The Impact of Perennial Legumes on Sward Productivity

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Abstract
The study was aimed impact of three perennial legumes species *Trifolium pratense, Trifolium repens* and *Lotus corniculatus* in mixture with *Festuca arundinaceea* on efficiency and productivity elements, at first harvest cycle. Leaf area index (LAI), net assimilation rate (NAR) and crop growth rate (CGR) has higher values 0.5-0.7 units in mixtures compared to pure grass. The highest values LAI, NAR and CGR are recorded *Trifolium pratense*, LAI = 8,2 m^2/ m^2; NAR = 4.4 g/m^2 leaf/day and CGR = 8,0 g/m^2/ day. Elements studied yield is positively correlated with each other, resulting LAI, NAR and CGR at a rate of 80-93 %. Yield of dry matter (DM) is positively correlated with LAI obtained for all species of legumes. High yield values indicate increase in the amount of organic matter in the canopy, depending on the species of legumes, with 1.3 to 4.4 t / ha.

Keywords: crop growth rate; elements yield; leaf area index; net assimilation rate; productivity.

1. Introduction

Yield different species or mixtures of species of perennial grasses and legumes for pastures have been extensively studied aiming to maximize it, especially by changing technological factors with direct action, fertilization is considered the key to increasing productivity [1-5]. Eco-physiological researches on plant growth and development have made contributions to the establishment of relations between growth factors and yield [6-11]. The researches aimed in most cases the species in pure culture, rather than mixtures of perennial grasses and legumes. The research presented in this paper refer to determining the contribution of factors that determine yield for pure culture of *Festuca arundinaceea* and in mixture with perennial legumes, *Trifolium repens, Trifolium pratense* and *Lotus corniculatus*.

2. Materials and methods

The studies were carried out between 2008-2009 on a sandy loam chernozem soil with pH 6.5, good supply of phosphorus and potassium. The biological materials were a pure grass sward of *Festuca arundinaceea* and mixture with *Trifolium repens, Trifolium pratense* and *Lotus corniculatus.* Four levels of N fertilizer were applied in the spring 0; 50; 100; 150 N kg. ha^{-1}, both for pure grass and mixture. Three harvests were obtained in 2008 and two harvests in 2009, due to dry in growth period. Sampling at the first harvest (CI) was realized at three phenological phases grass growth: apex 8-10 cm. (P1), pre-earing (P2) and earing (P3). There have been number of days to go before to achieving the stage of growth mentioned. In the laboratory measurements were made of components and total biomass of the plants. Were determined following efficiency: leaf area index (LAI), by direct measurement, and net assimilation rate (NAR), increase growth in a given period, crop growth rate (CGR), absolute growth rate.

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3. Results and discussion

The dynamic elements having role in the formation of crop yields for the first cycle in pure grass and different species of legumes mixture is shown in Table 1. The results obtained shows the following: LAI is positively correlated with phenological phase of growth and the level of N fertilization in all variants studied showing values increasing from P1 to P3 and from N_0 to N_{150}. *Festuca arundinaceea* pure crop recorded the highest value of LAI of 6.2 m^2 leaf / m^2 soil fertilization with N150 in phenophase earing. The presence of a species of legumes in the mixture has the effect LAI increased by 30-70 % in *Trifolium repens* with 150-300 % and 40-200 % for *Trifolium pratense* and *Lotus corniculatus.* The highest values of LAI were recorded to the mixture *Festuca arundinaceea-Trifolium pretense* 7-11 m^2 leaf / m^2 soil being influenced mainly by the morphological characteristics of the legumes mixture (Figure 1). Increased foliar index has the effect of DM accumulation greater photosynthetic capacity due to growth and stimulate symbiotic nitrogen fixation. NAR and CGR elements for plant growth are positively correlated with vegetation phases. Analysis of the results obtained lead to increase indicates that both NAR and the CGR increasing values of 8-10 cm from the apex (P1) at the pre-earing (P2) indicating an increase in the growth and physiological processes (Figure 2). The elements of the output are positively correlated with each other. LAI influenced the rate of 80-93 %, NAR and CGR achieving indices.

Table 1. The value of productivity randaments for grass and mixtures, cycle I. (Average 2008-2009)

Sward type	N Supply kg. ha $^{-1}$	DM t. ha $^{-1}$			LAI m^2 leaf /m^2 soil			NAR g/ m^2 leaf/day			CGR g/ m^2 /day		
		P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
pure grass	0	0.6	1.4	2.2	1.8	2.0	2.0	1.1	4.9	5.4	2.0	3.8	5.1
Festuca	50	0.8	1.8	2.9	1.8	2.8	4.0	1.5	5.5	6.2	2.7	5.1	6.7
arundinaceea	100	1.1	2.1	3.3	2.0	3.9	5.1	1.8	3.5	5.6	3.6	5.0	7.6
	150	1.1	2.3	3.7	2.2	4.8	6.2	1.6	3.2	5.7	3.5	6.5	8.5
mixture	0	0.8	1.7	2.7	2.1	2.9	3.4	1.2	3.9	4.8	2.5	4.7	6.3
Festuca	50	1.0	2.2	3.5	3.9	4.4	5.7	1.0	3.3	5.2	3.3	6.1	8.1
arundinaceea	100	1.1	2.3	3.7	3.9	5.5	6.3	1.0	2.8	5.2	3.5	6.5	8.6
Trifolium repens	150	1.2	2.6	4.1	4.5	6.4	7.4	1.2	2.7	5.4	3.8	7.2	9.5
mixture	0	1.2	2.6	4.1	3.6	5.9	7.4	1.1	2.9	4.8	3.7	7.0	9.3
Festuca	50	1.4	3.0	4.9	5.8	7.6	9.7	1.3	2.7	5.5	4.5	8.6	11.3
arundinaceea	100	1.5	3.2	5.2	5.8	8.4	10.0	1.5	2.6	5.7	4.8	9.1	12.0
Trifolium pratense	150	1.6	3.5	5.6	5.8	8.8	11.0	1.6	2.6	5.6	5.2	9.9	13.4
mixture	0	1.0	2.1	3.4	2.5	3.8	5.4	2.3	3.7	4.4	3.2	6.0	7.8
Festuca	50	1.1	2.3	3.7	3.7	4.7	6.3	1.7	3.3	4.4	3.5	6.5	8.5
arundinaceea	100	1.1	2.5	4.0	4.2	5.5	7.1	1.6	3.0	4.4	3.7	7.0	9.2
Lotus corniculatus	150	1.2	2.6	4.2	5.5	6.0	7.7	1.3	3.0	4.6	3.9	7.3	9.7

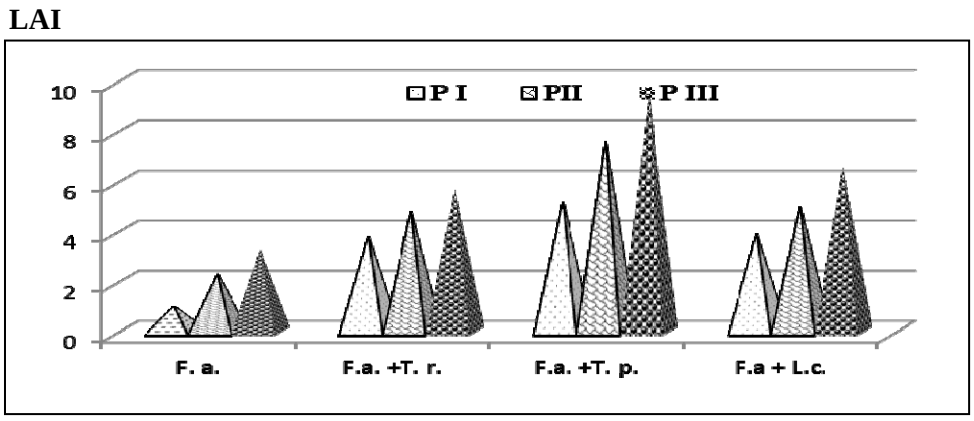
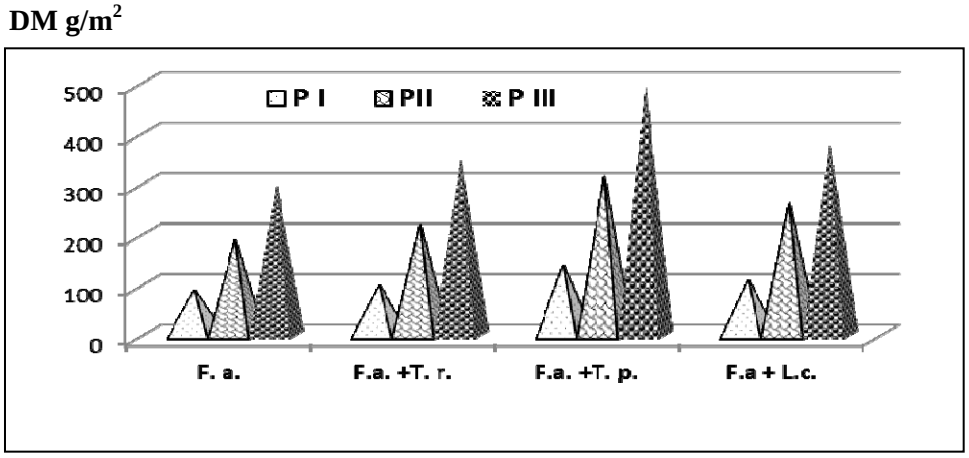


Figure 1. The evolution of LAI at first cycle of harvest



Figue 2. The evolution of DM at first cycle of harvest

4. Conclusions

The perennial legumes *Trifolium repens, Trifolium pratense* and *Lotus corniculatus.* significantly contributed to improving efficiency in the mixtures studied. LAI, NAR and CGR are elements that have the highest contribution to the formation of efficiency, helping to predicting crop. Nitrogen fertilization causes a positive influence on yield components, being more significant in pure culture of grasses. Increased leaf area is increasing intensification effect and greater accumulation of DM.

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