

INFLUENCE OF FERTILIZATION ON PRODUCTIVITY AND VEGETATION STRUCTURE IN SIMPLE MIXTURES OF *BROMUS INERMIS* LEYSS. AND *ONOBRYCHIS VICIIFOLIA* SCOP.

BOUREANU (CIOBANU) Cătălina^{1*}, STAVARACHE M.¹, SAMUIL C.¹
VÎNTU V.^{1**}

¹University of Agricultural Sciences and Veterinary Medicine, Iași

^{1*}Corresponding author e-mail: boureanucatalina@yahoo.com

^{**}coordinator

Abstract

Human intervention in grassland ecosystems was accentuated progressively and more of the primary natural grasslands becomes secondary, and the secondary ones, due to irrational exploitation evolved mostly regressive to other types of pastures with increasingly lower economic value. Thru grassland establishment is achieved by a dense vegetation cover that protects the environment, ensure high economic performance and good quality feed. Research conducted on a sown meadow on the Ezăreni farm, Didactic Station of USAMV have studied the influence of fertilization on productivity and the vegetation structure in simple mixtures of Bromus inermis Leyss. and Onobrychis viciifolia Scop. in the climatic conditions of the Depression of Jijia-Bahlui. The results showed that fertilization had a beneficial action on food regime, on the structure of plants and the vegetation cover, leading to obtain significant production increases, but also changes in the botanical composition of the temporary meadow.

Keywords: NP fertilization, DM production, grasses/legumes ratio

INTRODUCTION

The basic requirement to be taken into account in the composition of mixtures is that they must form a well concluded vegetation cover, with high yields, which ensure balanced development of the plants to a permanent meadow lasting well adapted to stationary conditions (BUTKUTÉ and DAUGĒLIENĒ, 2008).

In making mixtures will take into account the biological characteristics of species depending on the grassland use and exploitation lifetime of the

temporary pastures. Thus, for hayfields are used species with high waist, with almost the same pace of development, while for grassland, the species are near predominate midsize or low growth rate, different speed and high regeneration energy, resistance to soil compaction, great vivacity etc. (BELESKY *et al.*, 2002). In making mixtures will take into account the ability of species competing (competitiveness).

The introduction in the mixtures of aggressive species

alongside those with low competition time, lead to the elimination of the latter.

Competition ability is a property of species, however, is greatly influenced by environmental conditions and manner of exploitation (LAZARIDOU, 2008).

Choosing the most suitable species for mixture composition is the main condition for achieving a better vegetation cover that to maximize stationary conditions (soil type, slope, natural fertility, climatic conditions) (DUMITRESCU *et al.*, 1979).

In the research conducted by NYFELER (2008) has been shown to that the amount of nitrogen used for fertilization can be reduced by using a balance between legumes and grass used in the mixtures composition, achieving high yields. Application of fertilizers on grassland influence their production, the forage quality obtained, changes the structure the vegetation cover, soil properties and intervenes in the activity of soil microorganisms (KOSTUCH and KOPEC, 1991; KLECZEK, 1991).

Scheduling balanced production of mixtures by using varieties with different precociousness shows that early varieties of legumes and grasses in mixtures behave differently depending on participation in the composition of meadow (BONISCHOT, 1991).

In general after two years of use there are a series of changes in

the vegetation cover compared to the ratio grasses – legumes used in seeding. It has been found a decreasing of diverse plant species participation in vegetal structure until the disappearance of thereof of the vegetal cover (JANICKA and STYPINSKI, 1991). Most varieties of perennial grass meadows, which respond to a appropriate fertilization with high yields of green mass and dry matter, with good longevity, they present difficulties of fructification thanks to biological potential, much lower than the varieties with less endurance and less ability of twinning (HILL, 1980).

Cultivation of mixtures composed from perennial grasses and legumes have a number of advantages such as: higher productivity due to a better use of the ecological niches in that biotope; high yields of protein due to the presence of legumes and increasing the protein content in grasses through the presence of legumes; economy on nitrogen based fertilizer from atmospheric nitrogen fixation by bacteria *Rhizobium* sp. located in the radicular nodosities of legumes; obtaining a feed balanced in nutrients (carbohydrates, proteins, minerals and vitamins); silage possibilities; avoidance of meteorization in animals; high palatability of forage obtained; better resistance to frost and drought of plants grown in mixtures compared to pure cultures; better

space allocation for nutrition from the soil; larger capacity to restore the ground-structure (ROTAR, 1993). In general, the mixtures consisting from the perennial grasses and legumes have much lower requirements to fertilization with nitrogen compared to

temporary pastures formed only from grasses. Thus, when the share of legumes in grassland is over 60-70% and manner of use is mowing, nitrogen rate will be only 35-50 kg / ha and will be applied in spring before the vegetation (VÎNTU et al., 1996).

MATERIAL AND METHOD

Research has aimed to study the role of different doses of mineral fertilizers on productivity and structure of the vegetation cover on simple mixtures of smooth brome (*Bromus inermis* Leyss.) and sainfoin (*Onobrychis viciifolia* Scop.). To achieve the objectives, it was organized in the spring of 2014, an bifactorial experience, 5 x 4 type, with three repetitions, and harvested area of 10 m² variants. The factors studied were: *Factor A = culture system, with five graduations: a₁ - Bromus inermis* Leyss. 100% (control); *a₂ - Bromus inermis* Leyss. 75% + *Onobrychis viciifolia* Scop. 25%; *a₃ - Bromus inermis* Leyss. 50% + *Onobrychis viciifolia* Scop. 50%; *a₄ - Bromus inermis* Leyss. 25% + *Onobrychis viciifolia* Scop. 75%; *a₅ - Onobrychis viciifolia* Scop. 100%; *Factor B = fertilization with five graduations: b₁ - unfertilized - (control), b₂ - N₅₀P₅₀ kg/ha; b₃ - N₁₀₀P₁₀₀ kg/ha; b₄ - N₁₅₀P₁₅₀ kg/ha.*

Experience, organized on the

farm Ezăreni, from the Didactic Station of the University of Agricultural Sciences and Veterinary Medicine, was located on land sloping, with NE exhibition, soil type mold cambic weak leachate, loam-clay texture, content in humus of 4.2-4.8%, middle stocked with phosphorus (30-37 ppm.) and very well stocked in mobile potassium (235-320 ppm.), pH 6.5 to 6.9 in the layer of 0-20 cm soil. Harvesting was carried out under the hay time, at the beginning of flowering of sainfoin (25%). The amount of green matter per hectare was determined by weighing the obtained production on the harvested area of 10 m² and then reported per hectare. The dry matter content (US) was determined by drying in an oven at a temperature of 103°C for 3 hours according to the standard ISO 6496/2001. The results were interpreted statistically by analysis of variance and limit differences calculation.

RESULTS AND DISCUSSIONS

Research has shown that the

production of DM was positively

influenced by fertilization with mineral fertilizers based on nitrogen and phosphorus, and the results that were obtained varied both depending on the dose of fertilizer applied, as well as depending on the mixtures taken in the study. Regarding the influence of interaction between species or mixture and used fertilizer on dry matter production (Tab. 1), the differences compared to the control variants were analyzed statistically, with significant differences in all cases, both cycles of vegetation. The highest yield increases was made on mixtures of *Bromus inermis* Leyss. 50% + *Onobrychis vicifolia* Scop. 50%, *Bromus inermis* Leyss. 25% + *Onobrychis vicifolia* Scop. 75%. The highest production of 7,11 t·ha⁻¹ DM was registered in a mixture of *Bromus inermis* Leyss. 25% + *Onobrychis vicifolia* Scop. 75% fertilized with N₁₀₀P₁₀₀, which represents a doubling of production compared with the control, which was 3,61 t·ha⁻¹ DM.

The fertilized variants, the results showed that the higher production of dry substance, the mowing II, was obtained in variant *Bromus inermis* Leyss. 50% + *Onobrychis vicifolia* Scop. 50%, fertilized with N₁₀₀P₁₀₀, of 3,32 t·ha⁻¹ DM. Compared with the control, it has achieved very significant production increases. The lowest production was obtained in variant *Bromus inermis* Leyss. 100%, fertilized with N₅₀P₅₀, 2,18 t·ha⁻¹ DM.

Analyzing total production (Tab. 1) was found that the value recorded in variant *Bromus inermis* Leyss. 100%, unfertilized, was 5,16 t·ha⁻¹ DM, and the differences compared to the control at all variants studied were statistically assured. The yield production, was 10,23 t·ha⁻¹ DM, it was recorded in the mixture *Bromus inermis* Leyss. 25% + *Onobrychis vicifolia* Scop. 75% fertilized with N₁₀₀P₁₀₀, representing a doubling of production compared to the control.

A major influence on the amount of biomass accumulated and the number of crops obtained, during the growing season it had the temporary grassland exploitation mode. In the study from Didactic Station Iasi - Ezareni Farm, under the 2015-2016 agricultural years (the third year of operation), two cuts were obtained and the period of exploitation was of 118 days.

Influence of species or mixture used on dry matter production to first mowing (Tab. 2), the differences compared to the control in all variants analyzed were positive, statistically assured distinctly and very significant. The highest yield was obtained from a mixture of *Bromus inermis* Leyss. 25% + *Onobrychis vicifolia* Scop. 75% of 6,54 t·ha⁻¹ DM, compared to the control, which obtained 5,17 t·ha⁻¹ DM. Data obtained in second mowing, showed a production of 2,21 t·ha⁻¹ DM to the control, and the most productive mixture was found to be *Bromus inermis* 50%

Leyss. + *Onobrychis viciifolia* Scop. 50%, where it was recorded 3.15

t·ha⁻¹ DM, with a very significant increase compared to the control.

Table 1

The influence of the interaction between species or mixture and fertilizer used on the production of dry matter

Variant		Dry matter production (Mg·ha ⁻¹)		
		First cut	Second cut	Total
a ₁ (control) - <i>Bromus inermis</i> Leyss. 100%	b ₁ (control) - N ₀ P ₀	3,61 ^C	1,54 ^C	5,16 ^C
	b ₂ - N ₅₀ P ₅₀	5,18***	2,18**	7,36***
	b ₃ - N ₁₀₀ P ₁₀₀	5,70***	2,33**	8,03***
	b ₄ - N ₁₅₀ P ₁₅₀	6,21***	2,77***	8,98***
a ₂ - <i>Bromus inermis</i> Leyss. 75% + <i>Onobrychis viciifolia</i> Scop. 25%	b ₁ - N ₀ P ₀	4,75**	2,66***	7,41***
	b ₂ - N ₅₀ P ₅₀	5,55***	2,89***	8,44***
	b ₃ - N ₁₀₀ P ₁₀₀	5,96***	2,78***	8,74***
	b ₄ - N ₁₅₀ P ₁₅₀	6,47***	3,15***	9,62***
a ₃ - <i>Bromus inermis</i> Leyss. 50% + <i>Onobrychis viciifolia</i> Scop. 50%	b ₁ - N ₀ P ₀	5,21***	3,07***	8,28***
	b ₂ - N ₅₀ P ₅₀	5,86***	2,99***	8,85***
	b ₃ - N ₁₀₀ P ₁₀₀	6,01***	3,32***	9,33***
	b ₄ - N ₁₅₀ P ₁₅₀	6,61***	3,21***	9,82***
a ₄ - <i>Bromus inermis</i> Leyss. 25% + <i>Onobrychis viciifolia</i> Scop. 75%	b ₁ - N ₀ P ₀	6,32***	2,63***	8,95***
	b ₂ - N ₅₀ P ₅₀	6,26***	2,94***	9,21***
	b ₃ - N ₁₀₀ P ₁₀₀	6,45***	3,23***	9,68***
	b ₄ - N ₁₅₀ P ₁₅₀	7,11***	3,13***	10,23***
a ₅ - <i>Onobrychis viciifolia</i> Scop. 100%	b ₁ - N ₀ P ₀	5,83***	2,47***	8,30***
	b ₂ - N ₅₀ P ₅₀	5,61***	2,63***	8,24***
	b ₃ - N ₁₀₀ P ₁₀₀	6,04***	2,54***	8,58***
	b ₄ - N ₁₅₀ P ₁₅₀	6,20***	2,99***	9,18***
	LSD 0.05 =	0,69	0,46	0,95
	LSD 0.01 =	0,92	0,61	1,26
	LSD 0.001 =	1,20	0,80	1,64

In terms of overall production the variant *Bromus inermis* Leyss. 25% + *Onobrychis viciifolia* Scop. 75%, had the highest yield, of 9.52 t·ha⁻¹ DM, with a difference compared to the control statistically, very significant, while in the variant *Bromus inermis* Leyss. 100% it was recorded a production of 7.38 t·ha⁻¹ DM, highlighting the role of legumes in the formation of biomass. The contribution of *Onobrychis viciifolia* Scop. species. To achieve

the production of DM does not manifest itself only through the contribution of biomass, but also through the contribution of symbiotic fixed nitrogen that is used by the species of grasses used in the mixture, *Bromus inermis* Leyss. This is demonstrated by lower production of DM obtained in the variant were *Onobrychis viciifolia* Scop. is 100%, in comparison with the mixtures in which *Bromus inermis* Leyss. species is present in an amount of 25% to 50%.

Table 2

The influence of species or mixture used on dry matter production

Variant	Dry matter production (Mg·ha ⁻¹)			
	First cut	Second cut	Total	
a ₁ (mt) - <i>Bromus inermis</i> Leyss. 100%	5,17 ^C	2,21 ^C	7,38 ^C	
a ₂ - <i>Bromus inermis</i> Leyss. 75% + <i>Onobrychis viciifolia</i> Scop. 25%	5,68*	2,87**	8,55**	
a ₃ - <i>Bromus inermis</i> Leyss. 50% + <i>Onobrychis viciifolia</i> Scop. 50%	5,92**	3,15***	9,07***	
a ₄ - <i>Bromus inermis</i> Leyss. 25% + <i>Onobrychis viciifolia</i> Scop. 75%	6,54***	2,98**	9,52***	
a ₅ - <i>Onobrychis viciifolia</i> Scop. 100%	5,92**	2,66*	8,58**	
	LSD 0.05 =	0,44	0,36	0,57
	LSD 0.01 =	0,64	0,52	0,82
	LSD 0.001 =	0,97	0,78	1,23

Analysing data on the effect of fertilization on the production of DM at the first mowing it has been observed a significant influence and very significant, of fertilizers applied.

Compared with unfertilized control, where was recorded a

production 5,15 t·ha⁻¹ DM, the differences of all variants studied were positive, distinct significant and very significant. The highest production of dry matter of 6,52 t·ha⁻¹ DM it was achieved in the variant fertilized with N₁₅₀P₁₅₀ (Tab. 3).

Table 3

The influence of fertilization on dry matter yield production

Variant	Dry matter production (Mg·ha ⁻¹)			
	First cut	Second cut	Total	
b ₁ (mt) - N ₀ P ₀	5,15 ^C	2,47 ^C	7,62 ^C	
b ₂ - N ₅₀ P ₅₀	5,69*	2,73	8,42**	
b ₃ - N ₁₀₀ P ₁₀₀	6,03***	2,84	8,88***	
b ₄ - N ₁₅₀ P ₁₅₀	6,52***	3,05	9,57***	
	LSD 0.05 =	0,50	0,50	0,56
	LSD 0.01 =	0,67	0,67	0,74
	LSD 0.001 =	0,87	0,87	0,97

In the second mowing differences compared to the control were not significant due to adverse climatic conditions that can influence vegetation restoration, and biological characteristics of the species. The control variant was obtained a yield of 2.47 t·ha⁻¹ DM, and the highest production was registered at fertilized variant with N₁₅₀P₁₅₀.

Analysing data which are showing the effect of fertilization on total production of dm, it has been observed a distinct significant and very significant influence of the fertilizer dosages used. The highest yield production of 9.57 t·ha⁻¹ DM, was registered in the variant fertilized with N₁₅₀P₁₅₀ and the smallest yield production was recorded in the unfertilized variant of 7.62 t·ha⁻¹ DM.

The dynamic of yield production accumulation in fertilizer variants studied, showed that the yields obtained at the first sew, were higher compared to those recorded in the second mowing. At fertilization with N₁₅₀P₁₅₀ were recorded the biggest differences

compared to the control at both sews.

Complex fertilizers based on nitrogen and phosphorus favors both grasses and legumes. Thus achieving higher yield production, in soil conditions insufficiently stocked in both minerals shall be conditional upon the amount of fertilizer applied.

The mixture structure of perennial grasses and legumes is the most important link in the technology of cultivation in temporary meadows on which depends grassland productivity, fertilization system, method and duration of exploitation, changes in the composition of the vegetation.

Analyzing data form Fig. 1, in the first mowing, it is found that at the mixture with 75% *Bromus inermis* Leyss. and 25% *Onobrychis viciifolia* Scop. grasses weight ranged from 70.0% in fertilized variant N₅₀P₅₀ to 81.0% on at the variant fertilized with N₁₅₀P₁₅₀. The percentage of legumes in the vegetation cover was between 18,0% in fertilized variant N₁₅₀P₁₅₀ and 22,0% in variant fertilized with

N₁₀₀P₁₀₀. Species from other botanical families (weeds) had an insignificant share.

In the mixture 50% *Bromus inermis* Leyss. și 50% *Onobrychis viciifolia* Scop., percentage of participation was among the grasses was 42,0% in the fertilized variant with N₅₀P₅₀ and 60,0% in the variant fertilized with N₁₅₀P₁₅₀. Legumes had a share between 40,0% in the fertilized variant N₁₅₀P₁₅₀ and 57,% in the fertilized variant with N₅₀P₅₀. The percentage of participation în the mixtures of other botanical families was

between 1,0% și 3,0%.

On the mixture with 75% *Onobrychis viciifolia* Scop. and 25% *Bromus inermis* Leyss. participation percentage of legumes in the vegetation cover was between 60,0% in the fertilized variant N₁₅₀P₁₅₀ and 75,0% in the unfertilized variant. Grasses share was between 23,0% in the unfertilized variant. and 40,% in the fertilized with N₁₅₀P₁₅₀. Share of different species present in vegetation cover was between 1,0% și 2,0%.

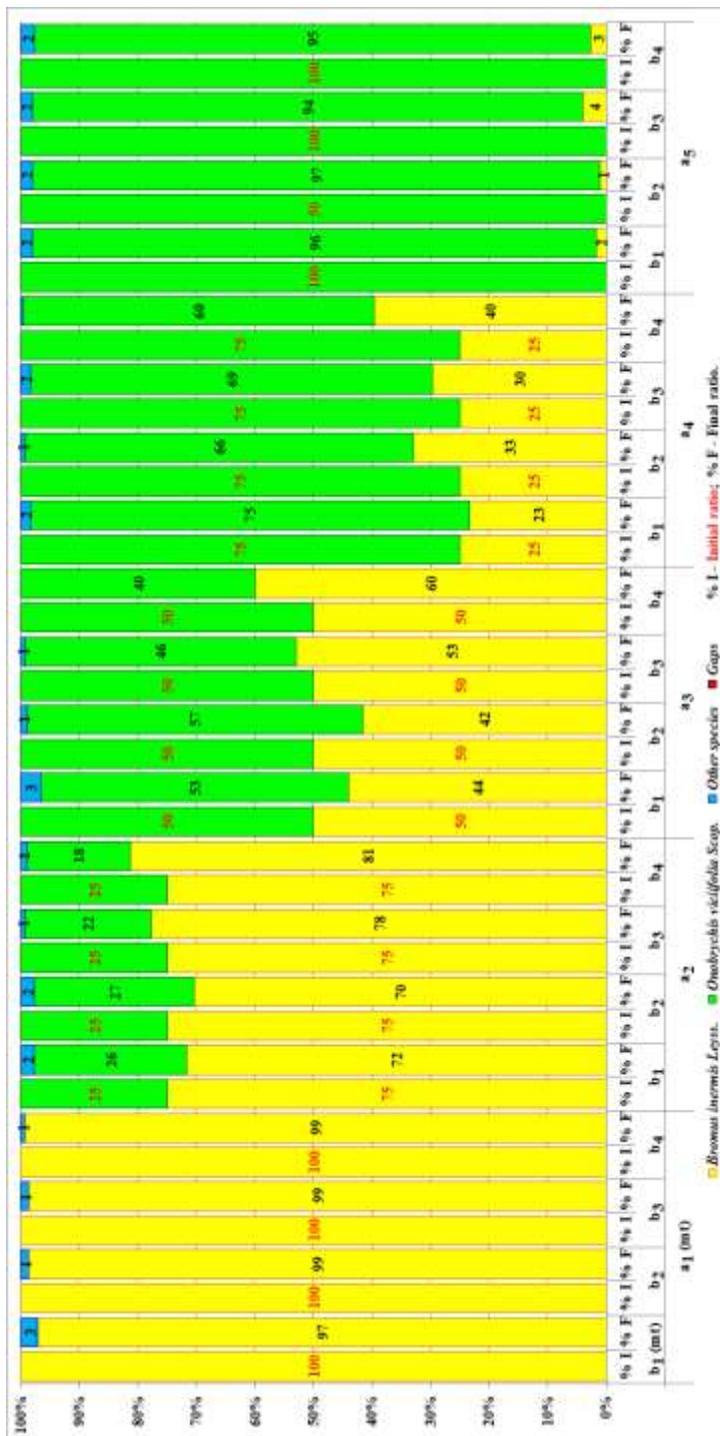


Fig. 1. The influence of interaction between species or mixture and fertilization used on the vegetation structure at the first mowing

At first sowing, the general trend has been the growth of the participation of mixed species *Bromus inermis* Leyss. and decline of the *Onobrychis viciifolia* Scop., in particular in the variants of fertilization N₁₀₀P₁₀₀ and N₁₅₀P₁₅₀, comparative with the initial proportion in mixtures structure.

Regarding the data obtained at the second sowing (figure 2) shows that at the variant with *Bromus inermis* Leyss. 100% the percentage of participation of various species group in vegetation cover was between 7.0% and 11.0%. Highest share was recorded at the control variant. It was observed a decrease in various species group, with increasing of fertilizers dose applied and a gain in percentage of *Bromus inermis* Leyss. Species.

In the mixture with 75% *Bromus inermis* Leyss. and 25% *Onobrychis viciifolia* Scop. grass share was between 34,0% in unfertilized variant and 24,0% in variants fertilized with N₁₀₀P₁₀₀. and N₁₅₀P₁₅₀. The percentage of legumes in the vegetation cover was been between 64,0% in unfertilized variant and 5,0 % in fertilized variant with N₁₅₀P₁₅₀. Various species share was reduced 2,0% and 3,0%.

To the mixture of 50% *Bromus inermis* Leyss. and 50% *Onobrychis viciifolia* Scop.)

percentage of grass participation was among 17,0% in variant fertilized with N₁₀₀P₁₀₀ and 24,0% in unfertilized variant, while legume had a share between 81,0% in variant fertilized with N₁₅₀P₁₅₀ and 79,0% in unfertilized variant. Share of different species present in vegetation cover was between 1,0% și 2,0%. The mixture used and the interaction between fertilization and mixture generated the biggest differences in case of this variant. It has also been observed that by increasing the dose of fertilizer the share of the *Onobrychis viciifolia* Scop. species, has registred a a significant increase (figure 2).

In the mixture 25% *Bromus inermis* Leyss. and 75% *Onobrychis viciifolia* Scop. the percentage of participation of grass in vegetal cover was been between 3,0% in unfertilized variant and 16,0% on fertilized variant with N₁₀₀P₁₀₀. Legume had a share between 83,0% on fertilized variant with N₁₀₀P₁₀₀ and 96,0% in unfertilized variant. The presence of various species group was between 1,0% and 2,0%.

In the variant 100% *Onobrychis viciifolia* Scop., various species were present in the vegetal cover in a percentage between 1% and 2%, appearance that is due large extent of sainfoin capacity to cover much better spaces where diverse species group would have been developed.

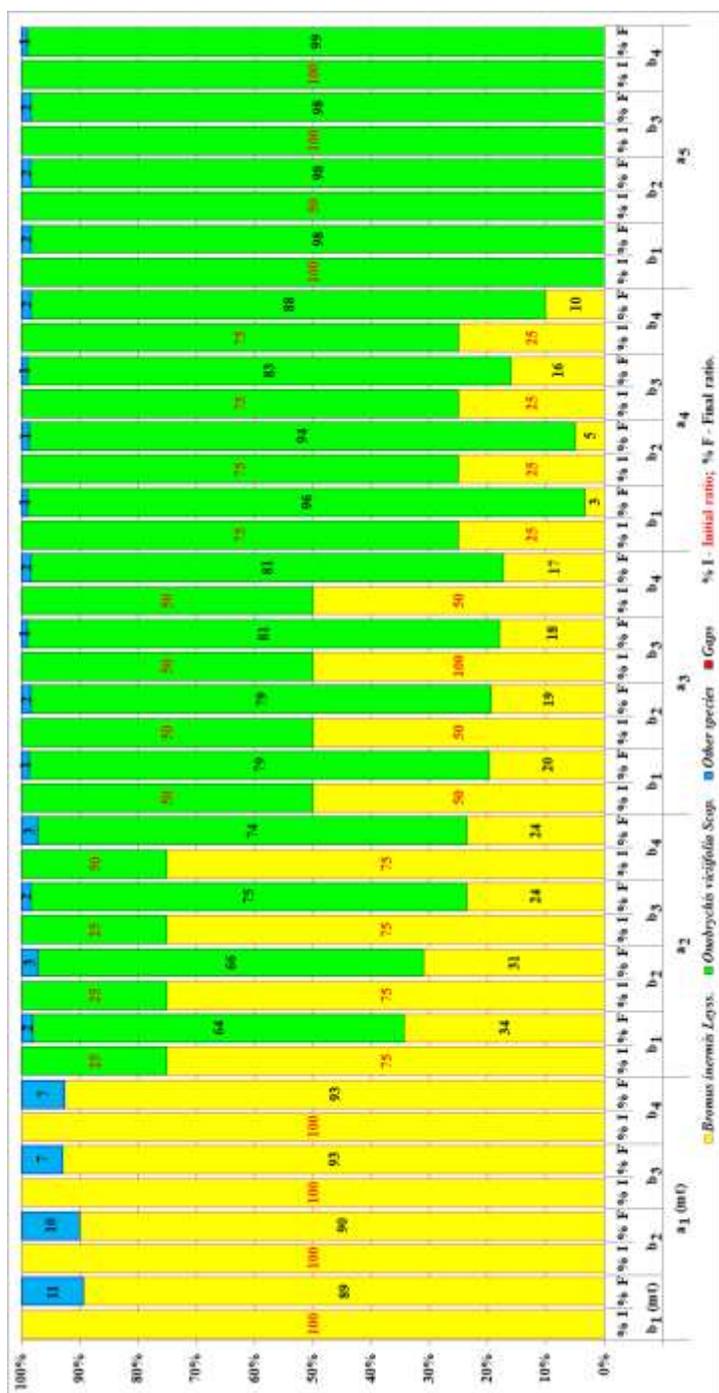


Fig. 2. The influence of interaction between species or mixture and fertilization used on the vegetation structure at the second mowing

CONCLUSIONS

Fertilization had a benefic action on balancing the food regime of plants, which leads to the increases of significantly yield production and nitrogen fertilization in increasing doses had modified the percent of species in the mixture, within the meaning to stimulate grasses on account of fall in the share of participation of legumes. Forage productions achieved on mixtures studied were influenced by the type of mixture, quantities of mineral fertilizers administered and climatic conditions of the agricultural year. Whichever variant fertilizer or mixture used, climatic conditions, especially rainfall, had a high influence on plant growth and

development.

Onobrychis viciifolia Scop. and *Bromus inermis* Leyss. can form simple mixtures but *Onobrychis viciifolia* Scop. species has a high degree of competitiveness, in unfertilized conditions, compared to *Bromus inermis* Leyss. species. Therefore the mixtures must be well grounded and also the fertilizer used.

Species structure from the vegetation cover was been influenced by the percentage of participation in the seeding rate of species from mixture or mineral fertilizers, as well as, inter-relationships and biological peculiarities of the species studied.

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