The Effect of Distance Between Rows on Sowing and of Mineral Fertilisers on a Complex Forage Mixture in Condition Specific to Transylvania Plain

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Abstract

Lately an increasingly importance is shown to complex forage mixture. In Transylvania Plain detailed studies are still required for highlighting the most suitable forage mixture for this area. These are needed also to support farmers, especially in the actual context when both agricultural and livestock systems are crossing a transitional period, characterized by decreases in production from year to year. Our study aims to follow the behaviour of a complex forage mixture formed by *Trifolium pratense* (15%), *Lolium perenne* (20%), *Festulolium* (25%), *Festuca arundinacea* (25%) and *Phleum pratense* (15%) under the influence of different technological inputs. The species were sown on two different distances between rows, namely 12.5 cm and 25 cm and it was fertilized with 4 different doses of mineral fertilizers and Ammonium nitrate (33.3%) in 4 different doses, as follows: V₁-control variant, unfertilized, V₂- N₅₀P₆₀K₈₀, V₃- N₇₅P₆₀K₈₀, V₄- N₁₀₀P₆₀K₈₀. The present study comprises data registered in 2013, data related to green mass and dry matter (DM) production and floristic composition of the mixture studied. The results registered helped us to identify the most efficient technology both from ecologic and economic point of view, able to provide increased productions and high quality forage.

Keywords: *mixture, production, floristic composition, fertilization.*

INTRODUCTION

Feed requirements for at least 60% of cattle and 80% of sheep is provided by meadows, areas including perennial forage (grasses and legumes) which have a pronounced anti-entropic action on soil, the main source of phytomass (Teodor Maruşca *et al.*, 2010). The economic and ecologic importance of grassland is outstanding (Rotar, 2010). Compared to the technologies applied to other crops, appropriate technologies in perennial vegetation can achieve the fastest and most complex ecological balance in the food chain soil - plant - animal - man.

Temporary meadows are an important source of feed, which still require a series of steps for achieving a considerable increase in production and quality in the coming years. Polyculture, within which several species are grown together, can reduce dependence on external factors to culture, economic risks and food insecurity, while protecting the environment and

(Liebman, 1995). The achievement of high forage production from the temporary meadows depends largely on the species and varieties used, the types of mixtures and soil fertility. Choice of species according to climatic requirements plays an important role both in the vegetation productivity and the quality of feed produced. Picasso *et al.*, 2011, following the behaviour of some forage species within a complex forage mixture has shown that complex forage mixture sustain a high productivity among time due to ecological complementarity between species. In order to obtain a certain proportion of species in mixture, which also enfaces feed quality, a special attention should be paid to seed mixture formation, which should have a suitable ratio between grasses and legumes (Staniak, 2011) and an optimal quantity of fertilisation.

Soil-climatic condition specific to Transylvania Plain drawn up a proper environment for agricul-

ture development. In Transylvania detailed studies are still required for highlighting the most suitable forage mixture for this area. These are needed also to support farmers, especially in the actual context when both agricultural and livestock systems are crossing a transitional period, characterized by decreases in production from year to year. Taking into account the stated facts, our study aims to follow the behaviour of a complex forage mixture formed by *Trifolium pratense* (15%), *Lolium perenne* (20%), *Festulolium* (25%), *Festuca arundinacea* (25%) and *Phleum pratense* (15%) under the influence of different technological inputs. Through these we aimed to identify the most efficient technology both from ecologic and economic point of view for able to provide increased productions and high quality forage.

MATERIAL AND METHOD

The experience was installed in the spring of 2012 in the field of Agricultural Research-Development Station, Turda, Romania. The soil type is phaeozem argilo iluvial vertic. The experimental sit is characterized by an annual medium temperature (2013) of 10.4°C and annual precipitations of 523.2 mm.

The complex forage mixture formed by *Trifolium pratense* (15%), *Lolium perenne* (20%), *Festulolium* (25%), *Festuca arundinacea* (25%) and *Phleum pratense* (15%) was installed according to the subdivided parcels method: in 8 variants with 4 replications, each plot having 50 m² (10 X 5 L). The species were sown on two different distances between rows, namely 12.5 cm and 25 cm. The mixture was fertilized in the beginning of

March month of every year with NPK complex and Ammonium nitrate (33.3%) in 4 different doses: V₁-control variant, unfertilized, V₂- N₅₀P₆₀K₈₀, V₃- N₇₅P₆₀K₈₀, V₄- N₁₀₀P₆₀K₈₀. The present study comprises data registered in 2013, data related to green mass and dry matter (DM) production and floristic composition of the mixture studied.

Green mass production was determined by weighting and the floristic composition after gravimetric method. The experimental plots were mowed three times/ year. Statistical interpretation of data was performed using Polifact program

RESULTS AND DISCUSSIONS

Results regarding green mass production

On the variants sown on 12,5 cm distance between roads (Tab. 1) we registered a green mass production between 48,79 t/ha and 64,39 t/ha. The highest production was registered on V₃, fertilized with N₇₅P₆₀K₈₀, with a difference of 15,60 t/ha from control variant, very significant from statistical point of view. In which concerns the variants sown on 25 cm distance between roads green mass production registered was between 53,93 t/ha and 61,20 t/ha (Tab. 1). The highest green mass production was registered on the variant V₂, fertilized with N₅₀P₆₀K₈₀, with a difference of 7,27 t/ha from control variant, very significant from statistical point of view.

Comparing the evolution of the variants sown on 12,5 cm distance between roads with those sown on 25 cm distance between roads (Tab. 2) we observed that these have a different reaction to mineral fertilization. The highest green mass production of 64,39 t/ha was registered on V₃-

Tab.1. The influence of experimental factors on green mass production

Nr.crt	Variant	Production [t/ha]	Percent [%]	Difference	Significance
	V1 D1	48,79	100,0	0,00	Mt
	V2 D1	54,71	112,1	5,92	***
	V3 D1	64,39	132,0	15,60	***
	V4 D1	59,82	122,6	11,03	***
	V1 D2	53,93	100,0	0,00	Mt.
	V2 D2	61,20	113,5	7,27	***
	V3 D2	60,77	112,7	6,84	***
	V4 D2	57,35	106,3	3,42	***
DL (p 5%) 1, 10		DL (p 1%) 1,67		DL (p 0.1%) 2,68	

Tab. 2. The influence which interaction between mineral fertilization- distance between roads has on green mass production

Nr. Crt.	Variant	Classification							
		1	2	3	4	5	6	7	8
		48,79	53,93	54,71	57,35	59,82	60,77	61,20	64,39
1	V ₁ D ₁		5,14	5,92	8,56	11,03	11,98	12,41	15,60
2	V ₁ D ₂			3,28	3,42	5,89	6,84	7,27	10,47
3	V ₂ D ₁				2,64	5,11	6,06	6,49	9,68
4	V ₄ D ₂					2,48	3,42	3,85	7,05
5	V ₄ D ₁						0,95	1,38	4,57
6	V ₃ D ₂							0,43	3,63
7	V ₂ D ₂								3,19
8	V ₃ D ₁								

Tab. 3. The influence of experimental factors on dry matter production

Nr.crt..	Variant	Production [t/ha]	Percent [%]	Difference	Significance
9	V1 D1	11.84	100.0	0.00	Mt
10	V1 D2	13.38	113.0	1.54	***
11	V4 D2	15.73	132.9	3.89	***
12	V2 D1	14.34	121.1	2.50	***
13	V4 D1	12.89	100.0	0.00	Mt.
14	V3 D2	14.77	114.6	1.88	***
15	V2 D2	14.58	113.1	1.69	***
16	V3 D1	13.30	103.2	0.41	*
DL (p 5%) 0.28		DL (p 1%) 0.42		DL (p 0.1%) 0.67	

sown on 12,5 cm, variant fertilized with N₇₅P₆₀K₈₀. This is followed by V₂ sown on 25 cm which registered 61,19 t/ha.

The lowest green mass production of 48,79 t/ha was registered on V₁, control variant, unfertilized, sown on 12,5 cm, with a difference of 15,60 t/ha from the highest production.

Results regarding dry matter production

On the variants sown on 12,5 cm distance between roads we registered a dry matter production between 11,84 t/ha and 15,73 t/ha (Tab. 3). The highest production was registered on V₃, fertilized with N₇₅P₆₀K₈₀, with a difference of 3,89 t/ha from control variant, very significant from statistical point of view. In which concerns the variants sown on 25 cm distance between roads dry matter production registered was bet-

ween 12,89 t/ha and 14,77 t/ha (Tab. 3). The highest dry matter production was registered on V₃, fertilized with N₇₅P₆₀K₈₀, with a difference of 1,88 t/ha from control variant, very significant from statistical point of view.

Similar results were reported by Plesa *et al.*, 2012 and Vintu *et al.*, 2010.

Dry matter production follows green matter production (Tab. 3). Therefore the highest dry matter production of 15,73 t/ha was registered on V₃, sown on 12,5 cm, variant fertilized with N₇₅P₆₀K₈₀. This was followed by V₂ sown on 25 cm which registered 14,77 t/ha dry matter production (with a difference of 0,96 t/ha compared to the highest production registered).

The lowest production was observed on V₁, control variant, unfertilized, sown on 12,5 cm which registered 1,84 t/ha.

Nor. crt	Variant	Classification							
		1	2	3	4	5	6	7	8
		11,84	12,89	13,30	13,38	14,34	14,58	14,77	15,73
1	V ₁ D ₁		1,05	1,46	1,54	2,50	2,74	2,93	3,89
2	V ₁ D ₂			0,41	0,49	1,45	1,69	1,88	2,84
3	V ₄ D ₂				0,08	1,04	1,28	1,47	2,43
4	V ₂ D ₁					0,97	1,21	1,40	2,36
5	V ₄ D ₁						0,24	0,43	1,39
6	V ₃ D ₂							0,19	1,15
7	V ₂ D ₂								0,96
8	V ₃ D ₁								

Tab. 4. The influence which interaction between mineral fertilization- distance between roads has on dry matter production

Average error SX = 0,08 ()							
Distance in classification	2	3	4	5	6	7	8
Values q	3,46	3,59	3,65	3,68	3,69	3,70	3,70
Values DS theoretically	0,28	0,29	0,29	0,29	0,29	0,29	0,29

The evolution of floristic composition

Analysing the complex forage mixture formed by red clover (*Trifolium pratense* (15%)), perennial ryegrass (*Lolium perenne* (20%)), festulolium (*Festulolium* (25%)), tall fescue (*Festuca arundinacea* (25%)) and timothy (*Phleum pratense* (10%)) we observed the superiority of leguminous plant, namely red clover (Fig. 1). Red clover showed a high capacity for competition. Even if on sowing red clover occupied just 15% from the total forage mixture, lesser than *Festulolium* (25%), under the influence of experimental factors he registered the highest percent of participation in mixture. The presence of red clover in this mixture was very stable, the only exception being V₃, sown on 25 cm where red clover's place was exchanged with *Festulolium*. Red clover is followed by *Festulolium* and perennial ryegrass. Red clover high capacity for competition was highlighted also by Søgaard and Weisbjerg, 2007. Analysing the behaviour of several species into an experience with forage mixtures they have noted that *Festulolium* had a strong reaction on fertilization and showed higher capacity for competition than perennial ryegrass.

Tall fescue has almost the same percent of participation in forage mixture like timothy. Accord-

ding to bibliography timothy has a good behaviour when is cultivated together with cocksfoot or tall fescue (AWI *et al.*, 2012). The registered data confirm previous researches which state that timothy isn't compatible with more aggressive species like *Lolium perenne* or *Bromus* sp. (AWI *et al.*, 2012).

CONCLUSIONS

Analysing the evolution of experimental variants we observed that they have different reaction to technological factors. In which concerns distance between rows we have noticed that the studied mixture is suitable to be sown on 25 cm between rows. On this density we registered the highest green mass production (53,93 t/ha) and dry matter production (12,89 t/ha; compared to control variant, unfertilised). In which concerns the evolution of floristic composition, ratios between species stained stable. Distance between rows influenced *Lolium perenne* and *Festulolium*, whose proportion in mixture are reversed on 25 cm density.

Species show strong reaction to fertilization. The lowest production, both of green mass and dry matter production are registered on control variant, unfertilized. Fertilization results in production

Fig. 1. Evolution of floristic composition

increases (with significant difference compared to control variant). For the studied mixture we recommend fertilization with $N_{75}P_{60}K_{80}$.

The results helped us to recommend the most suitable culture technology for the forage mixture studied (in the soil-climatic condition similar to those from the experimental area.) Therefore we recommend that the studied mixtures should be sown on 12,5 cm distance between rows and should be fertilized with $N_{75}P_{60}K_{80}$ (variant which registered the highest green mass (64,39 t/ha) and dry matter production (15,75 t/ha).

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