

RESEARCH CONCERNING THE INFLUENCE OF MIXTURE AND FERTILIZATION ON THE FORAGE QUALITY FROM *MEDICAGO SATIVA* L. AND *DACTYLIS GLOMERATA* L.

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Abstract

For most farmers to produce a balanced energy-protein feed directly from the field which provides high productions and conservation by silage opportunity is a priority. To improve the forage base it can be establish temporary grasslands, consisting of perennial legumes and grasses. The current paper presents the influence of binary mixtures from *Medicago sativa* and *Dactylis glomerata*, two of the most productive species, and of the fertilization on dry matter production, evolution of the vegetation cover, forage chemical composition. To achieve these objectives, we have experienced three different proportions of mixture, which were applied to four rates of mineral fertilizer. The highest productions were obtained from the mixture of 75% *Medicago sativa* + 25% *Dactylis glomerata*, fertilized with $N_{100}P_{50}$ in both two years experienced, of 4.63 Mg ha⁻¹DM and 5.94 Mg ha⁻¹DM, respectively. The structure of ground cover changed in both years with a significant increase of grass proportion on high rate of fertilization, mainly on 50%-50% mixture. All rates of fertilization had a significant effect on chemical composition of forage obtained from mixture.

Keywords: binary mixtures, *Medicago sativa*, *Dactylis glomerata*, mineral fertilization, forage quality.

INTRODUCTION

Lately, for the establishment of temporary pastures, alfalfa is sown in mixture with different forage plants growing on surfaces. The degree of intensification of temporary meadows is given also by the structure of

biological material used in their establishment. (Vintu et al., 2004).

Associated culture of alfalfa and grass has its limitations mainly of hardness to maintain a balance between components and the failure to

ensure optimal biological requirements of individual species (Hall et al., 2004).

The association of *Medicago sativa* in mixture with *Dactylis glomerata* has some essential advantages such as: superior productivity to *Medicago sativa* in pure culture, high yields of protein, nitrogen fertilizer economy, getting a balanced nutrient feed, silage opportunity, greater ability to restore soil structure, etc. (Veira et al., 2010).

Referring to an optimum ratio between the two species, some researchers have obtained the most important yields on the mixture 50% *Medicago sativa* + 50% *Dactylis glomerata* (Niderkorn et al., 2011), others to the mixture of 60% *Medicago sativa*+40% *Dactylis glomerata* (Timirgaziu, 1987), but most of best productions both for dry matter (DM) and crude protein (CP), were obtained at the 75% *Medicago sativa* +25% *Dactylis glomerata* variant, both in terms of irrigation or not with appropriate doses of fertilizer. (Balan Gabriela and Talpan Irina, 2008; Wilson and Orloff, 2008).

Perennial grasses in mixtures with alfalfa bacteria benefit from nitrogen-related

root. After Lorena Belén Guiñazú (2010), in the 100-400 kg/ha N fixed by alfalfa roots over 50% is made available to related plants. Increasing doses of nitrogen fertilization of grassland botanical composition changes in meaning enrichment grassy carpet of grass, on account of lower proportion of legumes and plants participation from other botanical families (Samuil, 1999; Balan Gabriela and Talpan Irina, 2008).

Researches referring to cultivated simple mixtures are relatively numerous, but are fewer those in the Central Moldavian Plateau which are focused particularly to *Medicago sativa* and *Dactylis glomerata* mixture without irrigation and to the role of fertilization on production as well on the chemical composition of the forage. This, probably because *Dactylis glomerata* is a demanding specie regarding management, climate and nutritive conditions. But, for farmers with a relatively low budget, *Medicago sativa* and *Dactylis glomerata* blend may be one of the most effective measures to improve the forage base, the mixture is considered to be the most intensive of associated crops and production could enable a

semi-silage or haylage with alfalfa of high quality due to fermentable carbohydrate intake given by *Dactylis*

glomerata (Colombari et al., 2001; Albrecht and Beauchemin, 2003).

MATERIAL AND METHOD

Experience has been established on Ez reni Farm from Iasi in spring of 2010, on a cambium chernozem, with pH between 6.7 and 6.8 and humus content of 2.73 to 2.93%, 21-25 ppm P_{AL}, 226-232 ppm K_{AL} and 112-139 ppm CaO. The average yearly temperature in the area is 9.6°C and the average yearly rainfall is 517.8 mm with a good repartition on spring, but with drought summers.

Factors studied were:

Factor A = mixture, with 3 graduations:

- a1 - *Medicago sativa* 100%;
- a2 - *Medicago sativa* 75% + 25% *Dactylis glomerata*;
- a3 - *Medicago sativa* 50% + 50% *Dactylis glomerata*.

Factor B = fertilization, with 4 graduations:

- b1 - control (unfertilized);
- b2 - N₅₀P₅₀;
- b3 - N₇₅P₅₀;
- b4 - N₁₀₀P₅₀.

The *Medicago sativa* cultivar used for establish the experience was Magnat, a Romanian cultivar and for *Dactylis glomerata* the cultivar was Ambassador, a very productive cultivar from Denmark. The mixture was established by manually mixing after calculating the seed quantity weighted depending on quality parameters of each specie. For fertilization were used 20N:20P mineral complex as based fertilization and ammonium nitrate for graduation and applied manually on early spring of each of the experimental year.

The data in this paper is referring to first harvest of year 2010 and 2011, respectively. In the first year the harvesting was performed at the opening of the *Dactylis glomerata* and full bud of the *Medicago sativa* and in the second year harvest was done at the full flowering of the *Dactylis glomerata* and full bud of the *Medicago sativa*.

Gravimetric analyses were performed before each cycle of harvesting.

Chemical composition of forage was determined using the following methods of analysis: total nitrogen (Nt) by Kjeldahl method, acid detergent fiber (ADF) and neutral detergent fiber (NDF) using Raypa Fiber Test and *Van Soest* method, crude ash (Ash.) by calcination of feed sample in a furnace at 500-600°C.

Relative feed value (RFV) was calculated using formula (I.N.R.A):

$$\text{DDM} = \text{Digestible Dry Matter} = 88.9 - (0.779 \times \% \text{ ADF})$$

$$\text{DMI} = \text{Dry Matter Intake} = 120 / (\% \text{ NDF})$$

RESULTS AND DISCUSSION

Influence of mixture and fertilization on the production the mixture *Medicago sativa* 50% + 50% *Dactylis glomerata* using N₁₂₀ dose the dry matter production from unfertilized control increased by 26%. Both *Medicago sativa* and *Dactylis glomerata* are highly

$$\text{RFV} = (\text{DDM} \times \text{DMI}) / 1.29.$$

The American Forage and Grassland Council (A.F.G.C) have endorsed to use RFV as a measure of forage quality. The Quality Grading Standard assigned by A.F.G.C. is:

1. Prime – RFV > 151
2. Premium – RFV 150-125
3. Good – RFV 124-103
4. Fair – RFV 102-87
5. Poor – RFV 86-75
6. Reject – RFV < 74

Data were statistically interpreted using the Statistically “R” Program for variance analysis and MsOffice™ Excel for correlations.

productive species, but which require an appropriate level of nutrients in the soil.

Intensive mixing of the two species respond very well to mineral fertilization and irrigation, obtaining significant production increases even at moderate doses. Thus, in a study at Lovrin in terms of

irrigation, Adrian Ionel (2003), presents that on (Table 1).

Table 1

Influence of mixture and fertilization on DM production from 2010 and 2011

Variants		2010	2011
		(Mg ha ⁻¹)	(Mg ha ⁻¹)
<i>Medicago sativa</i> 100% (control)	Unfertilized (control)	4.02	5.02
	N ₅₀ P ₅₀	4.10	5.15
	N ₇₅ P ₅₀	4.24	5.32*
	N ₁₀₀ P ₅₀	4.36*	5.50*
<i>Medicago sativa</i> 75%+ <i>Dactylis glomerata</i> 25%	Unfertilized	4.10	5.39*
	N ₅₀ P ₅₀	4.29	5.52*
	N ₇₅ P ₅₀	4.49*	5.79*
	N ₁₀₀ P ₅₀	4.63*	5.94*
<i>Medicago sativa</i> 50%+ <i>Dactylis glomerata</i> 50%	Unfertilized	4.05	5.31*
	N ₅₀ P ₅₀	4.15	5.47*
	N ₇₅ P ₅₀	4.40*	5.69*
	N ₁₀₀ P ₅₀	4.45*	5.87*
LSD 0.05		0.32 Mg ha ⁻¹	0.14 Mg ha ⁻¹

In this study, we foresee the mixture in terms of non-irrigation productivity and using lower doses of mineral fertilizers, based on the fact that leguminous specie from mixture provides to grass symbiotically fixed nitrogen. During 2010-2011 significant increases of DM production from control were obtained in all the mixture ratios tested. Using polynomial regression line was observed that in 2010

there was a significant correlation between nitrogen fertilization rate and dry matter production only for alfalfa in pure culture (*Medicago sativa* 100%) for $p = 5\%$, $r^2 = 0.991^*$ (fig. 1). For year 2011 there were record significant correlations both for *Medicago sativa* 100%, $r^2 = 0.997^*$ and for the mixture *Medicago sativa* 50% + 50% *Dactylis glomerata*, $r^2 = 0.992^*$ at $p=5\%$ (fig. 2).

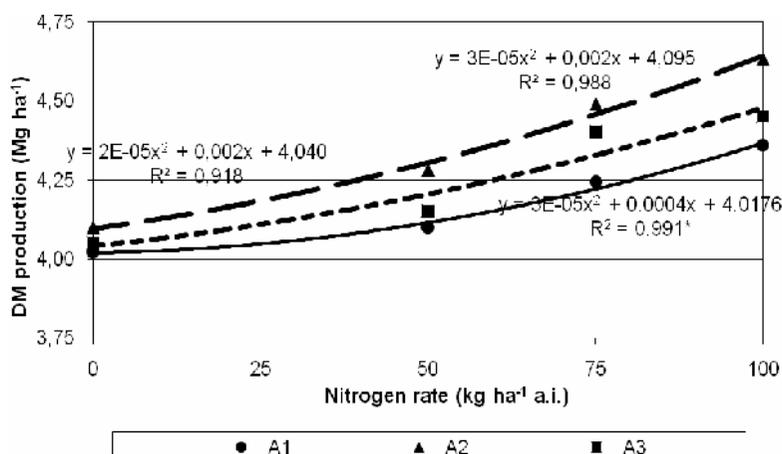


Figure 1. Polynomial line regression of the nitrogen dose on the DM production in 2010

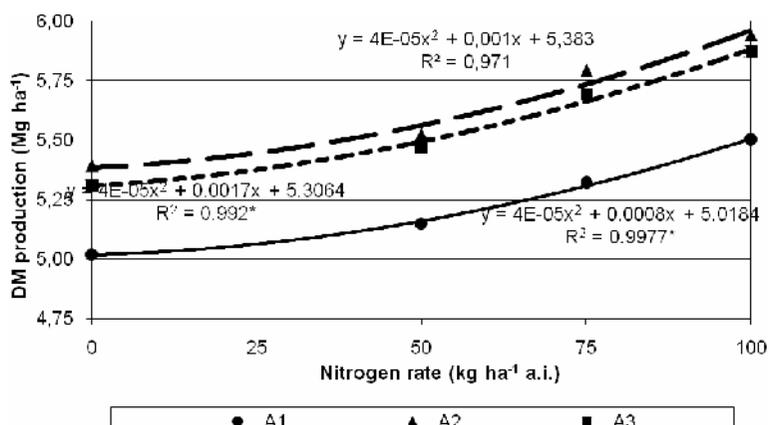


Figure 2. Polynomial line regression of the nitrogen dose on the DM production in 2011

Both in 2010 and 2011 the average DM productions were higher on *Medicago sativa* 75% + 25% *Dactylis glomerata* mixture followed by mixture *Medicago sativa* 50% + 50% *Dactylis glomerata*, both mixtures

surpassing *Medicago sativa* 100%.

Thus, in 2010 the highest average production of 4.63 Mg ha⁻¹ was obtained by mixture *Medicago sativa* 75% + 25% *Dactylis glomerata* with a fertilization dose used of N₁₀₀P₅₀, registering an

increase of 15% compared to control variant.

The mixture *Medicago sativa* 50% + 50% *Dactylis glomerata* had highest average production of 4.45 Mg ha⁻¹ registering an increase of 11% and *Medicago sativa* 100% had produced 4.36 Mg ha⁻¹DM with an increase of 9% by control using fertilization rate of N₁₀₀P₅₀. In 2011 the highest average production of 5.94 Mg ha⁻¹ was obtained by mixture *Medicago sativa* 75% + 25% *Dactylis glomerata* with a fertilization dose used of N₁₀₀P₅₀, registering an increase of 18% compared to control variant.

The mixture *Medicago sativa* 50% + 50% *Dactylis glomerata* had highest average production of 5.87 Mg ha⁻¹ registering an increase of 17% compared to control variant and *Medicago sativa* 100% had produced 5.50 Mg ha⁻¹ DM registering an increase of 10% at fertilization rate of N₁₀₀P₅₀.

From the study could be seen as alfalfa in pure culture responds well to moderate doses of nitrogen,

recording significant increases in both production years.

Influence of mixture and fertilization on the canopy cover structure

Both mineral and organic fertilizers cause significant changes in the structure of vegetation cover of temporary grassland (Nyfeler et al., 2008). Wilson and Orloff (2008) conclude that alfalfa and cocksfoot mixtures of different proportions ensures high yields, even unfertilized, their floral evolution is more powerful influenced by nitrogen fertilizer than their seeding structure. Thus, Balan Gabriela and Talpan Irina (2008) observed regarding competition between alfalfa and orchard grass, that from an initial mixture of 60% and 40% with the application of N₁₀₀ dose ratio was 70% and 30% in the second year at first harvest.

In this study there was recorded in the first experimental year at the first crop a relatively high percentage of plants from

other species, being higher in variants with *Medicago sativa* 100% (fig. 3) and lower in mixtures with *Dactylis*

glomerata as the percentage used of *Dactylis glomerata* in mixture was higher.

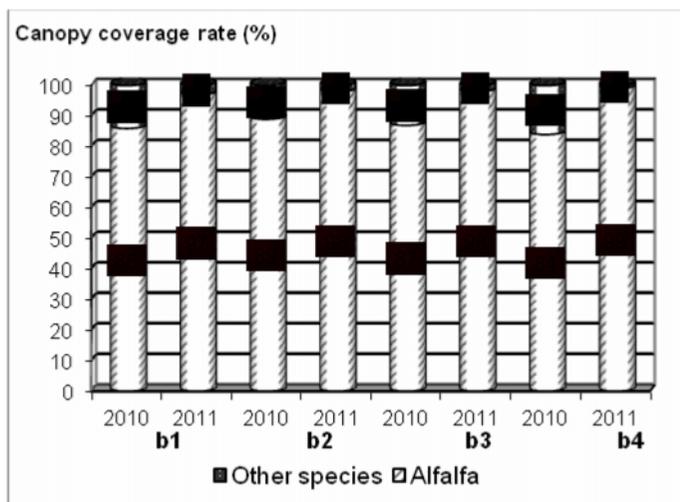


Figure 3. Evolution of canopy cover structure of *Medicago sativa*

It was also noted that on the *Medicago sativa* 100% variants, increasing doses of nitrogen favored different plants share (fig. 3), while on

mixtures *Medicago sativa* + *Dactylis glomerata* their percentage was lower, increasing instead the share of *Dactylis glomerata* (fig. 4.; fig. 5).

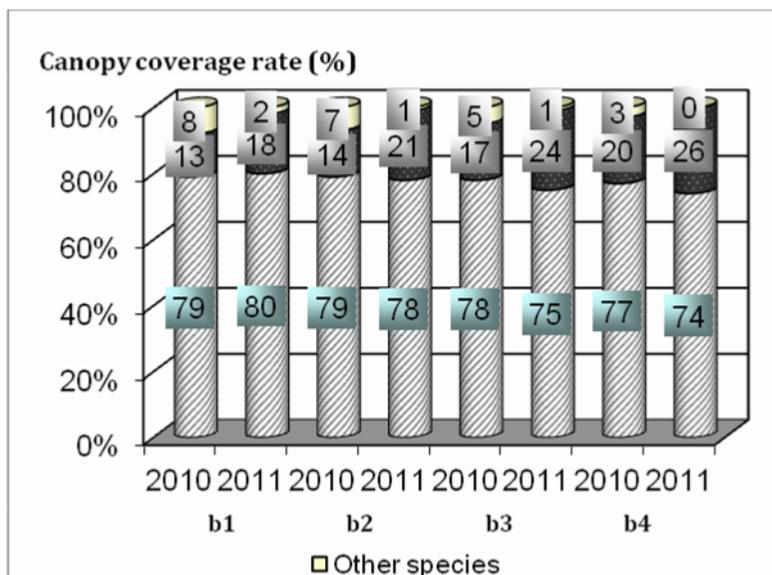


Figure 4. Evolution of canopy cover structure on mixture of *Medicago sativa* 75% + 25% *Dactylis glomerata*

On 75% - 25% mixture at harvest time in 2010, the share increased in all variants of fertilization in favor of *Medicago sativa* reaching 79% (N₀P₀ and N₅₀P₅₀) and 78% (N₇₅P₅₀) and 77% respectively at N₁₀₀P₅₀ rate. In year 2011, the *Medicago sativa* mixture share reached 80% on unfertilized variant, but decreased to 75% and 74% at variants fertilized with rates of N₇₅ and N₁₀₀ respectively (fig. 4).

On 50% - 50% mixture at harvest time in 2010, the

share increased in all variants of fertilization in favor of *Medicago sativa* reaching 62% and 61% (at doses of N₀P₀ and N₅₀P₅₀), 56% (N₇₅P₅₀) and 52% respectively at N₁₀₀P₅₀ rate.

In year 2011, the *Medicago sativa* alfalfa mixture share decreased to 58% on unfertilized variant and to 53% at N₅₀ rate and highly increased the share of *Dactylis glomerata* to 52% and 55% at variants fertilized with rates of N₇₅ and N₁₀₀ respectively (fig. 5).

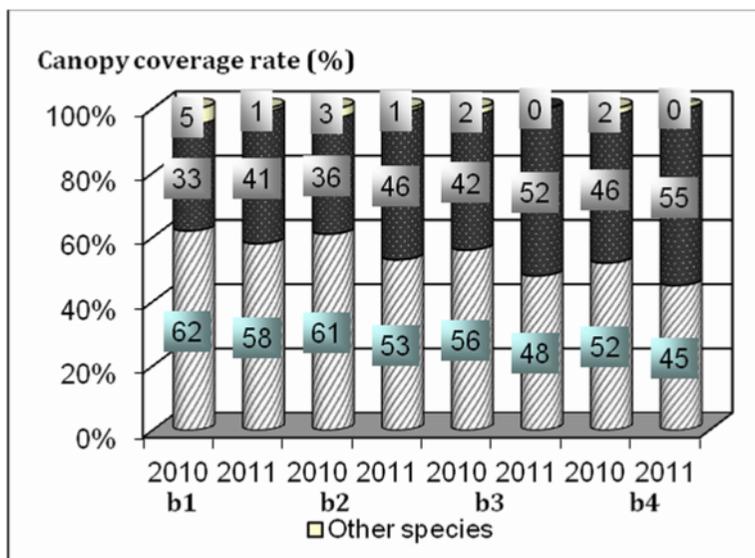


Figure 5. Evolution of canopy cover structure on mixture of *Medicago sativa* 50% + 50% *Dactylis glomerata*

Influence of mixture and fertilization on the quality of the forage

Quality of feed is influenced both by mixing and fertilization mainly because of the changes in canopy cover structure, but also had some influence the state of vegetation of these two species at the time of harvesting. In the first year due to slow installation of cocksfoot when harvesting this it was on green stage of vegetation and alfalfa was in full bud. In the second year, alfalfa was at full bud and cocksfoot was at full flowering.

In 2010 all variants of *Medicago sativa* 100% and of mixture *Medicago sativa* 75% + 25% *Dactylis glomerata* fertilized, were recorded very significant increases from control in terms of crude protein content. The highest average value was obtained from *Medicago sativa* 100% variant fertilized with dose of N₁₀₀ of 21.41% CP.

In general, increasing doses of nitrogen caused an increase in CP content, but also because of differences appeared in the stages of maturity of alfalfa and cocksfoot at the time of

harvest the ADF and NDF content also was increased.

Lowest ADF and NDF values were obtained from control variant of 30.29% respectively 38.41%. The mixture had 75% - 25% lower values for ADF and NDF than 50% - 50% mix (Table 2).

Although mixture 75% - 25% surpassed control variant, the fertilized variants had mean values below those fertilized from *Medicago sativa* 100%. Mixture 50% - 50% registered significant

and very significant differences from controls only on N₇₅ and respectively, on N₁₀₀ treatments (Table 2). Using polynomial regression line was observed that in 2010 there was a significant correlation between nitrogen fertilization rate and crude protein content for *Medicago sativa* 100% for $p = 5\%$, $r^2 = 0.999^*$ and as well the same for mixtures (fig. 6).

Table 2
Influence of mixture and fertilization on the chemical composition of forage on the first harvest (2010), DM based

Variants		NT%	CP%	Ash%	ADF%	NDF%	DDM	RFV
<i>Medicago sativa</i> 100%	Unfertilized	2.65	16.57	11.37	30.29	38.41	65.33	158
	N ₅₀ P ₅₀	2.84	17.74*	11.94 ^o	31.89*	39.12*	64.04	149
	N ₇₅ P ₅₀	3.08	19.25*	12.13*	34.91*	39.90*	61.68	144
	N ₁₀₀ P ₅₀	3.42	21.41*	9.87*	35.10*	40.93*	61.61	140
<i>Medicago sativa</i> 75%+ <i>Dactylis</i> <i>glomerata</i> 25%	Unfertilized	2.39	14.96 ^o	11.43 ^o	36.67*	42.84*	60.04	131
	N ₅₀ P ₅₀	2.75	17.22*	9.13 ^o	38.02*	44.00*	59.30	125
	N ₇₅ P ₅₀	2.91	18.18*	10.40*	38.66*	44.42*	58.79	123
	N ₁₀₀ P ₅₀	3.12	19.47*	9.28*	40.29*	47.09*	57.51	114
<i>Medicago sativa</i> 50%+ <i>Dactylis</i> <i>glomerata</i> 50%	Unfertilized	2.29	14.32 ^o	10.97 ^o	38.97*	44.33*	58.53	123
	N ₅₀ P ₅₀	2.59	16.17 ^o	10.54 ^o	40.03*	47.96*	57.73	114
	N ₇₅ P ₅₀	2.72	16.98*	10.34	42.29*	49.30*	55.96	106
	N ₁₀₀ P ₅₀	2.80	17.52*	10.18*	43.50*	50.57*	55.02	101
LSD	0.05	0.2%	0.2%	0.2%	0.2%			

Analyzing data from 2010 on the chemical composition of

feed produced, the best feed was obtained from control variant

(RFV = 158, premium class forage) and from *Medicago sativa* 100% variants (RFV = 149-140, premium forage). Forage of premium and good

quality was obtained from 75% - 25% mixture (RFV = 130-113). Forage of good and fair quality was obtained from 50% - 50% mixture (RFV = 122-101).

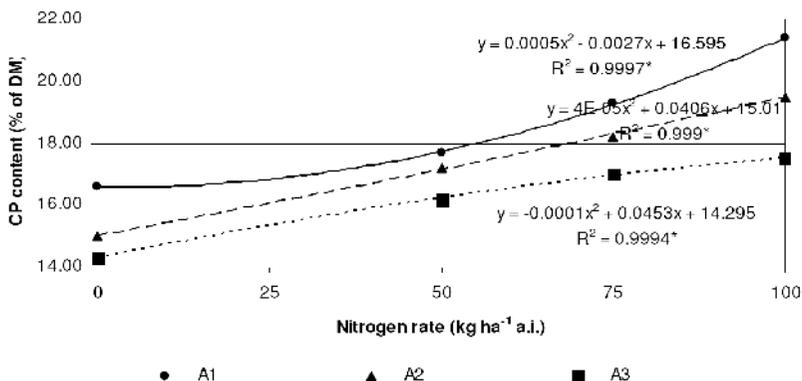


Figure 6. Polynomial line regression of the nitrogen dose for the CP content in 2010

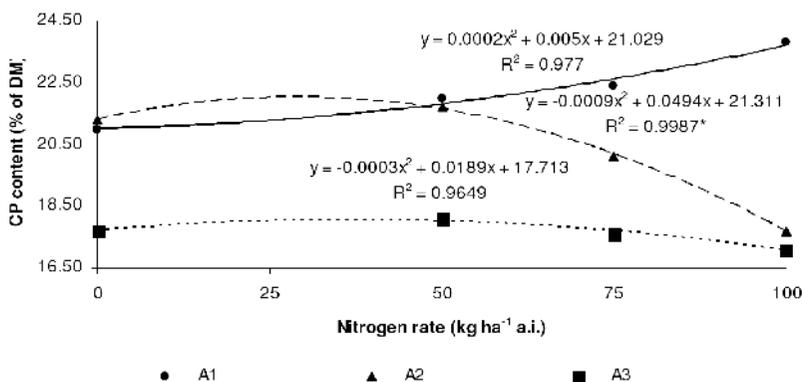


Figure 7. Polynomial line regression of the nitrogen dose for the CP content in 2011

In 2011 crude protein content of feed was higher than in 2010. Highest content was obtained from *Medicago*

sativa 100% variant fertilized with dose of N₁₀₀, respectively 23.79% CP of DM based.

Table 3

Influence of mixture and fertilization on the chemical composition of forage on the first harvest (2011), DM based

Variants		NT%	CP%	Ash%	ADF%	NDF%	DDM	RFV
<i>Medicago sativa</i> 100%	Unfertilized	3.37	21.03	8.85	29.29	37.61	66.11	164
	N ₅₀ P ₅₀	3.53	22.04*	8.22*	29.89*	40.57*	65.60	150
	N ₇₅ P ₅₀	3.58	22.36*	9.70*	31.91*	39.60*	64.02	150
	N ₁₀₀ P ₅₀	3.81	23.79*	9.89 ^o	32.01*	39.93*	63.95	149
<i>Medicago sativa</i> 75%+ <i>Dactylis</i> <i>glomerata</i> 25%	Unfertilized	3.40	21.25*	8.01 ^o	35.78*	41.88*	60.82	135
	N ₅₀ P ₅₀	3.47	21.69*	8.22 ^o	36.02*	43.40*	60.85	129
	N ₇₅ P ₅₀	3.22	20.11 ^o	9.22 ^o	37.66*	46.32*	59.57	120
	N ₁₀₀ P ₅₀	2.84	17.74 ^o	9.91 ^o	38.29*	46.79*	59.07	117
<i>Medicago sativa</i> 50%+ <i>Dactylis</i> <i>glomerata</i> 50%	Unfertilized	2.83	17.69 ^o	8.39 ^o	36.27*	43.23*	60.87	131
	N ₅₀ P ₅₀	2.89	18.06 ^o	8.48 ^o	38.03*	46.96*	59.28	117
	N ₇₅ P ₅₀	2.82	17.62 ^o	8.97 ^o	39.29*	49.00*	58.30	111
	N ₁₀₀ P ₅₀	2.73	17.07 ^o	9.27 ^o	41.50*	48.87*	56.57	108
LSD	0.05	0.2%	0.1%	0.1%	0.3%			

Crude protein content from mixtures of 75% - 25% and 50% - 50% decreased with increasing doses of nitrogen, because of the increasing proportion of *Dactylis glomerata* in the mixtures and its high stage of maturity at harvest (fig. 7). ADF and NDF contents also increased for mixture variants compared to 2010 values (Table 3). The only significant correlation between nitrogen fertilization rate and crude protein content was obtained for mixture *Medicago sativa* 75%

+ 25 % *Dactylis glomerata* for $p = 5\%$, $r^2 = 0.998^*$ (fig. 7). Analyzing data from 2011 on the chemical composition of feed produced, the best feed was obtained from control variant (RFV = 164, premium class forage) and from *Medicago sativa* 100% variants (RFV = 149-150, premium forage). Forage of premium and good quality was obtained from 75% - 25% mixture (RFV = 135-117). Forage of premium and good quality was also obtained from 50% - 50%

mixture (RFV = 131-108) (Table 3).

CONCLUSIONS

Both in 2010 and 2011 the average DM productions were higher on *Medicago sativa* 75% + 25% *Dactylis glomerata* mixture followed by mixture *Medicago sativa* 50% + 50% *Dactylis glomerata*, both mixtures surpassing *Medicago sativa* 100%. Thus, in 2010 the highest average production of 4.63 Mg ha⁻¹ was obtained by mixture *Medicago sativa* 75% + 25% *Dactylis glomerata* with a fertilization dose used of N₁₀₀P₅₀, registering an increase of 15% compared to control variant.

In 2011 the highest average production of 5.94 Mg ha⁻¹ was obtained by mixture *Medicago sativa* 75% + 25% *Dactylis glomerata* with a fertilization dose used of N₁₀₀P₅₀, registering an increase of 18% compared to control variant.

On 75% - 25% mixture at harvest time in 2010, the share increased in all variants of fertilization in favor of *Medicago sativa* reaching 79%

(N₀P₀ and N₅₀P₅₀) and 78% (N₇₅P₅₀) and 77% respectively at N₁₀₀P₅₀ rate.

On 50% - 50% mixtures at harvest time in 2010, the share increased in all variants of fertilization in favor of *Medicago sativa* reaching 62% and 61% (at doses of N₀P₀ and N₅₀P₅₀), 56% (N₇₅P₅₀) and 52% respectively at N₁₀₀P₅₀ rate.

In year 2011, on 50% - 50% mixtures the *Medicago sativa* mixture share decreased to 58% on unfertilized variant and to 53% at N₅₀ rate and highly increased the share of *Dactylis glomerata* to 52% and 55% at variants fertilized with rates of N₇₅ and N₁₀₀ respectively.

Crude protein content from mixtures of 75% - 25% and 50% - 50% decreased in 2011 with increasing doses of nitrogen, because of the increasing proportion of *Dactylis glomerata* in the mixtures and its high stage of maturity at harvest.

Both in 2010 and 2011 the best forage quality was obtained from the alfalfa in pure culture, recording increases in crude protein values with increasing doses of nitrogen and low ADF and NDF compared to mixtures.

The best mixture was 75% - 25% who achieved both the greatest dry matter productions and a premium forage quality using N₇₅P₅₀ and N₁₀₀P₅₀ fertilization doses.

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