

INFLUENCE OF MINERAL FERTILIZATION ON THE PRODUCTION OF A MIXTURE OF ALFALFA AND ORCHARD GRASS IN THE YEAR III OF VEGETATION

INFLUENȚA FERTILIZĂRII MINERALE ASUPRA PRODUCȚIEI LA AMESTECUL DE LUCERNĂ ȘI GOLOMĂȚ ÎN ANUL III DE VEGETAȚIE

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Abstract: This study was conducted during three production cycles of the third year of vegetation. The main objective was to determine the production of dry matter (DM) and crude protein (CP) made under the influence of mixture and fertilization with nitrogen on P₅₀ agrofond to alfalfa and orchard grass. To achieve these objectives, three variants of mixture were tested between alfalfa and cocksfoot that were applied to four rates of mineral fertilizers. The mixture 75% alfalfa (*Medicago sativa* L.) and 25% orchard grass (*Dactylis glomerata* L.) under the effect of dosing with N₁₀₀P₅₀ achieved the highest production increase of DM on cycle I, 108% (5.24 Mg ha⁻¹ DM) compared to the control, unfertilized alfalfa in pure culture (4.85 Mg ha⁻¹ DM). The highest increase for the CP yield was obtained on cycle I from the 100% alfalfa fertilized with doses of N₁₀₀P₅₀, 122% (1230 kg ha⁻¹ CP) from 100% alfalfa unfertilized (1009 kg ha⁻¹ CP). Alfalfa fertilized with N₁₀₀P₅₀ rate had the highest increases on total DM yield (106%, 10.64 Mg ha⁻¹ DM) and on total quantity of CP (124%, 2304 kg ha⁻¹ CP).

Keywords: mixture, fertilization, alfalfa, orchard grass, production

Rezumat: Prezentul studiu cuprinde datele pe trei cicluri de producție din anul al treilea de cultură. Principalul obiectiv l-a constituit determinarea producției de substanță uscată (SU) și de proteină brută (PB) sub influența amestecului și a fertilizării cu azot pe agrofondul P₅₀ la lucernă și golomăț. Pentru a realiza acest obiectiv, am experimentat trei variante de amestec între lucernă și golomăț la care s-au aplicat patru rate de îngrășăminte minerale. Amestecul lucernă 75% (*Medicago sativa* L.) + 25% golomăț (*Dactylis glomerata* L.) la doza de N₁₀₀P₅₀ a realizat cel mai mare spor privind producția de SU la ciclul I, de 108% (5,24 t/ha SU), comparativ cu martorul lucernă simplă nefertilizată (4,85 t/ha SU). Cel mai mare spor pentru cantitatea de PB a fost obținut la ciclul I de la lucernă 100% fertilizată cu N₁₀₀P₅₀, de 122% (1230 kg/ha PB), comparativ cu martorul (1009 kg/ha PB). Lucerna în cultură pură fertilizată cu doza maximă N₁₀₀P₅₀ a realizat cele mai mari sporuri la producția totală de SU (106%, 10,64 t/ha SU) și la cantitatea totală de PB (124%, 2304 kg/ha PB).

Cuvinte cheie: amestec, fertilizare, lucernă, golomăț, producție

With the modernization of Romanian agriculture, of the livestock sector by exploiting a biological material with a high productive potential, it has become imperative the intensification of grasslands. This can be done both through the use of valuable species and very productive cultivars of legumes and perennial grasses, blending perennial legumes and grasses, applying some agri-technology measures and through proper management of grasslands (Vîntu V. et al, 2004; Deak A. et al, 2009).

Association of alfalfa in mixture with orchard grass is regarded as one of the best options for intensive sown grasslands, cocksfoot being a specie that has a versatility and a growth rate

similar to alfalfa, both cultures, in optimal conditions, have a longevity of at least 4 year (Sanderson M.A. et al, 2005; Skinner R.H. et al., 2006).

Mixture of alfalfa with orchard grass has some important advantages such as: higher productivity compared with alfalfa grown in pure culture, high yields of protein, nitrogen fertilizer economy (Tomić Z. et al., 2011), obtaining a balanced energy-protein feed, good conservation by silage opportunities, better recovery capacity of the soil structure, etc (Lazaridou M., Noitsakis B., 2004).

MATERIAL AND METHODS

In order to achieve our objectives it was established an experience on Ezăreni Farm of the Didactic Resort of USAMV Iasi. The experience is placed on a cambium chernozem soil with pH values between 6.7 and 6.8 and humus content of 2.73-2.93%, 21-25 ppm P_{AL} , 226-232 ppm K_{AL} and 112 - 139 ppm CaO .

Prezent study is referring to the production data of the three harvesting cycles during of third experimental year, 2012. During the growing season (April-September), the average temperature was 19.1 °C with 1.8°C positive deviation from the annual average (17.3°C). The amount of growing season rainfall (281.2 mm) was with 54.3 mm lower than the annual average (335.5 mm). Spring was wet, but July, August and September were the months which recorded high negative deviations, of 19.6 mm, 38.1 mm and 34.3 mm compared to annual averages (69.2 mm, 57.6 mm, 40.8 mm), considering it under this aspect and temperature as a very dry period..

The studied factors were: Factor A: type of crop, three graduations: a1 - 100% alfalfa (Mt.), a2 - 75% alfalfa + 25% orchard grass, a3 - 50% alfalfa + 50% orchard grass. Factor B: mineral fertilization with four graduations: b1 - N_0P_0 (Mt.), b2 - $N_{50}P_{50}$, b3 - $N_{75}P_{50}$, b4 - $N_{100}P_{50}$. For sowing it was used seeds of Romanian alfalfa (*Medicago sativa* L.) Magnat cultivar and seeds of Danish orchard grass (*Dactylis glomerata* L.) Ambassador cultivar. Seed mix was done manually calculating and weighing the proportions and quantities depending on the quality parameters of each.

For fertilization were used ammonium nitrate ($N_{33.5}$) and nitrogen-phosphorus complex ($N_{20}P_{20}$). Mineral fertilizers were applied to the establishment of experience, with doses calculated for each variant. The harvest of cycle I was made at full flowering of orchard grass and at beginning of bud stage of alfalfa and the next two at full bud stage of alfalfa, orchard grass being at different vegetative stages.

On mixture 75% - 25% at harvest of cycle I, the participation rate of alfalfa in the canopy cover structure had decreased on fertilized variants from 83% (unfertilized) and 82% ($N_{50}P_{50}$ și $N_{75}P_{50}$) to 79%, on rate of $N_{100}P_{50}$. On cycle II, because of the poor reestablishment of the orchard grass after harvest, the participation rate of alfalfa in mixture 75% - 25% increased to 89% in unfertilized variant and to 87% and 85% in variants fertilized with rates of N_{75} și N_{100} , respectively. On cycle III,

alfalfa has dominating almost completely the canopy cover. On mixture of 50% - 50%, on first harvesting cycle, the rate of alfalfa in the canopy civer structure decreased from 62% in unfertilized variant to 49% and 45% in variants fertilized with rates of $N_{75}P_{50}$ and $N_{100}P_{50}$, respectively, increasing instead the rate of orchard grass. On cycle II, the participating rate of alfalfa in mixtures increased to 72% in unfertilized variant and 70% at rate of $N_{50}P_{50}$ and considerably decreased the rate of orchard grass to 37% and 43% in variants fertilized with rates of $N_{75}P_{50}$ and $N_{100}P_{50}$, respectively.

The statistical interpretation of data was performed by analysis of variance and differences limit calculation using SPSS software - ANOVA (Statistical Package for the Social Sciences).

RESULTS AND DISCUSSION

The combined influence of mixture and fertilization over dry matter (DM) production

In this study, we sought to emphasize the performance of mixture compared to alfalfa in pure culture, using low doses of nitrogen fertilizers based on the fact that cocksfoot can also benefit of alfalfa's nitrogen produced by symbiotic bacteria attached to its roots.

On cycle I, both alfalfa grown in pure culture and mixture 75% alfalfa + 25% orchard grass, showed significant differences in the DM yield compared to the control (4.85 Mg ha⁻¹ DM) only at the highest rates of fertilizer. The mixture 50% alfalfa + 50% orchard grass showed significant differences only at fertilized variant with dose of $N_{100}P_{50}$ (table 1). The mixture 75% alfalfa + 25% orchard grass had the highest yield of DM, of 5.24 Mg ha⁻¹ DM (108% increase) at $N_{100}P_{50}$ dose, followed closely by alfalfa 100% yield obtained at the same dose of fertilizer (5.22 Mg ha⁻¹ DM).

On the cycle II of production, only 100% alfalfa variant had significant differences compared to the control (3.39 Mg ha⁻¹ DM) and the highest yield of DM, 3.55 Mg ha⁻¹ DM for the variant fertilized with dose of $N_{100}P_{50}$ and also surpassing at dose of $N_{50}P_{50}$ (3.41 Mg ha⁻¹ DM) the maximum yields obtained by the two mixtures (2.92 Mg ha⁻¹ DM and 2.90 Mg ha⁻¹ DM).

The mixture 50% alfalfa + 50% orchard grass had negative significant differences on all variants of fertilization. On cycle III, both mixtures had negative significant differences compared to unfertilized alfalfa (tab.1). In 2012, combined the yields from the all three cycles, the highest DM



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production was obtained from 100% alfalfa (10.64 Mg ha⁻¹ DM, N₁₀₀P₅₀ dose), higher by 0.82 Mg ha⁻¹ from the total production of mixture 75% alfalfa + 25% orchard grass (9.82 Mg ha⁻¹ DM) and by 1.08 Mg ha⁻¹ DM from the total production of mixture

of 50% alfalfa + 50% orchard grass which produced 9.54 Mg ha⁻¹ DM at N₁₀₀P₅₀ dose (tab.3). Unfertilized variants of both mixtures showed negative significant differences compared to the control production.

Table 1.

Influence on cycles of interaction mixture x fertilization over dry matter production (DM) in year 2012

Varianta	N ₀ P ₀ (unfertilized, Mt)			N ₅₀ P ₅₀			N ₇₅ P ₅₀			N ₁₀₀ P ₅₀		
	Cycle I	Cycle II	Cycle III	Cycle I	Cycle II	Cycle III	Cycle I	Cycle II	Cycle III	Cycle I	Cycle II	Cycle III
	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹	Mg ha ⁻¹
Alfalfa 100% (Mt.)	4.85	3.39	1.81	4.98	3.41	1.82	5.14*	3.48	1.84	5.22*	3.55*	1.87
Alfalfa 75% + Orchardgrass 25%	4.74	3.31	1.78	4.92	3.27	1.74	5.15*	3.03 ⁰	1.70 ⁰	5.24*	2.92 ⁰	1.66 ⁰
Alfalfa 50% + Orchardgrass 50%	4.68	3.08 ⁰	1.68 ⁰	4.82	2.98 ⁰	1.63 ⁰	4.98	2.96 ⁰	1.61 ⁰	5.06*	2.90 ⁰	1.58 ⁰
LSD 5% Mg ha ⁻¹	0.18	0.14	0.09	0.18	0.14	0.09	0.18	0.14	0.09	0.18	0.14	0.09

The combined influence of mixture and fertilization over crude protein (CP) yield

On harvest cycle I, 100% alfalfa showed significant differences on the yield of crude protein (CP) compared to the control (1009 kg ha⁻¹) at all doses of fertilizer applied. The mixture 75% alfalfa + 25% orchard grass and mixture 50% alfalfa + 50% orchard grass showed no significant positive differences from control, mixture 50% alfalfa + 50% orchard grass having significant negative differences at all his variants (tab.2).

The 100% alfalfa variant had the highest yield of CP, 1230 kg ha⁻¹ CP (122% increase) at dose of N₁₀₀P₅₀. On harvest cycle II, 100% alfalfa registered significant differences regarding the yield of CP comparative to control (555 kg ha⁻¹ CP) at all fertilizer rates applied, making a maximum yield of 752 kg ha⁻¹ CP at rate of N₁₀₀P₅₀.

On mixture 75% alfalfa + 25% orchard grass the highest yield of protein obtained was 564 kg ha⁻¹ CP on variant fertilized with N₁₀₀P₅₀. On mixture 50% alfalfa + 50% orchard grass the highest yield of crude protein obtained was 505 kg ha⁻¹ CP on variant fertilized with rate of N₁₀₀P₅₀.

On the cycle III, both mixtures had negative significant differences from unfertilized alfalfa who achieved 296 kg ha⁻¹ CP (tab.2). The CP production of mixture 75% alfalfa + 25% orchard grass ranged from 245 kg ha⁻¹ CP on N₁₀₀P₅₀ dose to 290 kg ha⁻¹ CP for the unfertilized variant, and the production of mixture 50% alfalfa + 50% orchard grass ranged from 232 kg ha⁻¹ CP on N₁₀₀P₅₀ dose to 274 kg ha⁻¹ CP on unfertilized variant.

Significant differences compared to the control and the highest total yield of CP in 2012 were obtained from 100% alfalfa (2304 kg ha⁻¹ CP, 124% increase on N₁₀₀P₅₀ dose), higher by 414 kg ha⁻¹ CP to total production of the mixture 75% alfalfa + 25% orchard grass (1889 kg ha⁻¹ CP on N₁₀₀P₅₀ dose) and by 683 kg ha⁻¹ CP to total production of CP from mixture 50% alfalfa + 50% orchard grass which produced 1621 kg ha⁻¹ CP on N₁₀₀P₅₀ dose (tab.3).

The mixture 50% alfalfa + 50% orchard grass showed negative significant differences from unfertilized alfalfa (control) on all variants of fertilization.

Table 2.

Influence on cycles of interaction mixture x fertilization over yield of crude protein (CP) in year 2012

Varianta	N ₀ P ₀ (unfertilized-Mt.)			N ₅₀ P ₅₀			N ₇₅ P ₅₀			N ₁₀₀ P ₅₀		
	Cycle I	Cycle II	Cycle III	Cycle I	Cycle II	Cycle III	Cycle I	Cycle II	Cycle III	Cycle I	Cycle II	Cycle III
	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹	kg ha ⁻¹
Alfalfa 100% (Mt.)	1009	555	296	1086*	599*	301	1137*	663*	314	1230*	752*	321*
Alfalfa 75% + Orchardgrass 25%	995	488 ⁰	290	1055	556	278	1024	545	272	917 ⁰	564	245 ⁰
Alfalfa 50% + Orchardgrass 50%	816 ⁰	435 ⁰	274	858 ⁰	477 ⁰	261 ⁰	866 ⁰	498 ⁰	258 ⁰	851 ⁰	505 ⁰	232 ⁰
LSD 5% kg ha ⁻¹	77	44	25	77	44	25	77	44	25	77	44	25

Table 3.

Influence of interaction mixture x fertilization over total dry matter (DM) and crude protein (CP) yields in year 2012

Varianta	N ₀ P ₀ (unefertilizat-Mt.)		N ₅₀ P ₅₀		N ₇₅ P ₅₀		N ₁₀₀ P ₅₀	
	Total	Total	Total	Total	Total	Total	Total	Total
	Mg ha ⁻¹ DM	kg ha ⁻¹ CP	Mg ha ⁻¹ DM	kg ha ⁻¹ CP	Mg ha ⁻¹ DM	kg ha ⁻¹ CP	Mg ha ⁻¹ DM	kg ha ⁻¹ CP
Alfalfa 100% (Mt.)	10,05	1861	10,21	1986	10,46	2115*	10,64*	2304*
Alfalfa 75% + Orchardgrass 25%	9,83	1774	9,93	1889	9,88	1841	9,82	1726 ⁰
Alfalfa 50% + Orchardgrass 50%	9,44 ⁰	1525 ⁰	9,43 ⁰	1596 ⁰	9,55 ⁰	1621 ⁰	9,54 ⁰	1584 ⁰
LSD 5%	0,48 Mg ha ⁻¹	131 kg ha ⁻¹	0,48 Mg ha ⁻¹	131 kg ha ⁻¹	0,48 Mg ha ⁻¹	131 kg ha ⁻¹	0,48 Mg ha ⁻¹	131 kg ha ⁻¹

CONCLUSIONS

On cycle I, the mixture 75% *alfalfa* + 25% *orchard grass* had the highest yield of DM, of 5.24 Mg ha⁻¹ DM (108% increase) at N₁₀₀P₅₀ dose, followed closely by *alfalfa 100%* yield obtained at the same dose of fertilizer (5.22 Mg ha⁻¹ DM).

In 2012, combined the yields from the all three cycles, the highest DM production was obtained from 100% *alfalfa* (10.64 Mg ha⁻¹ DM, N₁₀₀P₅₀ dose), higher by 0.82 Mg ha⁻¹ from the total production of mixture 75% *alfalfa* + 25% *orchard grass* (9.82 Mg ha⁻¹ DM) and by 1.08 Mg ha⁻¹ DM from the total production of mixture of 50% *alfalfa* + 50% *orchard grass* which produced 9.54 Mg ha⁻¹ DM at N₁₀₀P₅₀ dose.

Significant differences compared to the control and the highest total yield of CP in 2012 were obtained from 100% *alfalfa* (2304 kg ha⁻¹ CP, 124% increase on N₁₀₀P₅₀ dose), higher by 414 kg ha⁻¹ CP to total production of the mixture 75% *alfalfa* + 25% *orchard grass* (1889 kg ha⁻¹ CP on N₁₀₀P₅₀ dose) and by 683 kg ha⁻¹ CP to total production of CP from mixture 50% *alfalfa* + 50% *orchard grass* which produced 1621 kg ha⁻¹ CP on N₁₀₀P₅₀ dose.

ACKNOWLEDGMENTS

This work was co-financed from the European Social Fund through Sectoral Operational Program Human Resource Development 2007-2013, POSDRU/88/1.5/S/52176 „Supporting the participation of doctoral students in doctoral programs”.

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