The Study of Several Perennial Fodder Legume and Grass Complex Mixtures for the Establishment of Temporary Pastures in Transylvanian Plain

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Abstract
Intensification of extremely weather phenomena during vegetation period of plants determined serious problems for Romanian farmers by partial or total disparagement of cultures in the last years. These problems are also common for fodder producing farmers from Transylvania. Among the alternatives, which farmers can follow, the revision of structure and gravity of crops can be considered. Sown pastures with complex mixtures (more than three perennial fodder grass and legume species) well adapted to the new ecological conditions, through their multifunctional character, can represent real alternatives to annual fodder crops. In this paper the results of a study regarding 8 complex mixtures of perennial fodder species and a pure alfalfa crop, cultivated on three levels of fertilization, are presented. The M7 mixture (*Trifolium pratense* L., *Lotus corniculatus* L., *Trifolium alexandrinum* L., *Dactylis glomerata* L., *Festuca pratensis* Huds., *Lolium x hybridum* Hausskn.) on the third cutting recorded the smallest yield difference between the unfertilized variant and the variant fertilized with the highest dose.

Keywords: mixtures, temporary pastures, yield

1. Introduction

The weather conditions in Transylvania during vegetation period of year 2010 were generally favourable to growth and development of majority of agricultural crops. However several extremely weather phenomena as torrential rainfalls, hail falls and intense heat periods were recorded in different important vegetation phases of plants and they negatively affected the yield of majority agricultural crops. During month June floods affected approximately 1600 ha [1, 2] in Cluj county and the most damaged cultures, as resulted from mass media [1], were annual crops namely maize (835 ha), wheat (311 ha), rape (135 ha), soybean (51 ha), as those affected on big surfaces. Besides harvest decreases of mentioned crops, floods caused soil and nutrient leaching especially in weeding crops cultivated on slope lands. As for perennial fodder crops, cultivated on slope lands, the damages can be much littler. A major negative impact on annul crops in Cluj county had also the hail falls while on pastures production this phenomenon had a limited impact considering the species biology, their perennial character and their regrowth capacity. The estimations of Agricultural Department for Rural Development Cluj reveal that as result of abundant rainfalls and hail falls from June of year 2010 a surface of agricultural land about 5176 ha was affected and the value of damages was about 5,771,650 RON [3]. From the

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total affected surface the biggest damages were recorded with maize (1350 ha and 1,129,944 RON), wheat (816 ha and 944.790 RON) while among the pastures 1146 ha of meadows were affected, respectively 142,288 RON value of damages. Another extreme weather phenomenon, namely high temperature, appeared during flowering-pollination-fecundation periods of several annual crops, cultivated for grain production in alimentary or animal feeding purpose. This phenomenon affected the level and quality of harvests obtained with these crops. Good examples in this respect are spring stalky cereal crops cultivated for grains. As for agricultural crops producing fresh matter (for example temporary pastures) the impact of such phenomenon was not felt. Dealing with these new challenges animal breeders can choose the establishment of temporary pastures as alternative measure for adaptation of fodder production with these conditions. In order to take advantage of all benefits offered by pastures it is necessary to know the latest information regarding the perennial fodder species and cultivars found on the Romanian certificated seeds market and recommended for certain ecological conditions, levels of fertilization and usages. Starting with this situation, it was considered important for Transylvanian farmers' as research for the establishment of new perennial fodder grass and legume complex mixtures to be reloaded [4, 5, 6, 7]. Through cultivation of these complex mixtures besides annual fodder crops, the fresh matter fodder supply could be more rhythmically.

2. Materials and methods

In the last decade of March of year 2010, in the perimeter of the Didactical Station Cojocna of the University of Agricultural Sciences and Veterinary Medicine from Cluj-Napoca, on a luvic phaeozem soil was set up an experiment with perennial fodder species. The soil in experimental field had the following agrochemical indicators and assessments [8] on a depth of 0-10 cm: neutral pH (6.96), a good supply in total N (0.33%), a very good supply in P (139 ppm), respectively a good supply in K (171 ppm). The experiment was set according to the randomized split-plot method with 27 variants, represented by a pure alfalfa crop and 8 fodder grass and legume complex mixtures (table 1) on three fertilization levels (F1–0N0P_2O_5, F2–60N70P_2O_5, F3–100N70P_2O_5 kg·ha^{-1}·y^{-1}), in three replications. The obtained results concerning the FM were statistically analyzed by the ANOVA and Duncan test, taking into consideration the M1 variant (pure alfalfa crop) as control.

3. Results and discussion

The first cycle of harvesting was initiated at 77 days after sowing, on 16 of June. The fresh matter (FM) yields obtained on first cutting (table 2) revealed yield increases in seven of those eight mixtures in comparison with pure alfalfa crop, considered as control crop. Among those 7 mixtures only M7, M8 and M2 recorded statistically ensured yield increases (table 2). The highest yield was obtained in M7 mixture (29.21 t·ha^{-1}), which included the following species: *Trifolium pratense* L., *Lotus corniculatus* L., *Trifolium alexandrinum* L., *Dactylis glomerata* L., *Festuca pratensis* Huds., *Lolium x hybridum* Hausskn. The yield increase with this mixture was very significant in comparison with the yields obtained with pure alfalfa culture and other mixtures (table 3). The smallest yield was recorded for mixture M6 which included de following species: *Lotus corniculatus* L., *Phleum pratense* L., *Dactylis glomerata* L., *Festuca arundinacea* Schreb., *Festuca pratensis* Huds. The yield obtained with this mixture recorded insignificant difference in comparison with both alfalfa crop and with M4 mixture (table 3). The second cycle of harvesting was initiated at an interval of 30 days after first cutting, on 16 of July. On the second cutting all the mixtures realized yield increases with a good and very good statistical assurance in comparison with yield obtained with pure alfalfa culture (table 4). The highest FM yield with this cycle of harvesting was obtained with M8 (28.96 t·ha^{-1}) and M7 (28.22 t·ha^{-1}) mixtures but the yield differences between these were not significant (table 5). With high FM yields were also remarked M2 (25.56 t·ha^{-1}) and M5 (24.05 t·ha^{-1}) mixtures with yield differences between them also not significant (table 5). On this cycle of harvesting the smallest FM yield was recorded with M4 mixture (9.90 t·ha^{-1}). The third harvesting was initiated in 16 of August, 30 days after the second cutting and after the fertilization. The unfertilized alfalfa control crop recorded the smallest yield (table 6). All the 8 mixtures in the unfertilized variants recorded yield increases in comparison with control, but only M7, M2, M8, and M5 mixtures recorded statistical ensured yield increases. The unfertilized variants of M6 (13.66 $t \cdot ha^{-1}$) and M4 (14.20 $t \cdot ha^{-1}$) mixtures recorded, as in the first cycle of harvesting, insignificant yield differences in comparison with pure alfalfa crop (12.82 $t \cdot ha^{-1}$). Among unfertilized variants the highest FM yield was obtained with M7 mixture (25.34 $t \cdot ha^{-1}$). Fertilization, irrespective of the applied dose, determined with all variants statistical ensured yield increases in comparison with unfertilized variant of pure alfalfa. In case of F2 fertilization dose (60N70P_2O_5 $kg \cdot ha^{-1} \cdot y^{-1}$) yields close to that of pure alfalfa crop (M1F2), respectively insignificant yield increases in comparison with this, were obtained with M6F2 and M4F2 mixtures. For the same fertilization dose M2F2, M7F2, M8F2, M5F2, M9F2 mixtures obtained high and significant yield increases in comparison with M3F2, M6F2 M4F2 mixtures and with alfalfa (M1F2). The use of the highest fertilization dose (F3-120N70P_2O_5 $kg \cdot ha^{-1} \cdot y^{-1}$) determined the obtaining of the highest FM yields with the same M8F3, M7F3, M9F3, M5F3, M2F3 mixtures but the yield differences among these were not significant. At this fertilization dose, the mixture with the smallest FM yield was M6F3 (20.31 $t \cdot ha^{-1}$) which recorded an insignificant yield increase in comparison with alfalfa crop M1F3 (19.44 $t \cdot ha^{-1}$).

Table 1. The grass and legume species used in pure culture and mixture

Crop/ Mixture (M)	Species
M1–control	*Medicago sativa* L.
M2	*Medicago sativa* L., *Trifolium alexandrinum* L., *Dactylis glomerata* L., *Lolium x hybridum* Hausskn. – new mixture
M3	*Lotus corniculatus* L., *Onobrychis viciifolia* Scop., *Dactylis glomerata* L., *Festuca pratensis* Huds., *Bromus inermis* Leyss. – old mixture for forest steppe area [6]
M4	*Medicago sativa* L., *Dactylis glomerata* L., *Festuca arundinacea* Schreb., *Lolium perenne* L. – mixture on market
M5	*Trifolium pratense* L., *Dactylis glomerata* L., *Festulolium* Asch. & Graebn., *Phleum pratense* L., *Lolium perenne* L. – mixture on market
M6	*Lotus corniculatus* L., *Phleum pratense* L., *Dactylis glomerata* L. (3 cultivars), *Festuca arundinacea* Schreb., *Festuca pratensis* Huds. – new mixture
M7	*Trifolium pratense* L., *Lotus corniculatus* L., *Trifolium alexandrinum* L., *Dactylis glomerata* L., *Festuca pratensis* Huds., *Lolium x hybridum* Hausskn. – new mixture
M8	*Trifolium pratense* L., *Trifolium repens* L., *Dactylis glomerata* L., *Festuca pratensis* Huds., *Phleum pratense* L., *Lolium x hybridum* Hausskn., *Lolium perenne* L. – new mixture
M9	*Medicago sativa* L., *Trifolium repens* L., *Bromus inermis* Leyss., *Festuca arundinacea* Schreb., *Lolium x hybridum* Hausskn. – new mixture

Table 2. The influence of mixtures of perennial fodder species on the FM yields ($t \cdot ha^{-1}$) on the first cutting

Mixture	FM yield ($t \cdot ha^{-1}$)	Yield increase (%)	Yield increase ($t \cdot ha^{-1}$)	Signification
M1	15.84	100.0	0.00	Control
M2	20.33	128.3	4.48	*
M3	18.25	115.2	2.41	-
M4	15.98	100.9	0.14	-
M5	18.09	114.2	2.25	-
M6	11.61	73.3	-4.23	-
M7	29.21	184.4	13.37	***
M8	21.62	136.4	5.77	*
M9	19.96	126.0	4.11	-

LSD (5%) 4.25 LSD (1%) 5.85 LSD (0.1%) 8.05

Table 3. The significance of differences among the FM yields (t·ha^{-1}) as influenced by mixtures on the first cutting

Mixture	FM yield (t·ha^{-1})	Signification	Theoretic significant differences (5%)	
M6	11.61	A		
M1	15.84	AB	2	4.25
M4	15.98	AB	3	4.45
M5	18.09	BC	4	4.59
M3	18.25	BC	5	4.67
M9	19.96	BC	6	4.73
M2	20.33	BC	7	4.79
M8	21.62	C	8	4.81
M7	29.21	D	9	4.84

Table 4. The influence of mixtures of perennial fodder species on the FM yields (t·ha^{-1}) on the second cutting

Mixture	FM yield (t·ha^{-1})	Yield increase (%)	Yield increase (t·ha^{-1})	Signification
M1	6.49	100.0	0.00	Control
M2	25.56	394.0	19.07	***
M3	11.68	180.0	5.19	***
M4	9.90	152.6	3.41	**
M5	24.05	370.7	17.56	***
M6	12.75	196.6	6.27	***
M7	28.22	435.1	21.74	***
M8	28.96	446.5	22.47	***
M9	14.73	227.1	8.25	***

LSD (5%) 2.39 LSD (1%) 3.30 LSD (0.1%) 4.54

Table 5. The significance of differences among the FM yields (t·ha^{-1}) as influenced by mixtures on the second cutting

Mixture	FM yield (t·ha^{-1})	Signification	Theoretic significant differences (5%)	
M1	6.49	A		
M4	9.90	B	2	2.40
M3	11.68	BC	3	2.51
M6	12.75	CD	4	2.59
M9	14.73	D	5	2.64
M5	24.05	E	6	2.67
M2	25.56	E	7	2.70
M7	28.22	F	8	2.71
M8	28.96	F	9	2.73

Table 6. The significance of differences among the FM yields (t·ha^{-1}) as influenced by fertilization on the third cutting

Mixture (M) /Fertilization dose (F)	FM yield (t·ha^{-1})	Signification	Theoretic significant differences (5%)	
M1F1	12.82	A		
M6F1	13.66	A	2	2.30
M4F1	14.20	A	3	2.43
M3F1	15.22	AB	4	2.49
M1F2	16.71	BC	5	2.55
M6F2	17.40	BCD	6	2.59
M4F2	18.59	CDE	7	2.62
M3F2	19.28	DE	8	2.65
M1F3	19.44	DEF	9	2.67
M6F3	20.31	EFG	10	2.69
M5F1	21.83	FGH	11	2.70
M3F3	22.01	GHI	12	2.72
M9F1	22.18	GHIJ	13	2.73
M4F3	22.47	GHIJ	14	2.74
M8F1	23.55	HIJK	15	2.75
M9F2	23.58	HIJKL	16	2.76
M5F2	24.29	HIJKLM	17	2.76
M2F1	24.39	HIJKLM	18	2.77
M8F2	24.59	IJKLM	19	2.77
M7F2	24.74	JKLM	20	2.78
M7F1	25.34	KLM	21	2.78
M2F2	25.47	KLM	22	2.78
M2F3	26.03	KLM	23	2.78
M5F3	26.25	LM	24	2.78
M9F3	26.32	M	25	2.78
M7F3	26.56	M	26	2.78
M8F3	26.77	M	27	2.78

4. Conclusions

All the studied fodder crops obtained in the first year of vegetation good FM yields. The three cycles of harvesting were initiated at the following intervals: first cycle on 77 days from sowing and the second and the third cycles at every 30 days. The M3 mixture, an old mixture recommended for forest steppe conditions, recorded higher FM yield than pure alfalfa culture on all those cycles of harvesting and irrespective of the level of fertilization applied. Among the new studied mixtures, in the first year of vegetation, M7, M8 and M2 mixtures were distinguished with high FM yield at each cutting, irrespective of the level of fertilization applied. In case of M7 mixture, on the third cutting, the smalles yield difference between the unfertilized variant and the variant fertilized with the highest dose was recorded.

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References

1. Cluj online: http://www.clon.ro/stiri/cluj
2. Ziua de Cluj: http://www.ziuadecj.ro/eveniment
3. Gazeta de Cluj. http://www.gazetadecluj.ro
4. Puia, I., Heinke Klemm, Reacţia la îngrăşăminte a speciilor *Dactylis glomerata* L. şi *Medicago sativa* L. în culturi pure şi în amestec. Lucrări ştiinţifice ale SCPCP Măgurele–Braşov, 1975, I, pp. 59–68
5. Puia, I., Heinke Klemm, Amestecurile şi monoculturile de specii furajere. Lucrări ştiinţifice ale SCPCP Măgurele–Braşov, 1977, III, pp. 3–11
6. Motcă, Gh., Oancea, I., Geamănu, L. I., Pajiştile României. Tipologie şi tehnologie. Ed. Tehnică Agricolă, Bucureşti, 1994, pp. 97- 150
7. Rotar, I., Carlier, L., Pasture culture. Ed. Risoprint, Cluj-Napoca, 2005, pp. 177-212
8. Rusu, M., Mărghitaş, M., Oroian, I., Mihăiescu, T., Dumitraş, A., Agrochemical handbook. Ed. Ceres, Bucureşti, 2005, Chapter. 5, pp. 246-346