.4	1.2
Total acidity (in H_2SO_4), g/l	4.19	4.15	4.02	4.11	4.01	4.10	4.14
Volatile acidity corrected (in H_2SO_4), g/l	0.21	0.51	0.24	0.23	0.23	0.33	0.27
pH IRTF	3.23	3.28	3.25	3.23	3.24	3.24	3.22
L-malic Acid, g/l	5.0	4.1	4.4	4.3	4.5	4.6	4.7
Tartric Acid, g/l	1.4	1.6	1.3	1.4	1.4	1.4	1.5
Total sulfure dioxide (total SO_2), mg/l	89	24	113	83	107	14	100

According to Table 3, the alcoholic fermentation was finished in all samples (residual sugar < 2g/l).

Alcoholic concentration of Lot No. 2 samples is very close to the first Lot, except for two (*Torulasporadelbrueckii*-TD and *Candida pyralidae*5%-RnMO5), that are 12,29 and 12,23 respectively.

The volatile acidity of samples is a little bit high but has no gap between samples of the same Lot.

The total acidity is less high comparing to the first Lot but the samples are homogeneous by this parameter, except samples TD and RnMO5(about 4,8g/l). Because these two samples had finished fermenting later than the others, their chemical analysis was carried out before sulfitage (total SO_2 54 and 50 mg/l respectively), also before treatement with cold that explain a higher concentration in tartric acid.

Tartric and malic acid consumption by yeasts is higher comparing to the precedent Lot (about 2 g/l of malic acid and 3 g/l of tartric acid with respect to their initial concentration in must).

Table 4. Analitical composition of wine obtained from Sauvignon de Poitou variety *(Lot 2)*

Parameters	Sauvignon de Poitou						
	Saccharomyces cerevisiae	Torulasporadelbrueckii	Candida pyralidae 2%	Candida pyralidae 3%	Candida pyralidae 5%	Metschni-kowia pulcherrima	Metschnikowia pulcherrima IFV
Alcohol concentration , % vol	12.69	12.29	12.58	12.42	12.23	12.42	12.44
Glucose+Fructose, g/l	1.3	2.1	1.2	1.4	1.5	0.5	0.8
Total acidity (in H_2SO_4), g/l	4.44	4.8	4.53	4.5	4.79	4.44	4.24
Volatile acidity corrected (in H_2SO_4), g/l	0.33	0.41	0.42	0.36	0.34	0.42	0.33
pH IRTF	3.33	3.44	3.37	3.37	3.38	3.35	3.09
L-malic Acid, g/l	6.6	6.4	6.6	6.4	6.7	6.7	6.9
Tartric Acid, g/l	1.0	2.1	1.3	1.4	2.1	1.0	1.0
Total sulfure dioxide (total SO_2), mg/l	119	54	117	116	51	115	115

Table 5. Analytical composition of wine obtained from variety Touraine Sauvignon (Lot 3)

Parameters	Sauvignon de Touraine					
	Saccharomyces cerevisiae	Candida pyralidae 2%	Candida pyralidae 3%	Candida pyralidae 5%	Metschnikowia pulcherrima	Metschnikowia pulcherrima IFV
Alcohol concentration , % vol	13.25	13.05	13.17	13.20	13.27	13.21
Glucose +Fructose /l	1.2	<0.4	1.0	1.0	0.4	<0.4
Total acidity (in H_2SO_4), g/l	4.00	4.32	4.2	4.12	3.84	3.92
Volatile acidity corrected (in H_2SO_4), g/l	0.34	0.26	0.24	0.24	0.32	0.24
pH IRTF	3.19	3.17	3.17	3.15	3.18	3.15
L-malic Acid, g/l	3.8	4.1	4.2	4.2	4.0	3.9
Tartric Acid, g/l	2.0	2.1	2.0	1.8	1.8	1.8
Total sulfure dioxide (total SO_2), mg/l	96	101	91	92	74	83

The alcoholic fermentation of Lot Nr 3 showed the fastest kinetics for several samples and from the amount of residual sugars - the most advanced. The obtained ethylic alcohol concentration (about 13,2 % vol) highlights the rich potential of must. The sample inoculated with *Torulasporadelbrueckii* strain allows the slowest fermentation of all analyzed samples. Regarding the total acidity, the gap between samples is not significant (about 0,2 g/l). Despite the chemical de-acidification of Lot, the consumption of tartric and malic acids is the most significant between all three researched groups (decrease with 3 g/l of malic acid and 2 g/l of tartric acid compared to the initial concentration of acids in must). The volatile acidity of samples of this Lot is the smallest and shows a quasi linear homogeneity.

The sensorial analysis of wines at this stage can not give the definitive results on the quality of products but provides an objective opinion on the ulterior development of wine during maturation. The samples do not show important organoleptic defects. The intensity of aroma and taste of the products was determined both by yeasts activity and aromatic varietal potential of grapes. Overall, the most appreciate was the Lot 2 (Poitou Sauvignon) because of more pronounced secondary aroma and a balanced taste.

The results of organoleptic analysis are listed in figures 4, 5 and 6.

Legend:
TD-*Torulaspora delbrueckii*
RnMO2-*Candida pyralidae 2%*
RnMO3-*Candida pyralidae 3%*
RnMO5-*Candida pyralidae 5%*
SC-*Saccharomyces cerevisiae*
MP- *Metschnikowia pulcherrima*
MPL8- *Metschnikowia pulcherrima selecteted from* IFV

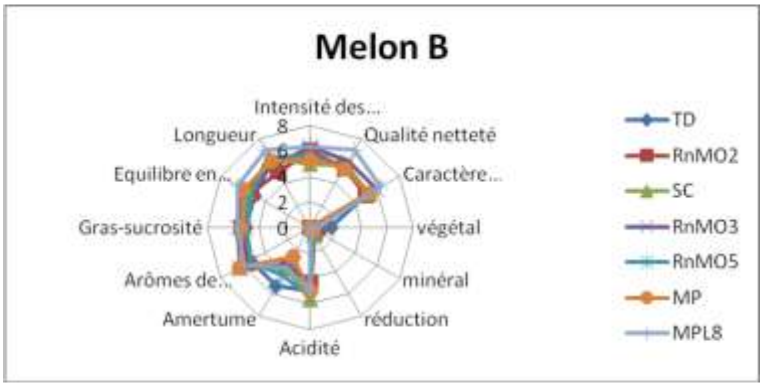

Fig.4. Sensorial analysis of wines (Lot 1)

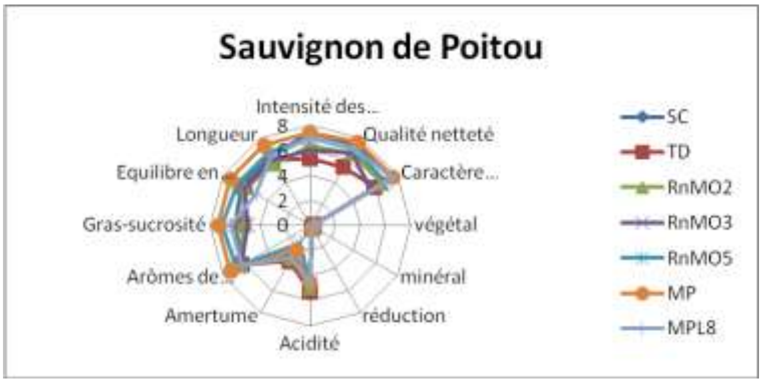

Fig.5. Sensorial analysis of wines (Lot No.2)

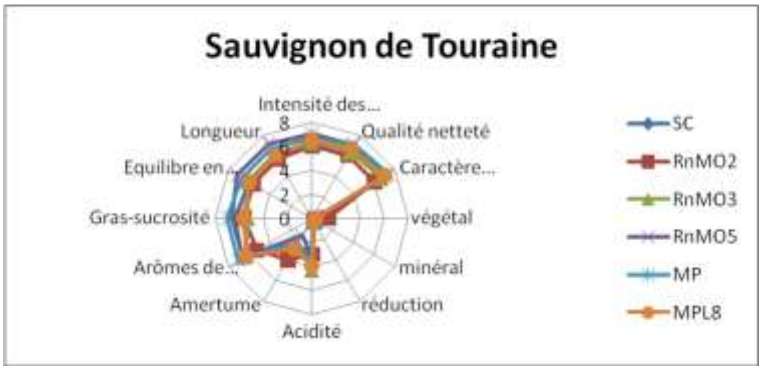

Fig. 6. Sensorial analysis of wines (Lot No.3)

Conclusions

(1) *Non-Saccharomyces* and *Saccharomyces* strains inoculated in musts from Melon B and Sauvignon varieties shows different kinetics behaviors and alcoholic fermentation was finished in almost all samples.

(2) An exception was found in a sample of Lot No.3 seeded with *Torulasporadelbrueckii*which has a slow kinetics of carbohydrates degradation. It was established that the fermentation kinetics is more a strain function than a function of used variety of grapes. The shape of curves of kinetics of fermentation was similarly to the curve of the referential sample.

(3) It was demonstrated the positive action of non-*Saccharomyces* yeasts on the organoleptic characteristics of wines.

(4) At the same time, their involvement in fermentation process doesn't achieve an excessive volatile acidity and other defects of aroma and taste.

(5) The involvement of *non-Saccharomyces* strains in practical oenology that keeps recent achievements in oenological biotechnologies allows an increase of aroma intensity (floral, fruitful etc.) in varietal wines with preservation of varietal aromas and taste in natural dry wines.

References

[1] Flanzy Claude, « Oenologie –fondementsscientifique et technologiques», Lavoisier TEC&DOC, pp.165-219, 1998;
[2] Application à l'oenologie des progrèsrécents en microbiologie et en fermentation », Office International de la Vigneet du Vin. ENSAA Dijon, ENSA Montpellier, pp.171-202, 1998;
[3] Ribereau-Gayon, J., Peynaud, E., Traitéd'oenologie. Vol I, Paris et Liège, 1960;
[4] Maîtrise des fermentations spontanées et dirigées, ITV-Nantes, pp.26, 2008
[5] Huet Myriam, Lauzeral Valérie, Dictionnaire des vins et alcools, Edition Hervas, pp.440, 1999;
[6] Recueil des méthodesinternationalesd'analyse des vins et des moûts, OIV, volume 1, Paris, edition 2011;
[7] Poulard Alain, Pascari Xenia, Rapport de stage « Sélection d'une souche non-Saccharomyces pour la fermentation des vins blancs », Institut Francais de la Vigne et du Vin, 2013, 54 pages;
[8] Gherciu-Musteţă Lidia, Poulard Alain, Gore Ecaterina, « Etude de la fermentation alcoolique en flores mixtessur Melon de Bourgogne », Universtite Technique de Moldova, 2009, 16 pages.

ROMANIAN PRIVATE FOREST DISTRICTS - BETWEEN PRODUCTION AND BIODIVERSITY CONSERVATION

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Abstract. *The purpose of this paper is to briefly describe the Romanian private forest sector in relation to the performances of private forest districts and the involvement of these forest administration entities in biodiversity conservation activities. The initiation in 1991 of forest property restitution process and its further implementation has had a major influence on forest management and administration; in 2002 the first Romanian private forest district was established. By 2010, 117 private forest districts managing around 1.42 million ha of forest had been established, their number increasing to 138 in 2012. At the beginning of 2013, 14 private forest districts were providing the custody or administration of 16 Natura 2000 sites, while three forest districts were FSC certified. Biodiversity conservation and increasing high financial demands of the forest owners represent significant challenges for Romanian private forest districts in the attempt to balance the social, economic and environmental interests.*

Keywords: biodiversity, FSC certification, Natura 2000, private forest districts

Introduction

Romanian forest property structure in the XIX, XX and XXI centuries had suffered substantial changes. Starting at Romanian provinces level and until now, data attesting the forest ownership structure and its management manner indicates a continue change, firstly generated by policies adopted during various periods. For example, the evolution of state-owned forest area (Table 1) shows that in 1930 the state owned 1.942 thousand ha (29.9% of the total forest area of 6.486 thousand ha), in 1990 the state owned and managed the whole forest area being (6.372 thousand ha), whilst it owned only 3.339 thousand ha in 2010, representing 51.25% of the total forest area of Romania.

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Table 1. Evolution of state-owned forest area

Year	1930	1947	1965	1990	2010
National forest area (thousands ha)	6,486	6,704	6,378	6,372	6,515
State-owned forest area (thousands ha)	1,942	1,963	6,378	6,372	3,339
% of state-owned forest of the total forest area	**29.9**	**29.0**	**100**	**100**	**51.2**

Sources: [18, 22, 24]

In the modern period, the functioning of the forestry sector, respectively the forestry regime introduction and implementation could not be assured without the establishment and operation of specialised institutions. Thus, since 1910 until 1930 the House of Forests (Casa Pădurilor) was operating as a state forestry administration, forest administration and guarding being performed via 14 regional directorates, 27 forestry regional units and 294 forest districts. In 1930, the new Law for Administration of Forests was enforced, the attributions of House of Forests being replaced by the services of the Autonomous House of State-Owned Forests (Casa Autonoma a Padurilor Statului) and of the Forestry Regime Directorate (Directia de Regim Silvic), whilst regulations regarding the forestry regime for all forests, regardless of ownership, started to be implemented [18]. After the establishment of the communist regime, in 1948, all Romanian forestlands, either privately-owned, belonging to local communities or to other legal entities have been transferred into state possession and administration [15]; the Ministry of Forestry was established, with 58 county forestry directorates and 467 forest districts, which were responsible for guarding, protection and development of forests belonging to the national forest fund [18]. After the fall of the communist regime, a reform of the forest sector was initiated, the first step in this intercession being realised in 1991 by the Romanian Government, which has embarked into the process of privatisation through restitution of forestland [2].

The forest restitution recognises the continuity of ownership rights of the owners and of their heirs, of local communities and institutions [3, 5] in the case of forest property hold before the nationalisation process in 1948. The restitution process has been carried out in three successive stages, based on three different laws that completed each other, namely Law no. 18/1991, Law no. 1/2000 and Law no. 247/2005 [14, 19, 23]. Furthermore, the process of transition towards the market economy has been a challenge also for Romanian forestry institutions.

While in the period 1990-2002 the responsibility for the management of forests, regardless of their owners, belonged only to the National Forest Administration (RNP) - Romsilva, which was structured into 42 directorates and 360 forest districts [1], in 2002 the first private forest district (PFD) was established in Bania village (Caras-Severin county) as an entity responsible for the administration and management of the forests owned by the local community [2]. The first regulatory documents defining the establishment and functioning of PFDs in Romania were the Governmental Ordinance no. 96/1998, Governmental Decision no. 997/1999 and the Ministerial Order no. 116 dated 13th of March 2002.

Regarding forest ownership, the Forest Code (Law no. 46/2008), specifies four different categories of ownership: (1) Public property of the state; (2) Public property of the local administrative-territorial units; (3) Private property of the local administrative-territorial units; and (4) Private property of individuals and legal entities. The same Code provides also the categories of entities allowed to undertake forest administration and/or forest services to different categories of owners (1, 2, 3, 4), namely the state forest districts (either within RNP Romsilva or PFDs). The PFDs could be established by different categories of forest owners (excluding the state) or by associations founded by such owners. Regarding the monitoring and controlling of the forestry regime implemented by the administrators of forest areas (state-owned or private forest districts) the responsible bodies are the Territorial Inspectorates for Forestry Regime and Hunting (RFIs), public institutions representing in the territory the central public authority responsible for forestry (presently the Ministry of Environment and Climate Change).

As a consequence of all post-1990 ownership and institutional changes, at the end of 2010 the total forest area of Romania was managed and administrated by 463 forest districts: 325 state forest districts (belonging to RNP Romsilva) and 138 PFDs. The evolution, structure and features of the private forest districts and forest areas managed by these entities have been relatively poorly studied and reflected in the national and international publications [4, 9, 11, 12, 13, 16], a first relevant study on such topics being published in 2012 [2].

The purpose of this paper is to describe and characterise the evolution of Romanian private forest districts based on the analysis of certain production indicators provided by the PFDs for the year 2010 as well as their involvement in biodiversity conservation, in order to get a better understanding of the evolution, structure, economics and features of Romanian private forestry.

1. **Methodology**

Detailed information on the existing authorised PFDs in 2010 was obtained from the official statistical reports (Silv forms), with the consent and support of the central public authority responsible for forestry - the Ministry of Environment and Forests. These documents are requested every year by the National Institute for Statistics. At the first level, Silv forms are collected from the state or private forest districts by RFIs depending on territorial competence area of each control structure. For analysis, a Microsoft Excel database containing information from Silv forms of 117 PFDs was generated, their detailed location and RFI's control competence being shown in Table 2 and Figure 1. Data processing was performed by PDF stratification in groups according to their corresponding RFI, using the datasets from the four Silv forms (i.e. Silv 1 - Forest area (by ownership type, functional category and species) under administration; Silv 2 - Economic situation, investments and assets; Silv 3 - Harvested volume and area (by ownership type and species); and Silv 4 - Forest regeneration and seedling production). Additionally, the information on protected areas managed by PFDs, available on the web page of the public authority responsible for environment and the FSC database regarding the certified forest areas and the public reports issued by the certification body were assessed.

2. Results and Discussions

2.1. Forest area, ownership and production of Private Forest Districts

Since 2002, the number of PFDs has rapidly grown [21], due to the restitution of forestlands. In regions with large restituted forest areas, the number of these entities is also significant. RFI Brașov has within the range of its control the highest number of PFDs (37), followed by Cluj (30) and Oradea (20), on the last place being situated RFI Bucharest, with no PFDs within its area of responsibility (Table 2, Fig. 1).

In 2010, the 117 PFDs were administrating around 1.42 million ha of forest area, representing 21.5% of the total national forest fund (6.51 million ha), according to the statistical data provided by the National Institute for Statistics. Considering the percentage of privately managed forest area from the total forest area under the responsibility of each RFI, it can be noticed that in Brașov RFI almost 50% of the forest is managed by PFDs, followed by Cluj, with around 35%. A small percentage of forests managed by PFDs (less than 20%) is found in the areaa under the responsibility of Suceava, Ploiești, Timișoara and Râmnicu Vâlcea RFIs (Fig. 2).

Regarding the ownership type of forest managed by PFDs, the most common one is the private property of individuals and legal entities (55%), followed by public property of the local administrative-territorial units (42%), whilst the private property of the local administrative-territorial units is modestly represented (Fig. 3a).

Table 2. Distribution of the total number of PFDs by RFI and the number of PFDs included in the study.

RFI	Total number of PFDs (2013)	Number of PFDs included in the study (2010)
Brașov	37	36
Cluj	30	29
Focșani	9	8
Ploiești	7	5
Suceava	14	3
Oradea	20	17
Timișoara	9	8
Râmnicu Vâlcea	12	11
Bucharest	0	0
Total	**138**	**117**

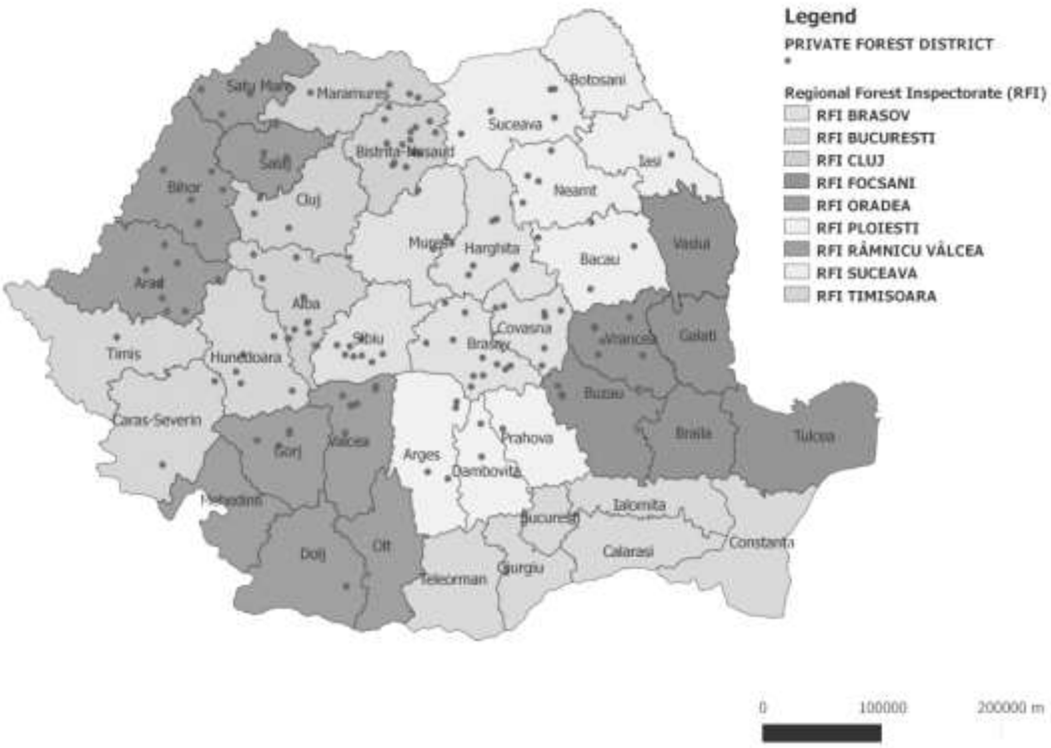


Fig. 1. National distribution of PFD offices and their allocation to RFIs.

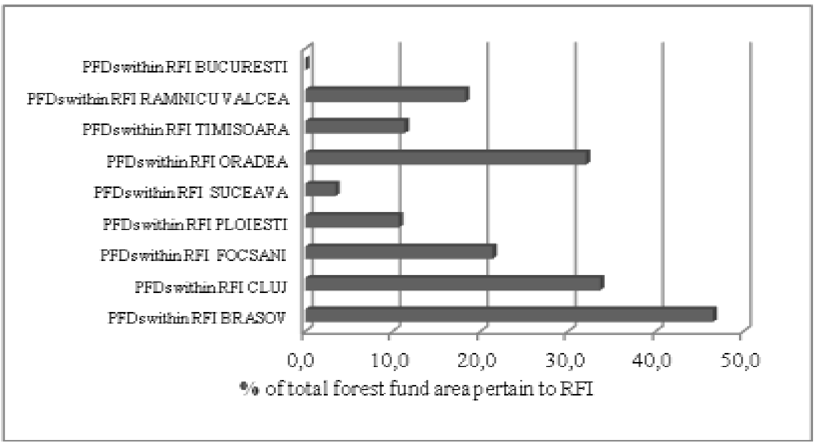
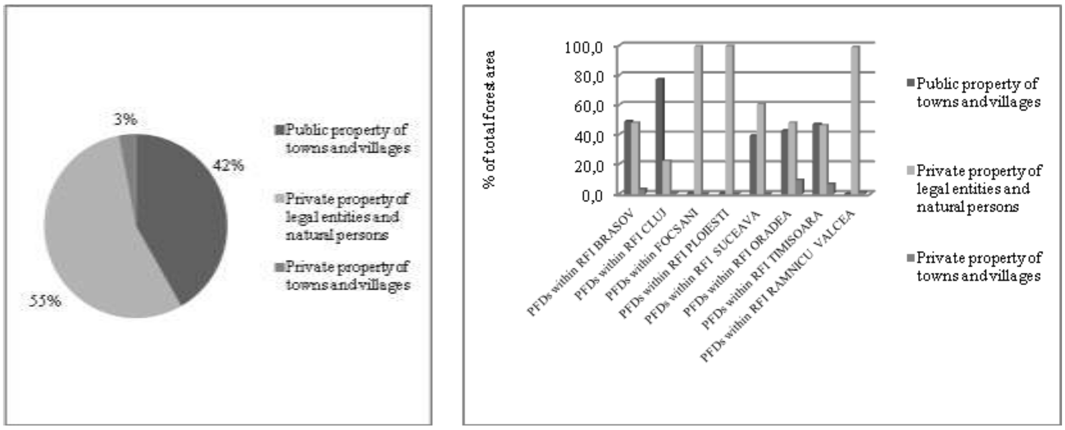


Fig. 2. Percentage of forest area managed by PFDs out of the total forest area under the RFI responsibility.

The largest forest area included in the category of private property of individuals and legal entities is found in Brașov RFI (where it represents 48% of the total forest area managed by PFDs), whilst this category of ownership reaches 99% of the total forest area managed by PFDs in Ploiești, Focșani and Râmnicu Vâlcea RFIs. The percentage of the public property of the local administrative-territorial units managed by PFDs is higher in Transilvania and Banat (Western, North-Western and Central Romania): Cluj RFI (77%), Brașov RFI (49%), Timișoara RFI (47%) and Oradea RFI (42%) (Fig. 3b).



a) b)

Fig. 3. Types of forest ownership managed by PFDs: a) national level, b) RFI level

In 2010, the volume of timber harvested by PFDs exceeded 5.8 million cubic meters [2], whilst forest regeneration was undertaken on an area of 5.61 thousand ha (excepting Cluj RFI, as data of Silv 3 form was not available), out of which 3.39 thousand ha of broadleaves and 2.22 thousand ha of conifers.

2.2. Biodiversity Conservation

By analysing the structure of the forest stands managed by PFDs it can be noticed that the forests from the Functional Group I (FG I - protection forests) represent a relatively high share of around 49%. According to Law no. 247/2005, the restitution of forests included in protected areas or having various special protection functions was allowed and this have led to a continuous increase of the share of forests from FG I managed by PFDs compared to 2006, when the percentage was 44% [2]. Large areas of protection forests are found in the PFDs under the responsibility of Râmnicu Vâlcea RFI (88%), Focșani RFI (85%) and Ploiești RFI (77%) (Fig. 8). The highest percentages of production forests are found within the range of RFIs Suceava (82%), Oradea (81%) and Brașov (66%).

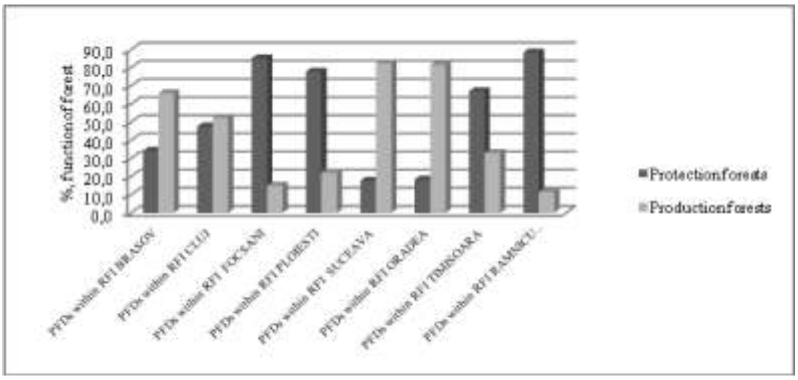


Fig. 8. Distribution of forest by functional categories (protection and production)

Regarding the protected areas management, this is performed based on a management plan elaborated by the administrators. The Government Emergency Ordinance no. 57/2007 has transposed the EC Habitats Directive and defines the management plan as being "the document which defines and assess the current situation of the natural protected area, defines the objectives, states the required conservation actions and regulates the activities that are allowed to be performed within the protected area's territory, according to the management objectives" [28].

The elaboration of a management plan is a complex process which should involve all interested groups at local level and falls into the responsibility of:

- *the administrators* of the site/protected area designated after the consultation with the Advisory Board and the approval by Government Decision - for the sites requiring by law their own administration/management unit;

- *the custodians,* with the notice of the Environment Protection Agency and the approval of the Ministry of Environment and Forests - for the sites which do not require by law their own administration/management unit [28].

In Romania, Natura 2000 network was established in 2007 by declaring new SCI (Site of Community Importance) and SPA (Special Protection Area) and reached 19.28% of the country territory, compared to a proportion of 4.1% covered by protected areas in 1989 [8]. The PFDs are also directly involved in the management/administration of protected areas/Natura 2000 sites. In several situations, due to a poor collaboration between authorities, local communities, forests owners and forest administrators, the implementation of Natura 2000 Network has become a challenge for the PFDs [8, 16]. In 2013, 14 PFDs were recorded as custodians or administrators for a total number of 16 SCIs or SPAs, covering 394.23 thousands ha, out of which 291.13 thousands ha are Sites of Community Importance (SCIs) and 103.09 thousands ha are Special Protection Areas (SPAs). Taking into account the data provided by the National Institute for Statistics, in 2102 in Romania there were 4.14 million ha of SPAs and 3.69 million ha of SCIs [20], it results that 7% of the total SCIs' area and 2.8% of the total SPAs' area are under direct administration/custody of PFDs, which are involved in the elaboration and implementation of the management plans. Moreover, all the sites being managed by PFDs are situated within the alpine bioregion. Most of the PFDs have become custodians/administrators in 2010, excepting Lignum Voluntari Forest District, which became earlier a custodian of Pădurea Izvorul Alb site.

By referring to the biodiversity of these sites, the presence of certain bird species considered threatened at European Union level could be noticed. Among these the following species should be mentioned: *Ciconia ciconia, Crex crex, Tetrao urogallus, Aquila pomarina, Pernis apivorus, Ciconia nigra, Dendrocopos medius, Lanius collurio, Botaurus stellaris, Ixobrychus minutus, Ardea purpurea, Aythya nyroca, Porzana porzana, Egretta garzetta or Anser albifrons*. At the same time, in most of the considered sites a high concentration of large carnivorous was recorded (brown bear, grey wolf, lynx/wildcat). Certain sites (e.g. sweet chestnut forest from Baia Mare or Larion) have been established due to the presence of forest species concentrations or floristic diversity. For all these sits, the PFDs must be able to identify protection measures and to implement the management plan in such a manner that the conservation attributes (values) for which the sites were established are not degraded. Therefore, important challenges for the custodians/administrators are related to the fight against poaching, anthropic activities in the sites/protected areas (e.g. building, uncontrolled tourism, bicycle riding, auto routes, flora tearing), overgrazing etc.

A significant problem faced by the PFDs that have taken into custody Natura 2000 sites is the lack of compensation mechanisms for the areas included in the sites. Stăncioiu et al. [16] mention the fact that G.E.O. no. 57/2007 does not detail the process and the methodology for compensation allocation (compensations only for private properties are foreseen). Furthermore, the same authors noticed the fact that the conservation restrictions must refer to the purpose for which the protected area was established, being carefully identified, without creating tensions between stakeholders or leading to unnecessary income losses to the owners by imposing certain restrictions.

Another mechanism for confirming the efficient management and for assuring the conservation of biodiversity is forest certification, which implies the compliance with performance standards specific to the forestry sector. By referring to FSC forest certification in Romania, the biodiversity conservation is assured by implementing Principle 6 (Environmental Impact) and Principle 9 (Identifying, protecting and monitoring the High Conservation Value Forests - HCVF) of the FSC standards of forest management [26]. Gullison [6] mentions that FSC certification scheme contains the some of the most rigorous standards for biodiversity conservation.

The forest certification has evolved rapidly in Romania in the last decade, in 2013 the total certified area reaching 2,386,934.7 ha [27] out of which 38,686.7 ha are private forests. In addition to the already certified PFDs other PFDs are in the process of FSC certification. At the same time, forest certification represents a voluntary market instrument, designed for reducing the illegal wood trade and for recognising and rewarding the efficient forest management, which increasingly becomes for many forest administrators/companies a surviving condition on the market international [7].

According to Gullison [6], forest certification influences positively the biodiversity conservation through several modalities:

- improving the forest management;

- identification and protection of the HCVFs;

- increased profitability.

Improving the forest management. Solving certain non-compliances with the FSC standard may lead to the improvement of forest management. Considering certain existing studies [6, 17], most of the non-compliances identified in the forest units by the auditing team are referring to issues related to biodiversity conservation. Thus, inappropriate use of chemicals (lack of methodology, inadequate concentrations) and their storage (referring to FSC Criterion 6.6), lack of certain measures for fighting the erosion, forest damages or lack of protection of threatened species (FSC Criterion 6.5) are some of the non-compliances identified in Romanian forests assessed for FSC certification [25]. Additionally, the lack of a monitoring system for the maintenance/improvement of certain conservation attributes has been the subject of some non-compliances identified by the auditing teams (FSC Criterion 9.4).

Identifying the HCVFs. Identification of High Conservation Value Forests represents an essential component in the FCS certification of forest management. FSC Principle 9 (FSC-STD-01-001) requires that the forests having high conservation value should be identified and monitored, assuring that the attributes for which they were recognised are not degraded or negatively affected [10]. Following this FSC Principle three certified PFDs identified a total area 0f 3.04 thousands ha of forests having High Conservation Value.

Profitability of certification. Forest certification represents a market instrument through which the owners promote (improve) the practices which promote biodiversity conservation, the market being an important driving factor for forest certification [7]. Obtaining certain market advantages would also be a stimulus for forest owners/administrators to adopt a sustainable forest management consistent fulfilling social, economic and environmental interests. Certification of some PFDs indicates that these units are able to fulfil certain international management requirements, and their yearly monitoring/supervision by the independent certifier proves the performance and the sustainability of the practiced management. The certification process is based on transparency, on consulting all interested factors/stakeholders and on complying with certain requirements regarding the sustainable management of the forest, balancing the social, economic and environmental interests. On the other hand, forest certification can represent in any moment an advantage on the market and an optimal manner of proving internationally the sustainable forest management.

3. Conclusions

Starting with 2002, PFDs have played an increasing role in Romania's forest management process, this type of administration becoming dominant in certain areas, especially where the proportion of restituted forestlands was massive. PFDs have become more important in Romanian forestry and have recorded noticeable performances in the process of private property administration and management.
Considering the territory allocated ti each RFI, it can be noticed that PFDs are mainly found in the North-Western and Western Romania (RFIs Brașov, Cluj, Oradea). For example, PFDs under Brașov RFI manage 34.5% of the total area administrated by PFDs across Romania, and represent almost 50% of the total forest area monitored by this RFI.

The most common form of property is the private one – forest belonging to physical/natural persons and legal entities (55%), and in the case of some RFIs such as Râmnicu Vâlcea, Focșani, Ploiești this type of ownership represents the vast majority (in all of these three RFIs, the forest under private property of natural persons and legal entities represents 99%).

The turnover of the PFDs within RFI Brașov represents 44% of the total turnover of the PFDs, and along with RFI Cluj and Oradea reaches 75% of the total turnover of Romanian PFDs. This turnover is mostly represented by wood sale; yet in case of PFDs from Râmnicu Vâlcea, Focșani and Oradea RFIs the turnover is also constituted from providing certain forest services. On the other hand, only the PFDs from Brașov, Cluj and Timișoara RFIs realise income from commercialising certain non-timber forest products (edible mushrooms and wild fruits).

Large areas covered with regenerations are found in the PFDs within RFIs Brașov, Oradea and Râmnicu Vâlcea, the artificial regenerations reaching the highest percentages in the PFDs within Suceava RFI (58.7%) and Brașov RFI(31.3%). The number of seedlings used in the afforestation works reached 10.029 million seedlings.

Large areas of forests in the Functional Group I (forests with protection functions) are found in the PFDs under the responsibility of RFIs Râmnicu Vâlcea (88%), Focșani (85%) and Ploiești (77.8%).

In Romania, 14 PFDs are administrators/custodians of 16 protected areas/Natura 2000 sites, representing 7% of the total SCIs area and 2.8% of the total SPAs area at national level. Three PFDs have certified their forest management according to FSC standards and manage 3.04 thousands ha of forests having high conservation value. Biodiversity conservation, poor forestry knowledge and increasingly financial demands of the forest owners represent important challenges of the Romanian private forestry. An important aim of the PFDs is to balance the social, economic and environmental interests, in the context of an increasingly demanding society.

References

[1] I.V. Abrudan, V. Marinescu, O. Ionescu, F. Ioras, S. A. Horodnic, R Sestras, Developments in the Romanian Forestry and its Linkages with other Sectors, *Notulae Botanicae Horti Agrobotanici Cluj-Napoca vol.* 37, no. 2, pp. 14-21, 2009.
[2] I.V. Abrudan, A Decade of Non-State Administration of Forests in Romania: Achievements and Challenges *International Forestry Review, vol. 14, no. 3, pp. 275-284,* 2012.
[3] L. Bouriaud, F. Schmithusen, Allocation of Property Rights on Forests through Ownership Reform and Forest Policies in Central and Eastern European Countries, *Swiss Forestry Journal vol. 156 no. 8, pp. 297-305, Zurich, 2005.*
[4] M. Dragoi, B. Popa, V. Blujdea, Improving Communication among Stakeholders through ex-Post Transactional Aanalysis – Case Study on Romanian Forestry. *Forest Policy and Economics, vol.* **13**, pp. 16-23, 2011.
[5] FAO, Review of Forest Owners' Organizations in Selected Eastern European Countries, by G.Weiss, I. Gudurić and B.Wolfslehner, Forestry Policy and Institutions Working Paper, no. 30, Rome, 2012.
[6] R.E. Gullison, Does Forest Certification Conserve Biodiversity? Oryx, vol. 37, no. 2, pp. 153-165, 2003.
[7] A.F. Hălălișan, M. Marinchescu, I.V. Abrudan, The evolution of forest certification: A short review, *Bulletin of the Transilvania University of Braşov*, series II, vol. 5 (54) no. 2, pp. 35-42, 2012.
[8] C.I. Ioja, M. Patroescu, L. Rozylowicz, V. D. Popescu, M. Vergheleț, M.I. Zotta, M. Felciuc, The Efficacy of Romanian Protected Areas Network in Conserving Biodiversity, *Biological Conservation*, vol. 143, pp. 2468-2476, 2010.
[9] F. Ioras, I.V. Abrudan, The Romanian Forestry Sector: privatisation facts. *International Forestry Review vol.* 8, pp. 361-367, 2006.
[10] S. Jennings, HCVF for Conservation Practitioners, Proforest, Oxford, pp. 20, 2004.
[11] A. Lawrence, A. Szabo, Ethics and Culture in the Forestry Profession: Emergent Changes in Post-Communist Romania. *Silva Carelica*: special issue on Forest Ethics, vol. 49, pp. 303-314, 2005.
[12] A. Lawrence, A. Szabo, Forest Restitution in Romania: Challenging the Value System of Foresters and Farmers, Environmental Change Institute, University of Oxford, UK, 2005.
[13] A. Lawrence, Forestry in Transition: Imperial Legacy and Negotiated Expertise in Romania and Poland, *Forest Policy and Economics, vol.* **11,** pp. 429-436, 2009.
[14] V. Marinescu, Changes in the Property Structure of the Forests in Romania as Generating Compulsions in the Elaboration of a viable Forest Policy, Lucrările

sesiunii ştiinţifice „Pădurea şi dezvoltarea durabilă” - Faculty of Forestry and Forest Engineerind, “Transilvania” University of Brasov PH, pp. 639-646, 2007.
[15] S. Poynton, A. Mitchell, G. Ionascu, F. Mckinnenn, J. Elliott, and I.V. Abrudan, *Economic Evaluation and Reform of the Romanian Forestry Sector*, Brasov, Romania, 2000.
[16] P.T. Stăncioiu, I.V. Abrudan, I. Dutcă, The Natura 2000 Ecological Network and Forests in Romania - Some Implications on Management and Administration, *International Forestry Review*, vol. 12, pp. 106-113, 2010.
[17] K. Thornberg, Impacts of Certification on Forests, Stakeholders and Markets-Case Study: Bainings Eco-forestry Project, Instruments for Sustainable Private Sector Forestry Project Series, IIED, London, 1999.
[18] A. Ungur, Pădurile României: trecut, prezent și viitor – politici și strategii, Devadata PH, Bucharest, 2008.
[19] M. Vasile, Privatisation of Forests from a Sociological Perspective. The Extended Case Study of Obştea Vrânceana, *Annals of „Ştefan cel Mare” University Suceava*, Section Silviculture, no. 1, 2009.
[20] ***Institutul Național de Statistică [National Institute for statistics], https://statistici.insse.ro
[21] ***Registrul Național al Administratorilor de Păduri [National Register of Forest Administrators], http://mmediu.ro
[22] ***RNP Romsilva-Overview, http://www.rosilva.ro/articole
[23] ***RNP Romsilva, Starea Pădurilor [Forests Condition], 2010, http://www.mmediu.ro/paduri
[24] ***Sinteza Raportului de audit privind ”Situația patrimonială a fondului forestier din România, în perioada 1990-2012” [Summary of Audit Report on “Patrimonial Situation of Romanian Forest Fund in the period 1992-2012”], http://www.curteadeconturi.ro
[25] ***Soil Association Public Reports, available on: http://info.fsc.org
[26] ***Standard for forest management FSC-STD-01-001 (FSC Principles and Criteria)
[27] ***www.info.fsc.org, ***www.natura2000.mmediu.ro

STUDY ON THE THERAPEUTIC EFFECT OF FEEDING SHEEP WITH DIETS CONTAINING AROMATIC PLANTS

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Abstract. *The three most promising plants were tested at the lowest level possible to determine their possible effects on gastrointestinal parasitic load of animals. For this study were used 80 lactating sheep naturally infected with nematodes pluriparous gastrointestinal (GIN). The relationship between the number of eggs and GIN load were assessed before the experiment with direct control of parasitological on a sheep slaughtered in the same herd (the herd). The 80 ewes were divided in 4 groups of 20 each: Group 1 (control), Group 2 (Carum carvi), Group 3 (Coriandrum sativum), Group 4 (Satureja Montana). There was analysed the variation of EPG (Total number of parasitic elements per gram of faeces) and LPG (Total number of larvae per gram of faeces) during the experimental period and the internal organs after the end of experiments.*

Keywords: aromatic plants, feeding, sheep

1.Introduction

One of the problems that the researchers had in view over time was therapy with medicinal and aromatic plants, including the possibility of eliminating intestinal parasites of sheep by feeding on such plants [1-5, 8-14]. Are also described some applications using herbs, with effects on the digestive tract, especially in human nutrition [6,7].

The three most promising plants, *Carum carvi*, *Coriandrum sativum* and *Satureja montana*, were tested at the lowest level possible (resulting from before analysing) to determine their possible effects on gastrointestinal parasitic load of animals. For this study were used 80 lactating sheep naturally infected with nematodes pluriparous gastrointestinal (GIN). The relationship between the number of eggs and GIN load were assessed before the experiment with direct control of parasitological on a sheep slaughtered in the same herd (the herd).

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2.Materials and Methods

The 80 sheep were divided randomly into 4 groups of 20 each: **Lot 1 (Control), Lot 2 (Carum carvi), Lot 3 (Coriandrum sativum), Lot 4 (Satureja montana).**
EPG was measured with a fecal performed qualitative and quantitative analysis, 3 days before the experiment, by the methodology of McMaster as described by Raynaud.

2.1 Experiemental protocol

During the experimental period (3 months), all sheep were fed together on a pasture between milking in the morning and the evening. Every day, after the evening milking, sheep were separated into 4 experimental groups and kept in separate pens until the next morning. In the pens they have received the amount of feed mixtures rationalized experimental that were available until the morning milking. After the morning milking sheep were mixed and put together at pasture. There have been three forage mixtures at the lowest dose resulting from previous experiences with 3 plants and concentrated. For the control group received the same amount of feed concentrates, no added herbs.
Since experimental day 0 and twice a month individual analyzes were performed quantitative coprologice measuring the number of parasite eggs per gram of faeces EPG from gastrointestinal nematodes GIN, for a total of 560 tests. Each day during the sampling from each of the 4 experimental groups was collected in an aggregate sample of faeces to be subjected to coprocultures (28 in total ie 4 day 0 + 2x3x4) for species identification GIN . Effect of experimental diets was evaluated by calculation if there was a reduction in faecal egg, per g of faeces (FeCr) using the formula: FeCr = [(geometric mean EPG in control - the geometric mean EPG animals treated) / control geometric mean EPG] x100.

3. Results and discussions

3.1.Laboratory testing situation regarding the parasitic cargo on investigated lots

Before starting the experiment, were collected and analyzed a faeces sample average from the flock to see the degree of infestation with gastrointestinal nematodes.
The relationship between egg count and GIN load were assesed before the experiment starts with direct parasitological control on a slaughtered ewe of the same flock. The test results showed 4 EPG (Total number of parasitic elements per gram of faeces) on the flok and on the slaughtered ewe and 7 LPG (Total number of larvae per gram of faeces) on the flock respectively 5 LPG on the

slaughtered ewe. In the slaughtered ewe liver were found adult fluke (Fasciola hepatica) larvae (Fig.1.-a and b).

a

b

Fig.1. Adult fluke (Fasciola hepatica) larvae

From the flock (1000 sheep) were selected 80 ewes for experience. The 80 ewes were divided in 4 groups of 20 each. Sheep in each group were marked with a color out to be easily identified.

Table 1. Variation of EPG and LPG during the experimental period

Nr. crt.	Parasitic load / Experimental day	Analysis type	**Livestock**/ sacrificed subject	Lot 1 - control	Lot 2	Lot 3	Lot 4
1	before forming experimental lots	EPG	**4**/4				
		LPG	**7**/5				
2	DAY 0	EPG		5	8	7	4
		LPG		3	3	2	3
3	DAY 15	EPG		18	7	10	2
		LPG		3	2	3	1
4	DAY 30	EPG		16	6	8	2
		LPG		3	2	2	1
5	DAY 45	EPG		14	1	1	1
		LPG		8	1	1	1
6	DAY 60	EPG		15	1	1	0
		LPG		7	1	0	1
7	DAY 75	EPG		18	0	0	0
		LPG		8	2	1	1
8	DAY 90	EPG		20	0	0	0
		LPG		9	1	2	1

EPG = Total number of parasitic elements per gram of faeces
LPG = Total number of larvae per gram of faeces

Every night the sheep were separated into groups and were given feed supplement as follows:
Group 1 (control) - a mixture of: 2.5kg maize, 2.5 kg peas.
Group 2 - a mixture of: 2.5kg maize, 2.5 kg peas, 1.14kg Carum carvi
Group 3 - a mixture of: 2.5kg maize, 2.5 kg peas, 1.16kg Coriandrum sativum
Group 4 - a mixture of: 2.5kg maize, 2.5 kg peas, 0.88kg Satureja montana
Evening after feed supplementation, experimental animals were kept in separate shelters until morning, when they collected fecal samples.
Faeces samples were collected and analyzed on days 0, 15, 30, 45, 60, 75, and 90 of experience.
The methods used were flotation method – Willis and Berman method, along with the sedimentation and repetead washings method.
Variation of EPG (Total number of parasitic elements per gram of faeces) and LPG (Total number of larvae per gram of faeces) during the experimental period are listed in the Table 1.

3.2. Microscopic research

A series of microscopuic analyses were needed to evaluate the evolution of intenstinal parasites during the experiment (Fig.2,3 and 4).

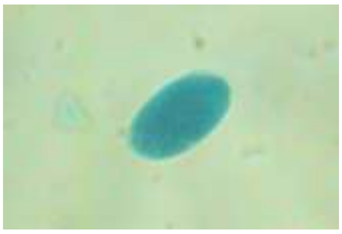


Fig. 2. Gastrointestinal Strongyl egg isolated with Willis method – coloration with lactophenol and toluidin blue – from the initial livestock – objective 20x microphotography with green filter

Fig. 3. Fasciola hepatica egg - lot 1 - 45 days-examination sediment-Ob.10

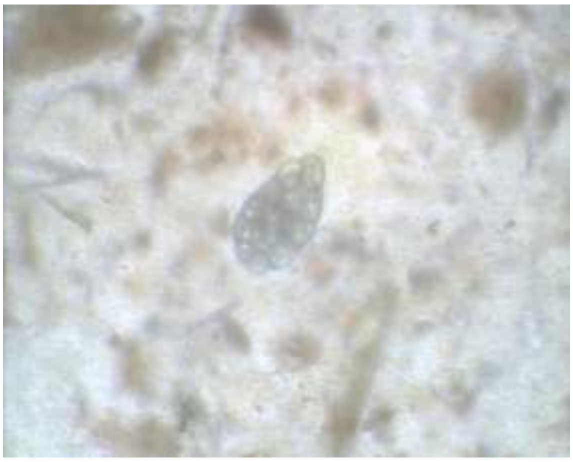


Fig. 4. Fasciola hepatica egg - lot 1 - 60 days - exam sediment - Ob.10 - phase contrast microscopy

3.3. Macroscopic analyses

The following are the 4 animals slaughtered at the end of the experience and appearance of internal organs (Fig. 5,6,7 and 8).

Lot 3 (Coriandrum sativum)

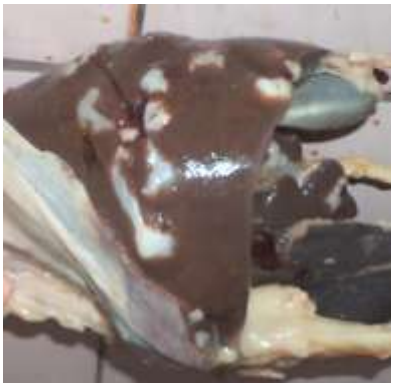
a. **b.**


c.

Fig. 7. a,b,c - We notice (after 90 days) the absence of parasites when given feed that has incorporated *Coriandrum sativum.*

Lot 4 (Satureja montana)


a.


b.


c.

Fig. 8. a,b,c - Angiocolitis parasitary. We notice (after 90 days) the absence of parasites when given feed that has incorporated *Satureja montana*.

Conclusions

(1) The research shows that the total number of parasitic elements per gram of faeces on lots 2, 3 and 4 decreasead from day 0 to day 60 and after day 75 it was practicaly zero.
(2) At the end of experiences (90 days) were not detected adult individuals of *Fasciola hepatica* in slaughtered animals.
(3) Total number of parasitic elements per gram of faeces on control lot varied, with values close to the end of the experience, with the early experience.
(4) At the end of experiences (90 days) were detected adult individuals of *Fasciola hepatica* in slaughtered animal.
(5) Doses of medicinal plants at the doses used in experiments led to the decrease in the number of eggs and larvae in feces compared to control.

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References

[1] Bojor, O., Ghidul plantelor medicinale si aromatice, Ed. Fiat Lux Bucuresti, ISBN 973-9250-68-8, 89-95, 105-107, 2003;
[2] Bojor, O., Popescu, O., Fitoterapie traditionala si moderna, editia a-V-a, Ed Fiat Lux Bucuresti, ISBN 978-973-9250-89-4, 138-169, 2009;
[3] Dobrescu, D., Farmacologie homeopata gennerala, Ed. Minesan Bucuresti, 2007;
[4] Gruia, R., Păşunatul în păduri este o soluţie în zootehnia montană ?, în broşura „Nouăţi privind modalităţile de organizare şi tehnologiile de producţie şi mecanizare pentru dezvoltarea agriculturii în zona montană" Editura Universităţii Transilvania Braşov, Vol.1, 32-35, 2005;
[5] Gruia, R., Nouăţi privind modalităţile de organizare şi tehnologiile de producţie şi mecanizare pentru dezvoltarea agriculturii în zona montană, Editura Universităţii Transilvania Braşov, Vol.1., 35-37, 2005;
[6] Gruia, R., Analiză privind ecoturismul şi plantele medicinale, Al II-lea Simpozion de Etnofarmacologie – Calitatea produselor biologic active şi tehnologii inovative de extracţie, Societatea Română de Etnofarmacologie, Braşov 30 iunie – 2 iulie, 2006;
[7] Gruia, R., Lazurcă, D. Cercetari privind perfectionarea metodelor de extractie a compusilor bioactivi din produse vegetale , A- 8-a editie *Zilele academiei de*

stiinte tehnice din Romania. Universitatea Transilvania din Brasov, 4-5 Octombrie 2013;

[8] James, A.D., Medicinal Herbs, Ed.C.R.C. Press LLC, USA, 2001;

[9] Loufty, B., Medicinal Plants of North Africa, Ref. Publication I.N.C., Michigan, USA, 1983;

[10] Moerman, E.D., Geraniums for the Iroquois (Guide to American Indian Medicinal Plants), Ref. Publications I.N.C. Algonac, Michigan, USA, 1981;

[11] Pastarnac, N., Gruia, R., Nutritia animalelor de blana, Ed. Ceres Bucuresti, 68-76, 1989;

[12] Pop, O.G., Gruia, R., *et al*., Plant species diversity in Sinca Noua área (Brasov county) and some issues regarding the conservation of protected species, Journal of EcoAgriTourism, Publishing Transilvania University of Brasov, Romania, Vol.8, No.1, 25-29, 2012;

[13] Taftă, V.M., Cresterea ovinelor si caprinelor, Ed. Ceres Bucuresti, 2010;

[14] Wijesekera, R.O.B. et al., The Medicinal Plant Industry, C.R.C. Press - USA, Boca Raton A, Arcbor, Boston - London, 1991.

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IRRIGATION, THE METHOD FOR PEDOLOGICAL DROUGHT CONTROL IN THE CONTEXT OF THE SUSTAINABLE TEHCHNOLOGIES IN CROPS FOR GRAINS FROM NORTH-WESTERN ROMANIA, 1976-2012

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Abstract. *The researches were carried out during 1976-2012 in the Agricultural and Development Station Oradea on the preluvosoil.* ***Ten to ten days, the soil moisture was determined and the graphs of the soil water reserve dynamics were realized for the depth 0-50 cm in winter wheat and for the depth 0 - 75 cm in maize, sunflower and soybean. The decrease of the soil moisture bellow easily available water content was considered pedological drought and the decrease of the soil moisture bellow wilting point was considered strong pedological drought. Pedological drought was determined every year and strong pedological drought was determined in 30% of the years studied, generally. The irrigation determined the increase of the plants water consumption values, yield gains very significant statistically, the increase of the yields stability and the improve of the water use efficiency.***

Keywords: crops for grains, irrigation, pedological drought, sustainable technologies

1. Introduction

Drought and desertification are the major problems of the world and United Nations Organization established the day of 27 June like The World Day of Desertification and Drought [1].

In Romania, the areas with desertification are considered Dobrogea and a part of South-Eastern Romania. An important part of Moldova, the Romanian Plain and a smaller area across the border with Hungary are considered the areas with transfer to desertification [2-6].

The drought are the extreme climate phenomena, the most complex and the most known natural hazard. The damages produced include the drought in the

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natural dezasters together with floodings, earthquakes, hurricanes, volcano eruptions. [7,8]

There are a lot of indices for drought characterization. In Romania, meteorological drought is one of the most known indies and 14 consecutive days without rainfall in the cold season (October-March) and 10 consecutive days without rainfall in the warm season are considered the period with meteorological drought. [9,10]

Domuţa C. (2004) proposed a new definition of the pedological drought in link with the one of the most important hydro physics indices: easily available water content. Pedological drought is defined like a period when the soil water reserve on the watering depth is situated bellow easily available water content. In the same time Domuţa C. (2004) proposed the drought indices called "strong pedological drought"; this indices is defined like period when the soil water reserve on the watering depth is situated bellow wilting point; wilting point is understanded like a point from an interval not like a fixe point.[11-14]

The paper presents the results researches obtained during 1976-2012 in the Western Romania at the Agricultural Research and Development Station Oradea, an area considered like a moderate wet one.

2. Materials and Methods

The researches were carried out on the preluvosoil with the following soil profile: Ap = 0-24 cm; El = 24-34 cm; Bt_1=34-54 cm; Bt = 54-78 cm; Bt/c =78-95 cm; C = 95-145 cm.

There is a big hydro stability (47.5%) of the aggregates (Φ = 0.25 mm) on ploughed land; bulk density (1.41 g/cm^3) indicates a low settling and total porosity is median.

On the subjacent depth of the ploughing layer, the bulk density characterizes the soil like moderate and very settled and total porosity is small and very small. Hydraulic conductivity is big (21.0 mm/h) on 0-20 cm; median (10.5 mm/h; 4.4 mm/h) on 20 – 40 cm and 40 – 60 cm and very small (1.0 mm/h) on 60 – 80 cm.

The watering depth (0-75 cm) was a fixed one and field capacity (FC = 24.2% = 2782 m^3/ha) and wilting point (WP = 10.1 = 1158 m^3/ha) have median values. Easily available water content (Wea) was established in function of texture: Wea = WP + 2/3 (FC – WP); (6); their values for 0-75 cm depth are 19.5% and 2240 m^3/ha.

All the soil profile are low acid (6.11 – 6.8), humus content (1.44 – 1.75 %) is small and total nitrogen is low median (0.127 – 0.157). After 35 years of good practices of soil management, the soil phosphorus content became very good (from 22.0 ppm to 150.8 ppm); on ploughing depth, potassium content (124.5 ppm) is median.

The multiannual average (1931-2011) of the annual rainfall were of 613.4 mm, 246.4 mm in the cold season (October- March) and 367.0 mm in the warm season (April - September). The annual average temperature is of the 10.2^{o}C and the air humidity is 78%.

The research field was placed in 1976 and it was one of the 30 research fields placed by the Research Institute for Irrigation and Drainage Băneasa Giurgiu in the all areas with irrigation possibilities for Romania.

The institute research programe called "The exploitation of the irrigation and drainage systems" and it was managed by Grumeza N. The variants studied were unirrigated and irrigated. In the irrigated variant in the research field from Oradea, the soil water reserve on the watering depth (0-50 cm for wheat, 0-75 cm for maize, sunflower, soybean) between easily available water content and field capacity. As consequence the soil moisture was determined ten to ten days and the irrigation was used when the soil water reserve decreased at the level of the easily available water content. Soil moisture was determined by gravimetric method (1976-1985) by gravimetric+neutron method (1985-2000) and by gravimetric method after that.

Using the soil moisture data on the watering depth, the graphs of the soil water reserve dynamics was realized These annual graphs permeted to count the days with soil water reserve bellow easily available water content and bellow wilting point.

3. Results and Discussions

3.1. Pedological drought and strong pedological drought in unirrigated winter wheat, Oradea 1976-2011

In the irrigation systems from Romania, a fixe watering depth was used and is used. In North Western Romania, Domuţa C. (2005) recomands 0-50 cm in unirrigated wheat; the soil water reserve on the watering depth decreased bellow easily available water content every year of the period 1976-2012; in 30% from year studied the soil water reserve decreased bellow wilting point. The biggest number with pedological and strong pedological drought were registered in June (Table 1)

Table 1.Pedological drought (PD) and strong pedological drought (SPD) in unirrigated winter wheat, Oradea 1976-2012

Specification	April	May	June	July	Total April-June
Pedological drought (PD)					
Number of days with PD	13.1	22.1	23.5	9.3	59
Frequency of the PD	28	96	100	69	100
Strong pedological drought (SPD)					
Number of days with SPD	-	1.7	5	2	6.8
Frequency of the SPD	-	18	30	18	30

3.2. Pedological drought and strong pedological drought in unirrigated maize

Pedological drought was determined starting with the April, sowing months in maize from North Western Romania. The biggest number with pedologial drought was determined in August; in August the biggest frequency of the pedological drought (100%) was determined, too. In the maize irrigation season (April-August) a number of 77.5 days with pedological drought was determined (Table 2).

Strong pedological drought was determined starting with July and the frequency of the phenomenon was 34%. August was the month with the biggest frequency of the strong pedological drought (table 2).

Table 2. Pedological drought (PD) and strong pedological drought (SPD) in unirrigated maize, Oradea 1976-2012

Specification	April	May	June	July	August	September	Total April-August
Pedological drought (PD)							
Number of days with PD	1.7	8.6	14.4	23.5	29.3	25.8	77.5
Frequency of the PD	14	41	79	89	100	93	100
Strong pedological drought (SPD)							
Number of days with SPD	-	-	-	3.3	7.6	4.5	10.9
Frequency of the SPD	-	-	7	28	34	24	34

3.3. Pedological drought and strong pedological drought in unirrigated sunflower, Oradea 1976-2011

In the all vegetation period of the sunflower, the pedological drought was determined: the biggest number of days with pedological drought (27.3) and the highest frequency (100%) was determined in August. A big number of days with pedological drought (27.0) and a high frequency (96%) of the phenomenon were registered in July, the month with the maximum values of the optimum water consumption (table 3).

Table 3.Pedological drought (PD) and strong pedological drought (SPD) in unirrigated sunflower, Oradea 1976-2012

Specification	April	May	June	July	August	Total April-July
Pedological drought (PD)						
Number of days with PD	2.1	11	18.8	27	27.3	58.9
Frequency of the PD	4	44	92	96	100	100
Strong pedological drought (SPD)						
Number of days with SPD	-	-	1.3	5.4	8.7	15.4
Frequency of the SPD	-	-	16	28	38	38

3.4. Pedological drought and strong pedological drought in unirrigated soybean, Oradea 1976-2012

Pedological drought was determined every year. The biggest number with pedological drought was registered in August, 27.2 days; it is followed by the July with 21.6 days. The frequency of the phenomenon was of 100% in August and of 93% in July (Table 4).

In the soybean irrigation season, the strong pedological drought was determined in June (14% from year studied), in July (30% from years studied) and in August (37% from years studied) (Table 4)

Table 4. Pedological drought (PD) and strong pedological drought (SPD) in unirrigated soybean, Oradea 1976-2012

Specification	April	May	June	July	August	September	Total April-August
Pedological drought (PD)							
Number of days with PD	-	7.2	13.5	21.6	27.2	18.0	69.5
Frequency of the PD	-	55	76	93	100	79	100
Strong pedological drought (SPD)							
Number of days with SPD	-	-	1.2	4.7	8.6	9.2	14.5
Frequency of the SPD	-	-	14	30	37	40	37

3.5. Pedological drought influence on plants water consumption

In comparison with the variant where the soil water reserve on watering depth was maintained between easily available water content and field capacity, in the unirrigated variants the values of the daily water consumption of the plants decreased.

The biggest differences were registered in June in winter wheat and in August in maize, sunflower and soybean (Table 5).

Table 5. Pedological drought influence on plants water consumption, Oradea 1976-2012

Crop	Variant	Daily water consumption											
		April		May		June		July		August		September	
		mm/ha	%	mm /ha	%	mm /ha	%	mm /ha	%	mm/ ha	%	mm/ ha	%
Winter wheat	Optimum irrigation	3.09	100	4.50	100	4.89	100	2.04	100	-	-	-	-
	Unirrigated	2.59	84	3.26	72	3.33	68	1.69	83	-	-	-	-
Maize	Optimum irrigation	1.81	100	3.04	100	4.15	100	6.09	100	4.80	100	2.65	100
	Unirrigated	1.53	85	2.58	85	3.59	86	3.99	66	2.70	56	1.62	61
Sunflower	Optimum irrigation	2.08	100	3.07	100	5.37	100	6.00	100	3.79	100	1.99	100
	Unirrigated	1.90	91	2.73	88	3.99	74	3.82	64	2.03	54	1.61	81
Soybean	Optimum irrigation	-	-	2.81	100	4.29	100	5.59	100	4.61	100	2.30	100
	Unirrigated	-	-	2.68	99	3.67	86	3.74	67	2.19	48	1.74	76

Tabel 6. Pedological drought influence on total water consumption -∑ (e+t) – in crops for grains from Crisurilor Plain, 1976-2012

Crop	Variant	∑ (e+t)		Covering sources of the water consumption				
				Soil reserve	Rainfall	Irrigation		
		mm/ha	%	mm/ha	mm/ha	mm/ha	%	Variation interval %
Winter wheat	Optimum irrigation	432.9	100	48.5	235.4	149.0	34	0-54
	Unirrigated	316.0	73	80.6	235.4	-	-	-
Maize	Optimum irrigation	630.0	100	53.6	327.9	245.2	39	7.4-61.2
	Unirrigated	434.3	69	106.4	327.9	-	-	-
Sunflower	Optimum irrigation	591.7	100	95.4	281.9	215.3	36	6-63
	Unirrigated	399.4	68	117.3	281.9	-	-	-
Soybean	Optimum irrigation	589.3	100	57.3	308.9	223.5	38	7-64
	Unirrigated	391.9	66	83.6	308.3	223.5	-	-

As consequence, the pedological drought determined the decrease of the values of the plants water consumption in comparison with optimum irrigated variant with 34% in soybean, with 32% in sunflower, with 31% in maize and with 17% in winter wheat.

In optimum water consumption of the plants the irrigation contribution was of 39% in maize, of 38% in soybean, of 36% in sunflower and of 34% in winter wheat. In the covering sources of the optimum water consumption, the irrigation participated with 34% (variation interval 0 - 54%) in winter wheat, with 39% (variation interval 7.4 – 61.2%) in maize, with 36% (variation interval 6- 13%) in sunflower and with 38% (variation interval 7 - 64%) in soybean. (Table 6).

3.6. Pedological drought influence on yield level and stability and on water use efficiency

Pedological drought determined an average of the yield decrease in comparison with the optimum irrigated variant of 44% in maize, of 42% in soybean, of 33% in sunflower and of 28% in winter wheat.

Yield stability of the yields was smaller in the unirrigated variants in comparison with optimum irrigated variant, as consequence the standard deviation values increase in the variants with pedological drought, the relative difference were of 74% in maize, of 49% in soybean, of 44% in winter wheat and of 9% in sunflower (Table 7).

Water use efficiency had the smaller values in the variant with pedological drought in comparison with the variants with optimum irrigation; the differences were of 19% in maize, of 13% in soybean, of 2% in sunflower and of 1% in winter wheat. (Table 8).

Table 7. Pedological drought influence on yield in the crops for grains, Oradea 1978-2012

Crop	Variant	Yield			Standard deviation	
		Average		Variation interval		
		kg/ha	%	kg/ha	kg/ha	%
Winter wheat	Unirrigated	6399	100	3993-8300	642	100
	Irrigated	4620	72	2736-7100	922	144
LSD 5%= 230; LSD 1%=370; LSD 0,1%= 630						
Maize	Unirrigated	12232	100	7850-16480	1879	100
	Irrigated	6870	56	1510-11840	3271	174
LSD 5%= 370; LSD 1%=490; LSD 0,1%= 720						
Sunflower	Unirrigated	3470	100	1757-4580	530	100
	Irrigated	2330	67	1350-3140	580	109
LSD 5%= 210; LSD 1%=380; LSD 0,1%= 720						
Soybean	Unirrigated	3130	100	1380-4048	547	100
	Irrigated	1806	58	300-3400	814	149
LSD 5%= 190; LSD 1%=310; LSD 0,1%= 640						

Table 8. Pedological druoght influence on water use efficiency (WUE) in the crops for grains, Oradea 1976-2012

Crop	Variant	WUE		
		Average		Variation interval
		kg/mm	%	kg/mm
Winter wheat	Optimum irrigation	14.8	100	6.8-24.6
	Unirrigated	14.6	99	4.9-24.5
Maize	Optimum irrigation	19.4	100	10.7-25.7
	Unirrigated	15.8	81	3.1-24.8
Sunflower	Optimum irrigation	5.8	100	3.1-8.9
	Unirrigated	5.9	98	2.6-8.1
Soybean	Optimum irrigation	5.3	100	-
	Unirrigated	4.6	87	-

Conclusions

The researches carried out during 1976-2012 in Oradea, in the moderate wet area, determined the following conclusions:

(1)Ten to ten determinations of the soil moisture and the graphs of the soil water reserve dynamics permeted to establish the number of days with pedological drought and strong pedological drought. The pedological drought is considered to be decrease of the soil water reserve on watering depth bellow the easily available water content; the strong pedological drought is considered to be the decrease of the soil water reserve on watering depth below wilting point.

(2)In unirrigated conditions the pedological drought was registered every year and strong pedological drought was registered in 30% of years studied in winter wheat, in 34% in maize, in 38% in sunflower and in 37% in soybean.

(3)Pedological drought determined the smaller values of the daily water consumption of the plants; the biggest differences in comparison with the daily water consumption from the variants with optimum irrigation were registered in June for wheat and in August for maize, sunflower and soybean. As consequence, the pedological drought determined the decrease of the total water consumption values.

(4)In average, for optimum water consumption, the irrigation participated with 34% in winter wheat, with 39% in maize, with 36% in sunflower and with 38% in soybean.

(5)In comparison with the optimum irrigated variant, the pedological drought determined the smaller yield with 44% in maize, with 42% in soybean, with 33% in sunflower and with 28% in winter wheat. The yields stability was smaller in the unirrigated variants and as consequence the values of the standard deviation increased with 44% in winter wheat, with 74% in maize, with 9% in sunflower, with 49% in soybean.

(6)The irrigation determined a bigger quantity of the yields for every one milimeter of the water used. Pedeloggical drought determined a smaller values of the water use efficiency with 1% in winter wheat, with 19% in maize, with 2% in sunflower and with 13% in sunflower.

References

[1] Lloyd-Hughes , B., Saunders, M. A. A drought climatology for Europe, International Journal of Climatology, pp.1571–1592, 15, 2002;

[2] Cattivelli, L. *et al.*, Drought tolerance improvement in crop plants: An integrated view from breeding to genomics, Field Crops Research, Vol. 105, Issues 1–2, 2 Jan, pp.1–14. , 2008;

[3] Domuţa, C., Oportunitatea irigaţiilor în Câmpia Crişurilor, Ed. Universităţii din Oradea, pp. 165-196, 2003;

[4] Domuţa, C., Irigarea culturilor, Editura Universităţii din Oradea, pp. 256-260, 2005;

[5] Domuţa, C., Tehnică experimentală, Ed. Universităţii din Oradea, pp. 112-150, 2005;

[6] Domuţa, Cr., Cercetările privind irigarea soiei în Câmpia Crişurilor. Ed. Universităţii din Oradea, pp. 45-120, 2012;

[7] Heim, R.R, Drought: a global assessment. pp 159-167, 2000;

[8] Pengxin, W., Zhengming, W., Jianya, G., Xiaowen, L., Jindi, W., Advances in Drought Monitoring by Using Remotely Sensed Normalized Difference Vegetation Index and Land Surface Temperature Products Advances in Earth Science, Vol.18(4), pp.527-533, 2003;

[9] Domuţa, C., Irigarea culturilor, Editura Universităţii din Oradea, pp. 95-124, 2009;

[10] Domuţa, C., (coord.), Irigaţiile în Câmpia Crişurilor, Ed. Universităţii din Oradea, 2009;

[11] Brejea,R., Ştiinţa solului – îndrumător de lucrări practice. Ed. Universităţii din Oradea, pp. 84-105, 2010;

[12] Brejea, R., Practicum de pedologie, Editura Universităţii din Oradea, 2011

[13] Domuţa, Cr., Subasigurarea cu apă a porumbului, soiei şi sfeclei de zahăr din Câmpia Crişurilor, Ed. Universităţii din Oradea, pp.142-161, 2011;

[14] Borza, I., Valorificarea apei de către cultura porumbului din Câmpia Crişurilor Ed. Universităţii din Oradea, pp. 75-112, 2007;

[15] Borza, I., Stanciu, A., Fitotehnie. Ed. Universităţii din Oradea, pp. 332-352, 2010.

RESEARCHES ON RATIONAL UTILIZATION OF IMPROVED GRASSLANDS FROM MOUNTAIN REGION

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Abstract. *The inappropriate utilization of mountain grasslands, absence of improving works and fertilization, etc., had leaded to degradation, on various stages of grassy carpet, due to the invasion of species with low nutritional value. Among those are the degraded Nardus stricta grasslands, spreaded on large surfaces. In this paper are shown the results on botanical composition, fodder quality, milk quantity and quality, agrochemical indices, etc., obtained on Nardus stricta grasslands improved by different methods starting from 1995 and rationally used for 18 years. Researches have been carried out at Research Base for Mountain Grasslands (RBMG) Blana-Bucegi, at 1800 m altitude, in Bucegi Plateau on a slight tilted terrain with Eastern exposure located at the base of Blana Peak (1875 m). The improving methods had profoundly changed the botanic composition from experimental field, influencing positive the milk production, that reached values up to 3,8 times higher at improved plots compared with the control variant.*

Keywords: *Nardus stricta* grasslands, improving, milk production, quality

1. Introduction

Animal husbandry on subalpine grasslands is a very important economical solution to use these forage resource [3].

The domestic animals kept on those pastures for 80-100 days are providing better productions compared to the ones from lower altitudes, with no other supplementary feeding, excepting the fodder from grasslands [1, 4].

Transhumant herding is still present and has even intensified on the accessible mountains, like Bucegi Massif [2].

On these surfaces it can be used improvement methods, determining higher yields, a substantial improvement of botanical composition and implicitly of fodder quality [6, 7].

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An example on improvement measures and rational use by cow grazing the subalpine grasslands it can be found at Research Base for Mountain Grasslands (RBMG) Blana Bucegi.

RBMG Blana Bucegi is located on the Bucegi Mountains Plateau, on the South side, between Blana (1875 m) and Nucet (1863) Peaks, at an altitude of 1800 m with a slight slope and Eastern exposure (Photo 1).

Photo. 1. Image of location of Research Base for Mountain Grasslands (processed image, www.bing.com/maps)

2. Material and method

Experimental plots (Photo 2):

1. **Plot Ac**: *Nardus stricta* natural grassland fertilized with:
   - 200 kg /ha N + 100 kg /ha P_2O_5 +100 kg/ha K_2O in 2000
   - 150 kg /ha N + 75 kg /ha P_2O_5 +75 kg/ha K_2O in 2001
   - 100 kg /ha N + 50 kg /ha P_2O_5 +50 kg/ha K_2O in 2002
   - 150 kg /ha N + 100 kg /ha P_2O_5 +100 kg/ha K_2O in 2010
   - 100 kg /ha N in 2011
   - 50 kg /ha N in 2012
2. **Plot B**: *Nardus stricta* natural grassland fertilized with 150 kg/ha N + 75 kg/ha P_2O_5 + 75 kg/ha K_2O over a period of three years (1996-1998), followed by paddocking with dairy cows in 2004 and 2010.

3. **Plot C**: *Nardus stricta* natural grassland limed up to 2/3 from hydrolytic acidity (in 1995), fertilized in three years (1996-1998) with 150 kg /ha N + 75 kg /ha P_2O_5 +75 kg/ha K_2O, followed by paddocking in 2003 and 2009
4. **Plot D**: sown grassland, limed in 1995, fertilized with minerals (NPK) in 1996-1998 period identic as B and C plots, followed by paddocking with cows in 2002 and 2008

Sown mixture consists in: *Phleum pratense* Favorit variety (40%), *Festuca pratensis* Transilvan variety (25%), *Lolium perenne* Marta (5%), *Trifolium hybridum* – Brasov local variety (15%), *Lotus corniculatus* Livada (15%).

5. **Plot T**: *Nardus stricta* grasslands, rationally used within 30 years, located in the interior of experimental field from Research Base for Mountain grasslands Blana Bucegi.

All experimental plots have been grazed by dairy cows, Schwyz breed (Maramures Brown), adapted to harsh mountain conditions, with a proper health situation and a uniform milk production (12-14 l/livestock unit), being excluded the primiparous cows and the old ones.

Grazing system was free (continuous), with a stocking rate of 4 livestock units (LU) per hectare (3 cows/plot) in Ac, B, C and D and 1,5 LU/ha in T plot.

Photo. 2. Experimental plots from Research Base for Mountain Grasslands (photo by V.A. Blaj)

In order to determine the yield and to take samples for assessing the fodder quality there have been placed 3 cages, in all experimental plots, each with a 2 square meters surface in three replicates.

The harvesting was done once a year, in the first decade of August, during the blooming of grass species.

Chemical analyses in order to determine de fodder quality have been done at the chemical laboratory from Research and Development for Grasslands Brasov and the soil samples by the Office of Pedological and Agrochemical Studies Brasov.

The milk production/ dairy cow was determined on every week by measuring the milk quantities from the milking process on Wednesday evening and Thursday morning.

For determining the quality for each experimental year, once every two weeks, milk samples have been taken,. The samples have been analyzed in order to determine the main physicochemical parameters, using a quick milk analyzer, Ekomilk Total type.

3. Results and discussions

3.1. Yield and the fodder quality obtained in 2013

Dry matter yield (DM) obtained for each experimental plot registered a great variation. DM had values between 1,42 t/ha, for T plot (control – natural grassland) up to 3,74 t/ha, for D plot (sown grassland) with an average of all plots of 2,84 t/ha. The differences between the yields from improved plots, compared to the control plot are statistically assured at DL 0,1% - very significant positive difference (Figure 1). Differences registered also between the improved plots. Thus the difference between D and Ac plots was of 0,70 t/ha and 0,92t/ha between D and B plots.

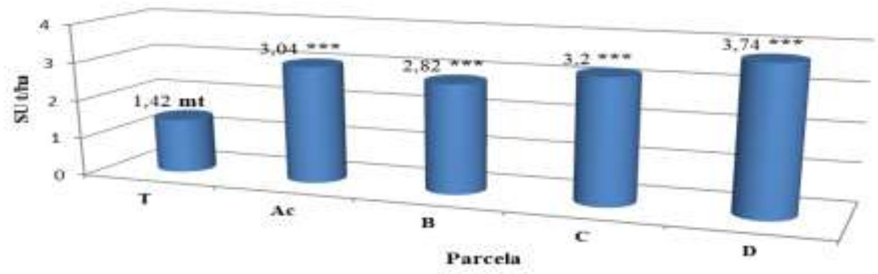

Fig. 1. Dry matter yields of experimental plots, Blana, Bucegi 2013

After the quantitative determinations, to estimate the fodder quality, each weighing 200 g, from all cages located in the experimental plots, samples have been taken.

The nutrients have been determined using the Gerhardt System for determining the fiber fractions and total nitrogen, the organic matter digestibility coefficients by Near Infrared Spectroscopy (NIRS)

The results (average for every plot) of chemical analyses of fodder samples as well as the DM yield are shown in table 1.

Table 2. Results of chemical analyses from the experimental plots, Blana Bucegi, 2013

Plot	*Dry matter, t/ha*	*Crude protein,%*	*Ash, %*	*Crude fiber,%*	*ADF,%*	*ADL,%*	*NDF,%*	*DMD,%*	*OMD,%*
T	1.42	12.53	8.73	27.30	30.83	3.30	50.07	69.77	66.57
Ac	3.04	12.67	8.00	29.90	34.43	4.00	54.20	61.73	58.10
B	2.82	11.70	7.57	32.13	36.70	4.10	56.40	61.33	57.80
C	3.20	12.53	8.30	28.77	33.20	4.10	52.53	65.37	61.57
D	3.74	12.33	7.33	30.50	34.60	3.40	53.87	65.40	61.63
Average	2.84	12.75	7.99	29.72	33.95	3.78	53.41	64.72	61.13

Crude protein content registered small variation between experimental plots, ranging from 11,70 to 12,67%, characterizing a fodder with a medium nutritional value. But regarding the DM obtained at each plot, the crude protein quantity was of 461 kg/ha at D plot (sown – fertilized - limed) meaning with 159% higher than control plot – T (Table 6). Mineral content had values around 8% with variations between 7,33% at D plot and 8,73% (T plot).

Cellular walls content (ADF, NDF, ADL) registered small variations. The average NDF content was 53,41% of DM, with small variations (50,07% – 56,40%) characterizing a fodder with a medium nutritional value. Dry matter digestibility (DMD) coefficients of analyzed samples had medium to good values (61,33-69,77).

The nutritional values of analyzed samples were medium due to the advance vegetation phase when the samples were taken. We have to keep in mind that the samples have been taken from un-grazed surfaces and the values are just as guides. The fodder consumed by animals surely has a higher nutritional value, considering the possibility of a selective and repeated grazing of species with higher nutritional values and so with a better digestibility.

3.2. Botanical composition of the grassy carpet and the soil agrochemical indices

The use of technological methods on subalpine grasslands had led to a change of botanical composition, by the appearance of species with a higher pastoral value, and the improvement of nutritional condition for present species and the reduction of *Nardus stricta* participation rate on grassy carpet.

Table 3. Botanical composition of improved *Nardus stricta* grasslands after 18 years of grazing, Blana Bucegi, 2013

% participation

Species	***Plot***				
	T	**Ac**	**B**	**C**	**D**
GRASSES total	**74**	**68**	**69**	**65**	**74**
Spontaneous	74	68	69	65	64
Nardus stricta	15	2	4	-	-
Festuca nigrescens	20	10	12	17	2
Festuca ovina	5	2	+	+	+
Agrostis rupestris	10	8	7	1	3
Agrostis capillaris	+	7	18	13	32
Phleum alpinum	2	8	5	4	+
Poa media	5	22	2	2	+
Poa pratensis	13	+	14	26	23
Poa annua	+	+	+	+	-
Anthoxanthum odoratum	+	6	+	+	-
Deschampsia flexuosa	2	3	2	+	-
Deschampsia caespitosa	+	+	5	3	4
Sown	**2**	**-**	**-**	**-**	**10**
Phleum pretense	2	-	-	-	7
Festuca pratensis	-	-	-	-	3
LEGUMINOASE total	**6**	**4**	**8**	**15**	**18**
Trifolium repens	6	4	8	15	18
OTHER FAMILIES total	**20**	**28**	**23**	**20**	**8**
Potentilla aurea	7	4	3	1	+
Ligusticum mutellina	10	5	2	1	+
Ranunculus montanum	1	1	+	2	2
Polygonum bistorta	1	15	15	12	1
Hieracium aurantiacum	+	+	+	+	-
Campanula napuligera	1	2	1	1	+
Taraxacum officinale	+	+	2	2	2
Achillea millefolium	+	+	+	+	+
Alchemilla sp.	+	+	+	1	3
Other species	+	1	+	+	+
***Pastoral value**)**	**40**	**26**	**42**	**52**	**61**

*) Good: 50-75 points; Medium: 25-50 points; Low: 5-25 points

At limed plots (C and D) *Nardus stricta* species is totally replaced by valorous spontaneous species (C plot) or sowed species (D plot). A diverse botanical composition can ensure a milk with special organoleptic qualities. The degree of participation of white clover (*Trifolium repens*) in the grassy carpet has growth, reaching values of 15 to 18%, with good influence on fodder quality and on biological nitrogen fixation.

Another positive aspect is the participation degree of Kentucky bluegrass (*Poa pratensis*), that reaches values of 13% to 26%, a species with good fodder qualities for the subalpine climate.

The pastoral value (PV) of experimental plots, in according with the nutritional value of the species from grassy carpet ranged between 26 to 52%. The D plot (fertilization – liming - sowing), with a PV = 61 points and C plot (fertilization - liming), with a PV of 52 points, are remarkable. These values prove the higher level of fodder quality for studied grasslands, when liming is used along with other improvement methods.

As a result of improvement methods and rational utilization, also modifications on the soil chemical composition are appearing (Table 3).

The soils are still having a strong acid pH (5,1) with a high content of mobile aluminum (2,14).

It can be seen a substantial growth of phosphorous content in soil as a result of chemical fertilization and paddocking. Regarding the potassium, the content in soil for this element is variable with no correlation with experimental plots.

Table 4. Soils agrochemical indices from experimental plots, Blana Bucegi, 2013

Plot	***Analysis / MU***								
	pH	Al me/ 100 g soil	Ah me/ 100 g soil	SB me/ 100 g soil	V %	H %	TN %	P ppm	K Ppm
T	5,1	1,740	14,9	8,7	36,8	9,54	3,51	22,0	116,5
Ac	4,8	3,640	23,5	10,8	29,7	12,15	3,60	25,5	148,0
B	4,9	3,440	22,1	10,4	32,0	15,39	4,92	46,0	237,0
C	5,5	0,460	13,5	19,9	59,5	12,60	7,49	106,0	250,0
D	5,2	1,400	23,3	11,2	32,4	10,26	3,32	37,0	240,0
Average	5,1	2,136	19,46	12,2	38,08	11,988	4,568	47,3	198,3

3.3. Milk production

Within the grassland utilisation, presentation of the results in animal product units (ex. milk quantities, live unit gain, etc.) permit us to evaluate more objectively the economic potential of those surfaces.

In Table 4 it is showed the milk production evolution during the grazing season (72 days in 2013) from the subalpine grasslands on RBMG Blana, Bucegi. The average milk quantity varies from one decade to other, being higher on the first 4 decades (11,2 – 13,8 liters/day/dairy cow) and lower on the last 4 decades (6,2 – 8,9 l/day/dairy cow).

Fat and protein productions registered the same variation as milk production. This is due to the fact that the fat and protein content had very small variation during the grazing season.

Table 5. Average cow milk production, Blana Bucegi, 2013

(Grazing period – 72 days)

Mounth	***Decade***	***No. of days***	***Plot***					*Average*
			T	**A_C**	**B**	**C**	**D**	
June	II (12-20)	9	10,7	14,3	13,5	15,3	15,0	13,76
	III (21-30)	10	10,1	12,0	11,4	12,3	14,1	11,98
	Average	**19**	**10,4**	**13,1**	**12,4**	**13,7**	**14,5**	12,82
Julie	I (1-10)	10	9,8	12,5	11,6	14,3	15,0	12,64
	II (11-20)	10	9,3	10,8	9,5	12,1	14,2	11,18
	III (21-31)	11	8,1	7,6	8,4	10,1	10,5	8,94
	Average	**31**	**9,0**	**10,2**	**9,8**	**12,1**	**13,1**	10,86
August	I (1-10)	10	7,3	8,7	8,4	9,3	11,0	8,94
	II (11-20)	10	6,6	7,3	7,2	8,6	9,3	7,80
	III (21-22)	2	5,2	5,6	6,3	6,7	7,2	6,20
	Average	**22**	**6,8**	**7,8**	**7,7**	**8,7**	**9,9**	8,17
Average (Total)		**72**	**8,7**	**10,2**	**9,8**	**11,5**	**12,5**	10,56
Animal load LU/ha			**1,5**	**4**	**4**	**4**	**4**	
Milk production over 72 days			**943**	**2938**	**2825**	**3324**	**3606**	

From the study of milks physicochemical characteristics resulted that over the all grazing period, the values are in normal limits, with no notable differences between experimental plots (Table 5). The difference is registered only from quantitative point of view.

Table 6. Cow milk analyses results, Blana Bucegi, 2013

Plot	Fat %	DMF*) %	Density	Protein %	Freezing point ^{0}C	Lactose %	pH
T	3,60	8,58	1,0285	3,24	-0,564	4,71	6,62
Ac	3,95	8,66	1,0286	3,27	-0,567	4,72	6,67
B	3,86	8,74	1,0292	3,31	-0,571	4,66	6,64
C	4,03	8,81	1,0290	3,33	-0,574	4,82	6,63
D	3,61	8,67	1,0290	3,27	-0,569	4,76	6,62
Average	3,81	8,69	1,0289	3,28	-0,569	4,73	6,63

***)** Dry matter without fat

3.4. Feed conversion efficiency in milk production

Researches carried out over different altitudinal levels estimated that the milk production for every individual animal drops with 0,4l/100 m due, mainly, to climatic conditions. On those conditions, the specific intake for producing one liter of milk grows with 0,05 kg DM/l for each 100 m altitude, thus from approximately 10.000 l/ha produced at 600-800 m, reaches only 5.000 l/ha at 1600-1800 m altitude for a grazing period of only 85 days [5].

In 2013 on subalpine grasslands it was registered a conversion ratio better than the one from 2012 (Table 6). The average dry matter intake for producing a liter of milk was of 1,1 kg. At the improved plots the feed intake was of 1,0 kg and at control plot of 1,5 kg/l. Analyzing the protein conversion ratio, results an average intake of 137 grams for a liter of milk, with variations ranging from 117 to 189 g depending on the experimental plot. For one kg of fat it takes, on average, 29 kg of DM, lower in case of improved plots (24-29 kg DM/1 kg of fat). Average protein conversion ratio is of 4,0/1, lower (3,3/l) at D plot and higher (5,7/l) at control plot (T).

Table 7. Feed conversion ratio indices on subalpine grasslands, Blana Bucegi, 2013

Specification	MU	Plot					Average
		T	Ac	B	C	D	
DM yield	t/ha	1,42	3,04	2,82	3,20	3,74	2,84
	%	100	214	199	225	263	x
CP yield from fodder	kg/ha	178	385	330	401	461	351
	%	100	216	185	225	259	x
Milk production	L/ha	943	2938	2825	3324	3606	2727
	%	100	312	300	3352	382	x
Fat from milk	kg/ha	34	117	109	136	131	105
Milk protein	kg/ha	31	97	94	111	118	90
Kg SU for 1 L milk	Kg/L	1,5	1,0	1,0	1,0	1,0	1,1
g PB for 1 L milk	g/L	189	131	117	121	128	137
Kg SU for 1 Kg fat		42	26	26	24	29	29
Protein ratio from fodder/ milk protein		5,7/1	4,0/1	3,5/1	3,6/1	3,3/1	4,0/1

Conclusions and recommendation

By promoting the improvement methods and rational utilization of subalpine grassland from Research Base for Mountain Grasslands (RBMG) Blana Bucegi, with dairy cows, have been obtained dry matter yields ranging from 1,42t/ha at control plot up to 3,74 t/ha at sown grassland; milk production was of 943 l/ha at the control plot and of 3606 l/ha at the plot sown-limed-fertilized.

Establishment of reseeded pastures (var. D) in specific sub-alpine conditions of degraded grasslands by *Nardus stricta* species, cane by an indirect solution to protect biodiversity in the mountainous area. Such, it can achieve a higher animal stocking rate in these areas, avoiding the animal access in the protected area where there are rare species (endemism) and grazing is prohibited.

Improvement of permanent grasslands from subalpine level by liming, paddocking combined with mineral fertilization with phosphorous (C plot) represents the combination that we recommend for increasing the yields and also milk production.

References

[1] Bărbulescu C., Gh. Motcă, 1983, Păşunile munţilor înalţi, Editura Ceres, Bucureşti;

[2] Blaj V.A., 2009, *Cercetări privind ameliorarea și valorificarea superioară a pajiștilor subalpine din Munții Bucegi*, Teza de doctorat, USAMV București;

[3] Burcea P., Marușca T., Neagu M., 2007, *Pajiștile Montane din Carpații României*, Editura Amanda Edit, ISBN 973-87447-7-6;

[4] Cernelea E., C. Bistriceanu, 1977, *Cultura şi exploatarea pajiştilor montane,* Editura Ceres, Bucureşti;

[5] Marusca T. coordonator, 2010, *Tratat de reconstrucţie ecologică a habitatelor de pajişti şi terenuri degradate montane,* Editura Universitatii "Transilvania " din Brasov, ISBN 978-973-598-787-9;

[6] Maruşca T., J. Frame, 2003, *Pasture improvement strategies in the Carpathians pacage with dairy cows,* EGF, Bulgaria, Optimal Forage Systems for Animal Production and the Environment, Grassland Science in Europe, vol.8, 219-221;

[7] Maruşca T.,2004, *Gospodărirea ecologică a pajiştilor montane,* Broşură, CEFIDEC Vatra Dornei, 75 p.

NEW TECHNOLOGICAL SOLUTIONS FOR GRASSLAND IMPROVEMENT BY OVER SOWING METHOD

Tudor Adrian ENE[1], Vasile MOCANU[2]

Abstract. *In this paper new technological solutions for mechanization of grassland farming are presented. Technological alternatives are focused on mechanization of over sowing operations for improvement of degraded grasslands invaded by hummocks of different sizes and density rates or invaded both of non-value vegetation and hummocks.New technological alternatives for mechanization of the over sowing operations are based on complex aggregates, using the current research results from agricultural engineering. The utilization of the complex farming aggregates provide realization of 2 or 3 operations by one passing machine, while within usual variants are used simple aggregates, achieving one operation by one pass. In comparison with usual variants, the new technological solutions of mechanization require less fuel consumptions, lower necessary labour force and reduced passing number.*

Keywords: technological variants, over sowing, improvement, equipment, machines.

1. Introduction

The operation of grassland over sowing (direct drilling) consist of introducing the grass and legume seeds into the soil, where competition from the existing sward can be diminished.

The over sowing of degraded grasslands is a rapid, economic and certain method for improvement of degraded grasslands, being succesfully suitable on surfaces, such as: less density of grass sward; the soils where the total tillage (ploughing, rotary cultivating etc.) isn’t possible and there is risk of decreasing the soil portability and animal stocking rate; eroded and sliding grounds; nude terrains after the control of non-value wood vegetation and hummocks leveling operation; paddocking surfaces [2].

New technological solutions of mechanization of over sowing workings are based on complex farming aggregates, using current research results from agricultural engineering as fertilizer equipments, EF 2,5 and EF 3,75 type,

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equipment for herbicide on bands, EEB 2,5 type, respectively sowing equipment, ESR 3,75 type and specific machinery and equipments for grassland farming.

2. Materials and methods

The over sowing technology of the degraded grasslands is intended to: realising the optimum conditions for plant growing; diminishing the competition of the old vegetation; over sowing and grassland utilization after over sowing operation.

For realizing the optimum conditions for plant growing, operation involves: liming, phosphorus and potassium fertilizing and non value vegetation, hummocks and stones clearing.

The control of the competition from the old grass sward must be done both before and after over sowing operation.

The new technological solutions, in comparison with usual technology, use complex aggregates providing the realization of 2 or more operations by one pass, and so less passing number.

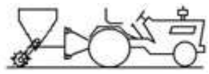
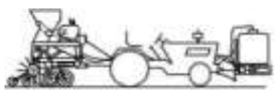
Thereby, depending on work conditions and grassland degradation level, can be used aggregates as: clearing the hummocks and old vegetation simultaneously with fertilising; clearing simultaneously with over sowing; diminishing the old grass sward competition before over sowing simultaneously with fertilization; over sowing simultaneously with diminishing the old grass sward competition [1].

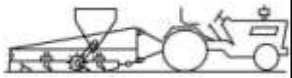
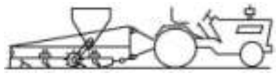
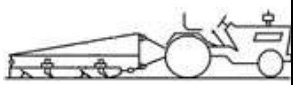
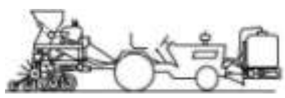
Depending on stationary area conditions, can be met next situations:
a-degraded grassland with hummocks: **see Figure 1**;
b-degraded grassland with large hummocks and high density level: **see Figure 2**;
c-degraded grassland because both non value vegetation and hummocks: **see Figure 3**.

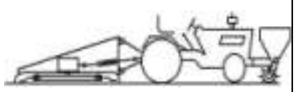
In table 1, new tehnological solutions for mechanization of grassland over sowing in according with working conditions and degradation stage of grassland (a, b or c), are schematically presented [1].

Usual technology for over sowing the degraded grasslands uses aggregates providing the realization of one operation by one pass machine. Depending on the stationary area conditions and operation, are used specific equipment and machinery or suitable for other crops such us: for clearing the hummocks, micro uneven grounds and animal excrement spreading, equipment for grassland levelling; for diminishing the old grass sward competition by clearing the hummocks, micro uneven grounds and animal excrement spreading, machine for grassland clearing MCP 2,5 type; for clearing the hummocks and non value vegetation, machine for grassland clearing MCP 2,5 type; for spreading the chemical fertilizer, machine MIC 500 type; for over sowing, direct drilling machine for over sowing the degraded grassland MSPD 2,5 type; for diminishing the old grass sward competition by cutting and chopping, machine for grassland clearing MCP 2,5 type. Operation of such equipment and machinery is done with tractors suitable for working in slope conditions [1, 2, 3].

Table 1. New technological variants for mechanization of grassland improvement by over sowing method [1]

Operation	The recommended aggregate(*		
	Code	**Draft presentation**	**Aggregate component**
0	1	2	3
a. Degraded grassland with hummocks			
a.1. Variant 1			
- clearing of hummocks and micro uneven grounds und animal excrement spreading; - grass sward aeration; - over sowing.	**U1**		Wheel tractor of 78-60 kW (65-80 HP) + Equipment for grassland levelling + Equipment for grassland seeding ESR 3,75 type
- chemical fertilization (phosphorous and potassium).	**U2**		Wheel tractor of 33- 40 kW (45-55 HP) + Equipment for fertilizing EF 3,75 type
- diminishing the old grass sward competition by cutting and chopping.	**U3**		Wheel tractor of 60-74 kW (80-100 HP) + Machine for grassland clearing MCP 2,5 type
a.2. Variant 2			
- clearing of hummocks, micro uneven grounds and animal excrement spreading; - grass sward aeration; - chemical fertilization (phosphorous and potassium).	**U4**		Wheel tractor of 48-60 kW (65-80 HP) + Equipment for grassland levelling + Equipment for fertilising EF 3,75 type
- over sowing; - diminishing the old grass sward competition.	**U5**		Wheel tractor of 60-74 kW (80-100 HP) + Machine of over sowing of degraded grassland MSPD 2,5 type + Equipment for herbicide in bands EEB 2,5 type

b. Degraded grassland with large hummocks and high density level			
b.1. Variant 1			
- clearing of hummocks, micro uneven grounds and animal excrement spreading; - grass sward aeration; - chemical fertilization (phosphorous and potassium).	**U4**		Wheel tractor of 48-60 kW (65-80 HP) + Equipment for grassland levelling + Equipment for fertilising EF 3,75 type
A second perpendicular passing consist in: - clearing of hummocks and micro uneven grounds and animal excrement spreading; - grass sward aeration; - over sowing.	**U1**		Wheel tractor of 78-60 kW (65-80 HP) + Equipment for grassland levelling + Equipment for grassland seeding ESR 3,75 type
- diminishing the old grass sward competition by cutting and chopping.	**U3**		Wheel tractor of 60-74 kW (80-100 HP) + Machine for grassland clearing MCP 2,5 type
b.2. Variant 2			
- cleaning of hummocks and micro uneven grounds and animal excrement spreading	**U6**		Wheel tractor of 60 -74 kW (80-100 HP) + Equipment for grassland levelling
A second perpendicular passing consist in: - clearing of hummocks, micro uneven grounds and animal excrement spreading; - grass sward aeration; - chemical fertilization (phosphorous and potassium).	**U4**		Wheel tractor of 48-60 kW (65-80 HP) + Equipment for grassland levelling + Equipment for fertilising EF 3,75 type
0	1	2	3
- over sowing; - diminishing the old grass sward competition.	**U5**		Wheel tractor of 60-74 kW (80-100 HP) + Machine of over sowing of degraded grassland MSPD 2,5 type + Equipment for herbicide in bands EEB 2,5 type

c. Degraded grassland with non-value vegetation and hummocks			
- diminishing the old grass sward competition by clearing the non-value vegetation, hummocks, micro uneven ground and animal excrement spreading; - chemical fertilization (phosphorous and potassium).	**U7**		Wheel tractor of 60 -74 kW (80-100 HP) + Machine for clearing grasslands MCP 2,5 + Equipment for chemical fertilizing EF 2,5 type
- over sowing; - diminishing the old grass sward competition.	**U5**		Wheel tractor of 60-74 kW (80-100 HP) + Machine of over sowing of degraded grassland MSPD 2,5 type + Equipment for herbicide in bands EEB 2,5 type

(*

When the operations on the grasslands affected by erosion and also located on slope conditions are required the following measures:

-on slope greater than 7^o (12%) required works are operated on the level curves according to strictly following technology: on long versants, where soil erosion is favoured, the works required to grass establishment must be operate in parallel strips with level curves;

-uncultivated strips are to be worked into next year when the first set of bands is already established;

-strips vary in width depending on the slope size as follows: on slope of 7-9^o (12-16%) between 30 and 40 m; on slope of 9-14^o (16-25%) between 20 and 30 m; on slope of 14-18^o (25-32%) between 12 and 20 m, respectively on slope of 18-22^o (32-40%) between 7 and 12 m;

-operation of machinery and equipment is done by special tractor for slopes conditions (tractor with double traction, equipped with double wheels or caterpillar).

3. Results and discussion

In table 2 are presented the total fuel consumption, necessary labour force and the number of machine passes, both for usual and new technological solutions.

Table 2. New technology for improving the degraded grasslands by over sowing method [1, 3].

Specification	Technology		Fuel consumption, l ha^{-1}	Necessary labour force, man hour ha^{-1}	Number of passes
a.Degraded grasslands with hummocks	Usual		22,4	3,61	4
	New	Var 1	14,1	2,47	3
		Var 2	12,3	2,00	2
b.Degraded grasslands with large hummocks and high density level	Usual		26,2	4,41	5
	New	Var 1	15,9	2,80	3
		Var 2	16,3	2,80	3
c.Degraded grassland with non-value vegetation and hummocks	Usual		33,2	5,10	4
	New		22,5	2,78	2

The data are given for each situation in which the degraded grasslands are located (a, b and c).

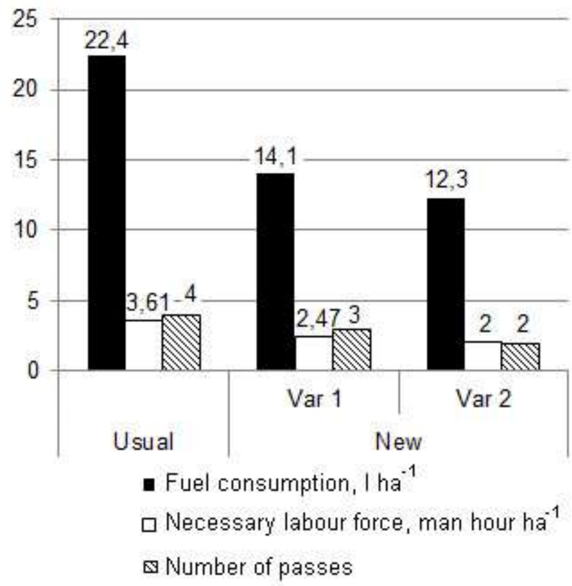


Fig.1. Comparative of fuel consumption, necessary labour force and number of passes between new and usual technology, for degraded grassland with hummocks.

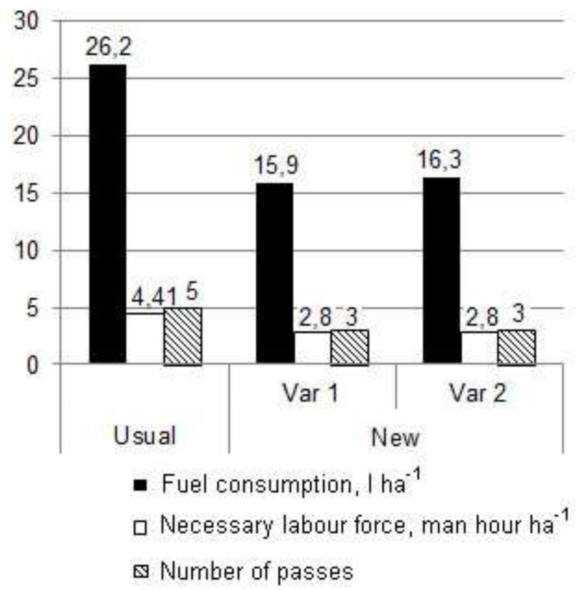


Fig.2. Comparative of fuel consumption, necessary labour force and number of passes between new and usual technology, for degraded grassland with large hummocks and high density level.

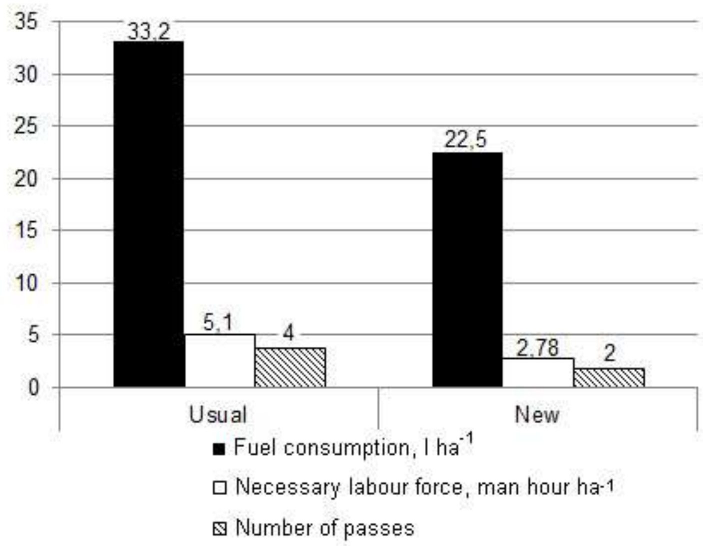


Fig.3. Comparative of fuel consumption, necessary labour force and number of passes between new and usual technology, for degraded grassland because both non value vegetation and hummocks.

The data presented in Table 2 and Figures 1, 2 and 3, in according with working conditions and degradation stage of grassland, demonstrates the following:

- total fuel consumption for usual alternatives varies between 22,4 and 33,2, l ha^{-1};
- total fuel consumption for new mechanization solutions ranges between 12,3 and 22,5, l ha^{-1};
- consumption of labour force for usual variants of mechanization varies between 3,61 and 5,1, man hour ha^{-1};
- consumption of labour force for new mechanization technologies ranges between 2,0 and 2,8, man hour ha^{-1};
- the number of aggregate passes for usual solutions varies between 4 and 5;
- the number of aggregate passes for new mechanization solutions range between 2 and 3.

4. Conclusions

The new mechanization technologies for improving the degraded grasslands by over sowing method, compared with usual variants for different stationary area conditions, require a reduced comsumption of fuel (33...45 %) and labour forces (37...45 %) with a smaller number of aggregate passes (1...2).

By lowering fuel consumption, necessary labour force and the number of machine passes, new technological solutions of mechanization of works for improving degraded grasslands, by over sowing method, have a reduced environmental impact, environment pollution (air, water, soil) is less, inputs are lower and costs decrease proportionally.

References

[1] Mocanu V., Hermenean I., *Tehnologii pentru mecanizarea cu inputuri minime a lucrărilor de întreţinere şi îmbunătăţire a pajiştilor*; (Editura Universităţii Transilvania din Braşov, România, 2008).

[2] V. Mocanu, T.A. Ene, V.A. Blaj, Monica Tod, *Different direct drilling methods for improving degraded grasslands,* Journal of Mountain Agriculture of the Balkans. **15(3)**, 616 (2012).

[3] I. Hermenean, V. Mocanu, – *New mechanization alternatives with low inputs for over sowing degraded grasslands*; Proceeding of Symposium *Trends in European Agriculture Development*, vol. **41(2)**, Editura Agroprint, Timişoara, 432 (2009).