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The Distribution of Fresh Matter Yields in Some Mixtures of Perennial Grasses and Legumes

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Abstract. For many farmers the temporary pasture represents an alternative source in the constant supplying with fresh matter (FM) fodder for animals. The use of perennial fodder grass-legume mixtures best adapted to the local ecological conditions as well as the knowledge of the opportunity of fertilization can represent the guaranty and the efficiency of this source. The knowledge of fresh matter yield distribution on cuttings and on different fertilization doses in accordance with the ecological conditions of a specific zone permits a rational planning of fodder crops structure in a farm. The yields of M5 mixture (*Trifolium pratense, Dactylis glomerata, Festulolium, Phleum pratense, Lolium perenne*) on the three doses of fertilization varied very little, reason for it is recommended to be cultivated without fertilization in the similar ecological conditions with those from Jucu.

Keywords: yield, fresh matter, fertilization, cutting

INTRODUCTION

The actual climatic changes and the coming out of new plant varieties impose to the farmers the choosing of a new strategy both in plants culture and in pastures culture (De Vliegher and Carlier, 2009; Peeters, 2009). In these conditions in the selection of fodder plants for temporary pastures it is necessary to know the newest information regarding the species and the cultivars of perennial fodder plants (Motcă *et. al.* 1994; Vintu *et. al.* 2010) available on the certified seeds market in Romania. Because of the absence of such information in the Transylvanian area it was considered as necessary to reload the research for the establishment of new perennial fodder grass-legume complex mixtures which have to permit to the farmers a rational planning of perennial fodder crops structure.

MATERIALS AND METHODS

The results presented in this paper were obtained based on the research done in 2010 in the experimental field of Jucu in the Didactic Station of UASVM Cluj-Napoca. The experiment was organized by subdivided plots method with 9 crops (8 complex mixtures composed of perennial fodder grasses and legumes, respectively a control variant represented by pure alfalfa crop), 3 levels of fertilization (N0P0, N60P70 and N120P70 kg·ha^{-1}) and 3 replications. Those nine variants comprised the following species and mixtures (M): M1. *Medicago sativa;* M2. *Medicago sativa, Trifolium alexandrinum, Dactylis glomerata, Lolium hybridum;* M3. *Lotus corniculatus, Onobrychis viciifolia, Dactylis glomerata, Festuca pratensis, Bromus inermis;* M4. *Medicago sativa, Dactylis glomerata, Festuca arundinacea, Lolium perenne;* M5. *Trifolium pratense, Dactylis glomerata, Festulolium, Phleum pratense, Lolium perenne;* M6. *Lotus corniculatus, Phleum pratense, Dactylis glomerata, Festuca arundinacea, Festuca pratensis;* M7. *Trifolium pratense, Lotus corniculatus, Trifolium alexandrinum, Dactylis glomerata, Festuca pratensis, Lolium hybridum;* M8. *Trifolium*

pratense, Trifolium repens, Dactylis glomerata, Festuca pratensis, Phleum pratense, Lolium hybridum, Lolium perenne; M9. *Medicago sativa, Trifolium repens, Bromus inermis, Festuca arundinacea, Lolium hybridum.*

The experiment was set in the spring of 2009 and after sowing the fertilization of variants according to the experimental scheme (N0P0, N60P70 and N120P70 kg·ha^{-1}) was done.

During vegetation period scavenging cuttings were done because the sown species appeared very hard being affected by drought and strongly competed by weeds. In the second year of vegetation and first year of production (2010) the variants were over-sown in March. In 2010 during vegetation period three cuttings in the heading phenophase of grasses were done. The above mentioned fertilization doses were applied after the first cutting. The fresh matter yield of each variant was determined by gravimetric method. The obtained data were statistical analyzed using Duncan and ANOVA tests.

RESULTS AND DISCUSION

At the first cutting on unfertilized soil in all mixtures increases of fresh matter yields in comparison with pure alfalfa crop were recorded (table 1). It has to be remarked that among those four mixtures (M3, M5, M7, M8) which recorded very significant yield increases in comparison with alfalfa crop (table 3), M7 and M8 are new mixtures in comparison with those recommended for the studied area (M3) or available on market (M5). The obtained fresh matter yield increases varied between 4.69 t·ha^{-1} in M3 and 7.58 t·ha^{-1} in M5. The yield differences recorded among these four variants were significantly in comparison with the yield of M5, pointing out the importance of species in the achievement of the highest yield. The fertilization with N60P70 kg·ha^{-1} dose determined the decrease of fresh matter yield in pure alfalfa crop in comparison with unfertilized alfalfa crop. At this fertilization dose very significant yield increases in comparison with pure alfalfa crop were obtained in the M5, M7 and M8 mixtures (Tab. 3), but the yield differences recorded among these mixtures were not significantly.

Based on comparison of the yields obtained by each one of the three mixtures on fertilized and unfertilized soil it can be observed that yield differences are not significantly. In case of the maximum fertilization dose (N120P70 kg·ha^{-1}) a stronger yield decrease than in case of medium dose was recorded in pure alfalfa crop but the yield difference registered in comparison with unfertilized alfalfa crop was not significantly.

The mixtures M8, M7 and M5 recorded as well at this maximum fertilization dose high fodder yields, comprised between 8.17 t·ha^{-1} and 9.03 t·ha^{-1}. The comparison of yields obtained by M8, M7 and M5 mixtures at maximum fertilization dose with the yields obtained for all the other fertilization doses does not indicate statistical significant differences. After the first cutting the fertilization according to the experimental scheme for 2010 was applied.

It has to be remarked that at the second cycle of cutting on unfertilized soil the yields obtained for all variants were higher than at the first cutting (table 1). For most of the mixtures the fresh matter yields on unfertilized soil were higher than that of pure alfalfa crop. Among all unfertilized variants only in M5, M7 and M8 mixtures very significant yield increases (12.06 t·ha^{-1} FM) respectively distinct significant yield increases (10.86 t·ha^{-1} FM and 9.34 t·ha^{-1} FM) in comparison with the alfalfa crop were obtained (Tab. 3). Of the yield differences recorded among the three variants, only the difference between M5 and M8 (2.71 t·ha^{-1} FM) was significantly.

Tab. 1

The influence of interaction of mixture and fertilization factors on the fresh matter yield (t·ha^{-1}) at first and second cutting

Variants Fertilization/Mixture		FM yield (t·ha^{-1})	Signification	Variants Fertilization/Mixture		FM yield (t·ha^{-1})	Signification
F3	M1	2.16	A	F2	M2	8.14	A
F2	M1	2.47	A	F1	M2	8.85	A
F1	M1	3.25	AB	F3	M2	9.08	A
F1	M4	4.48	BC	F2	M4	11.29	B
F3	M6	4.59	BCD	F1	M4	11.33	B
F2	M4	5.25	CDE	F3	M4	11.60	B
F1	M6	5.35	CDE	F2	M1	13.23	BC
F2	M2	5.37	CDE	F3	M3	13.33	BC
F3	M2	5.49	CDE	F3	M1	13.68	BCD
F3	M4	5.51	CDE	F1	M1	13.75	BCD
F1	M2	5.83	CDEF	F2	M3	14.78	CD
F3	M3	6.05	CDEFG	F1	M3	15.99	DE
F2	M6	6.58	DEFGH	F3	M6	16.09	DE
F2	M3	6.63	EFGHI	F2	M9	17.99	EF
F2	M9	6.64	EFGHI	F3	M9	18.06	EF
F1	M9	7.19	EFGHIJ	F1	M9	18.53	F
F3	M9	7.51	FGHIJ	F1	M6	18.71	F
F1	M3	7.94	GHIJK	F2	M6	19.11	F
F2	M8	8.14	HIJK	F3	M7	22.15	G
F3	M8	8.17	HIJK	F1	M8	23.10	GH
F1	M8	8.28	HIJK	F2	M8	23.14	GH
F3	M7	8.40	HIJK	F3	M5	23.28	GH
F1	M7	8.61	IJK	F2	M7	23.46	GHI
F3	M5	9.03	JKL	F2	M5	23.75	GHI
F2	M7	9.08	JKL	F1	M7	24.61	GHI
F2	M5	9.63	KL	F3	M8	25.52	HI
F1	M5	10.83	L	F1	M5	25.81	I
Theoretic significant differences (5%): 1.72-2.08				Theoretic significant differences (5%): 2.19-2.65			

At the N60P70 kg·ha^{-1} fertilization dose both pure alfalfa crop and most of the mixtures recorded decreases of fresh matter yields in comparison with the variants placed on unfertilized soil. Distinct significant fresh matter yield increases at this fertilization dose in comparison with pure alfalfa crop (table 3) were obtained in M5, M7 and M8 mixtures (10.52 t·ha^{-1}, 10.23 t·ha^{-1} and 9.90 t·ha^{-1}). The yield differences among these three variants were not significantly. Fertilization with N120P70 kg·ha^{-1} dose determined distinct significant and significant yield increases in M5, M8 and M7 mixtures (table 3). Of the yield differences recorded among the three mixtures only that one between M8 and M7 (3.36 t·ha^{-1} FM) was significantly.

At the third cutting on unfertilized soil the lowest yield (2.70 t·ha^{-1} FM) was obtained in pure alfalfa crop and the highest yield (10.09 t·ha^{-1} FM) was obtained in M7 mixture (Tab. 2).

Tab. 2

The influence of interaction of mixture and fertilization factors on the fresh matter yield (t·ha^{-1}) at the third cutting

Variants Fertilization/Mixture		FM yield (t·ha^{-1})	Signification	Theoretic significant differences (5%)
F1	M1	2.70	A	
F1	M2	3.89	B	1.16
F1	M4	5.03	B	1.22
F2	M1	6.48	C	1.25
F2	M2	6.99	CD	1.28
F1	M3	7.21	CDE	1.3
F1	M6	7.85	DEF	1.32
F1	M8	8.25	EF	1.33
F3	M1	8.45	EFG	1.34
F1	M9	9.03	FGH	1.35
F1	M5	9.61	GHI	1.36
F3	M2	10.01	HIJ	1.37
F1	M7	10.09	HIJ	1.37
F2	M3	10.82	IJK	1.38
F2	M4	10.89	JK	1.38
F2	M9	10.93	JK	1.39
F2	M6	11.80	KL	1.39
F3	M3	12.23	LM	1.39
F2	M7	12.57	LMN	1.39
F2	M8	12.73	LMNO	1.4
F3	M9	12.98	LMNO	1.4
F2	M5	13.15	MNO	1.4
F3	M6	13.64	NO	1.4
F3	M7	13.64	NO	1.4
F3	M8	13.67	NO	1.4
F3	M4	13.69	NO	1.4
F3	M5	13.95	O	1.4

At the third cutting on unfertilized soil all the mixtures obtained very significant yield increases in comparison with pure alfalfa crop (Tab. 3). The comparison among the yields obtained at the third cutting by the mixtures which recorded the highest yields at the first and the second cuttings (M5, M7 and M8) showed that between M7 and M5 were not recorded significant fresh matter yield differences while between M7 and M8 (1.84 t·ha^{-1}) and between M5 and M8 (1.36 t·ha^{-1}) were recorded significant fresh matter yield differences.

The fertilization with N60P70 kg·ha^{-1} dose determined the increase of fodder yield in all variants in comparison with unfertilized variants. The highest fresh matter yields were obtained in M5, M8 and M7 mixtures (13.15 t·ha^{-1}, 12.73 t·ha^{-1}, 12.57 t·ha^{-1}), but the yield differences among these mixtures were not significantly. At the fertilization with maximum dose N120P70 kg·ha^{-1} in all variants were recorded yield increases in comparison with the yields obtained at the fertilization with N60P70 kg·ha^{-1} dose. Five of the mixtures (M7, M6, M8, M4 and M5) recorded very near fresh matter yields, which varied between 13.64 t·ha^{-1} and 13.95 t·ha^{-1}, even if the differences recorded among these variants were not significantly.

Tab. 3

The influence of mixture and fertilization factors on the fresh matter yields (t·ha^{-1}) and the distribution of the yields on the three cuttings

Mixture	First cutting			Second cutting			Third cutting		
	N0P0 kg·ha^{-1}	N60P70 kg·ha^{-1}	N120P70 kg·ha^{-1}	N0P0 kg·ha^{-1}	N60P70 kg·ha^{-1}	N120P70 kg·ha^{-1}	N0P0 kg·ha^{-1}	N60P70 kg·ha^{-1}	N120P70 kg·ha^{-1}
M1-control	3.25	2.47	2.16	13.75	13.23	13.68	2.70	6.48	8.45
M2	5.83*	5.37*	5.49**	8.85	8.14	9.08	3.89*	6.99***	10.01*
M3	7.94***	6.63**	6.05**	15.99	14.78	13.33	7.21***	10.82***	12.23***
M4	4.48	5.25*	5.51**	11.33	11.29	11.60	5.03***	10.89***	13.69***
M5	10.83***	9.63***	9.03***	25.81***	23.75**	23.28**	9.61***	13.15***	13.95***
M6	5.35	6.58**	4.59*	18.71	19.11	16.09	7.85***	11.80***	13.64***
M7	8.61***	9.08***	8.40***	24.61**	23.46**	22.15*	10.09***	12.57***	13.64***
M8	8.28***	8.14***	8.17***	23.10**	23.14**	25.52**	8.25***	12.73***	13.67***
M9	7.19**	6.64**	7.51***	18.53	17.99	18.06	9.03***	10.93***	12.98***
LSD 5% 2.29				LSD 5% 6.30			LSD 5% 1.18		
LSD 1% 3.12				LSD 1% 8.65			LSD 1% 1.60		
LSD 0.1% 4.23				LSD 0.1% 11.87			LSD 0.1% 2.14		

Tab. 4

Distribution of mixture yields on cuttings as influenced by fertilization

Variant/ Fertilization/ Mixture	Fresh matter yield - first cutting (t·ha^{-1})	Ratio from the total yield %	Fresh matter yield - second cutting (t·ha^{-1})	Ratio from the total yield %	Fresh matter yield - third cutting (t·ha^{-1})	Ratio from the total yield %	Total yield (t·ha-1)
F1M1	3.25	16.50	13.75	69.80	2.70	13.70	19.70
F1M5	10.83	23.42	25.81	55.80	9.61	20.78	46.25
F1M7	8.61	19.88	24.61	56.82	10.09	23.30	43.31
F1M8	8.28	20.89	23.10	58.29	8.25	20.82	39.63
F2M1	2.47	11.14	13.23	59.65	6.48	29.21	22.18
F2M5	9.63	20.70	23.75	51.00	13.15	28.30	46.53
F2M7	9.08	20.13	23.46	52.00	12.57	27.87	45.11
F2M8	8.14	18.50	23.14	52.58	12.73	28.92	44.01
F3M1	2.16	8.89	13.68	56.32	8.45	34.79	24.29
F3M5	9.03	19.52	23.28	50.32	13.95	30.16	46.26
F3M7	8.40	19.00	22.15	50.12	13.64	30.88	44.19
F3M8	8.17	17.25	25.52	53.89	13.67	28.86	47.36

The fresh matter yield recorded for each variant and the statistical analysis of obtained data determine the focalization of attention on the M5, M7 and M8 mixtures respectively at the distribution of their yields on the three cuttings in accordance with the three fertilization doses (tTab. 4). On unfertilized soil for all the three cuttings these mixtures recorded yields which represented, as mean from the total yields, 21% at the first cutting, 57% at the second cutting and 22% at the third cutting. The fertilization with N60P70 kg·ha^{-1} dose determined the uniformity of yields of the three mixtures in all the three cuttings. Thus, the yields of these mixtures represented, as mean from the total yields, 20% at the first cutting, 52% at the second cutting and 28% at the third cutting. For this level of fertilization as well increases of yield ratios in the third cutting were observed. The fertilization with maximum dose (N120P70 kg·ha^{-1}) determined the following repartition of fresh matter yields: 19% at first cutting, 51% at second cutting and 30% at third cutting.

CONCLUSIONS

The mixtures of perennial fodder grasses and legumes provided, in the ecological conditions of Jucu, higher fresh matter yields than the yield of alfalfa crop, traditionally cultivated by farmers. The mixture M3 recommended in the last standardization of mixtures for the forest steppe was surpassed by new under testing mixture (M7. *Trifolium pratense, Lotus corniculatus, Trifolium alexandrinum, Dactylis glomerata, Festuca pratensis, Lolium hybridum*) or by mixture already on market (M5. *Trifolium pratense, Dactylis glomerata, Festulolium, Phleum pratense, Lolium perenne*). The yields of M5 mixture on the three doses of fertilization varied very little, reason for it is recommended to be cultivated without fertilization in the similar ecological conditions with those from Jucu.

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