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RESEARCH ON THE DYNAMICS OF THE PRODUCTIVITY COMPONENTS IN *DACTYLIS GLOMERATA* L., UNDER THE CONDITIONS OF THE ROMANIAN PLAIN

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Abstract

Cocksfoot (Dactylis glomerata L.) is one of the most important species of perennial grass, with the highest frequency in the floristic composition of temporary grasslands. Its widespread occurrence as forage crop is due to the high productivity, great vivacity, ecological plasticity and various possibilities of use. The research conducted at Moara Domnească Experimental Farm between 2009 and 2011 concerned two varieties of cocksfoot, Regent and Ambassador and two types of culture, i.e pure culture and a mixture with alfalfa (Medicago sativa L.). Our research studied the elements that contributed to the cocksfoot yield, i.e. the leaf area index (LAI), the leaf area ratio (LAR), the specific leaf area (SLA), the leaf weight ratio (LWR) and the speed growth indices (net assimilation rate - NAR, crop growth rate – CGR and relative growth rate - RGR). During the experiments (2009-2011), on average, at the first cycle of harvest, both varieties of cocksfoot showed higher specific leaf area values between 11.99 and 22.55 $m^2.kg^{-1}$ at Regent variety and between 12.66 and 24.62 $m^2.kg^{-1}$ at Ambassador variety. The highest growth speed of cocksfoot plant was registered at the first harvest cycle, i.e 8.35 $g.m^{-2}.day^{-1}$ at Regent variety and 10.22 $g.m^{-2}.day^{-1}$ at Ambassador variety.

Key words: *dactylis glomerata*, *leaf area index*, *leaf surface, growth speed, yield.*

INTRODUCTION

Dactylis glomerata is a species native to Central and Western Europe, but it has been cultivated in Nord America for over 200 years [2]. Cocksfoot is one of the most common forage plants, found in the spontaneous flora of Europe, North America and the temperate zone of Asia and United States of America. In our country, this species has the largest ecological plasticity. It is widespread in areas of alfalfa crop, being the main partner in the mixture with the alfalfa crop [3].
Research conducted in our country has shown that *Dactylis glomerata* species adapts quite well to the conditions of the Romanian Plain, achieving high and stable production both as irrigation and irrigated culture [4].
The crop yield, in meaning of useful or economic production, and its quality is a result of the interaction between genetic characteristics of species and varieties, cultural factors and the changes that they suffer under the influence of cultural techniques applied [1].
Dactylis glomerata is one of the most productive perennial grasses of temperate regions, achieving annual yields between 15 and 20 $t.ha^{-1}$ DM. Also, this species conserve the great production potential regardless of the use system and compared with other species of perennial grasses, it remains productive both poor and unfertilized soils [5].

MATERIAL AND METHOD

For the dynamics knowledge of the elements that contribute to the yield, an experiment was organized at the Experimental Farm Moara Domnească with *Dactylis glomerata* in pure crop and mixed with 30% *Medicago sativa*, on a preluvosol soil.
The experiment used two varieties of *Dactylis glomerata* (Regent and Ambassador) in pure culture and mixed with variety of *Medicago sativa* La bella Campagnola. A uniform fertilization was achieved with 50 P_2O_5 and 100 N.

Climatic characteristics of the experimental area are the following: rainfall of 556.1 mm and an average annual temperature of 10.5 ^{0}C.
The experimental years (2009-2011) were characterized by deficient rainfall on the growing season and annual average temperatures higher than the multiannual average.
Usually, in these years has been a significant rainfall deficit in April and May, i.e in the period of the first harvest formation at perennial grasses, and in August and September at the third harvest.
The important yield elements of the *Dactylis glomerata* species, determined as dynamics on growing period were:
LAI – leaf area index (m^2 leaves/m^2 soil), through direct measurements = Density x Foliar area;
LAR – leaf area ratio ($m^2.kg^{-1}$) = LAI/ Dry Matter Production (DM) ($kg.m^{-2}$);
SLA – specific leaf area ($m^2.kg^{-1}$) = LAI / Dry Matter production of leaves (kg $DM.m^{-2}$);
LWR – leaf weight ratio (%) = Leaves mass x 100/ Dry Matter Production;
NAR – net assimilation rate ($g.m^{-2}leave.day^{-1}$) = Increase in dry matter production in a period (g $DM.m^{-2}$)/ Growth days x LAI;
CGR – Crop growth rate – (g m^{-2} $soil.day^{-1}$) = LAI x NAR;
RGR – Relative growth rate ($g.kg^{-1}.day^{-1}$) = LAR x NAR.
To interpret the results, there was performed statistical analysis of production data, and also the quantitative analysis of growth (after Amezaine, Hassan T., [1]) to determine the yield elements.
Every year, at the first harvest cycle, the determination was performed during apex -10 cm, and the last at early flouring. The following cycles, the determinations were made every 20 days until harvest.

RESULTS AND DISCUSSIONS

The dynamics of the yield elements in *Dactylis glomerata* are synthesized for the period 2009-2011 in Table 1.

The dynamics of the yield components, during the three experimental years, shows that, at the first cycle of harvest, the leaf area index (LAI), the leaf area ratio (LAR) and the specific leaf area (SLA) and the leaf weight ratio (LWR) registered significant increases as the vegetation grew.
At the other cycles, the values of the same yield elements decreased as the plants grew because of a lower share in the total production of dry matter.
Average values of leaf area index at the first cycle of harvest were between 1.2 and 3.7 at the variety of cocksfoot Regent and 1.3 -4.9 at Ambassador variety, the highest values were obtained in the heading phase of plants.
On average, during the experimental period, at the first cycle of harvest, the cocksfoot varieties showed a high specific leaf area, especially during the heading, namely 22.55 $m^2.kg^{-1}$ at Regent variety and 24.62 $m^2.kg^{-1}$ at Ambassador variety (Table 1).
At the beginning of the vegetation leaves represented 75-76% from total mass of plants, and with the increasing in vegetation, when the cocksfoot plants were in the heading phase, the leaves ratio decreased detrimental with strains representing 48-51%.
The absolute rate of growth for the cocksfoot plants showed maximum values between 8 to 13 of May in both varieties tested, when the plants were in the heading phase, namely 8.35 $g.m^{-2}.day^{-1}$ at Regent variety and 10.22 $g.m^{-2}.day^{-1}$ at Ambassador variety.

Correlations between the yield elements

Calculating the correlations between the main elements of yield during the experimental period led to the following results:
a) Between the leaf area index and the leaf area, in relation to total production of dry matter or to the total production of dry matter obtained only by leaves there are significant positive correlations (Fig. 1 and 2).
b)The determination coefficients had different values in the variety of *Dactylis glomerata*, respectively from 0.840 to 0.916 on Regent variety and from 0.893 to 0.988 on Ambassador variety.

Table 1. Productivity components at *Dactylis glomerata* in pure crop, first cycle of harvest, Moara Domnească 2009-2011

Year Productivity components	Variety	2009		2010		2011		Average	
		Apex-10 cm	Heading	Apex-10 cm	Heading	Apex-10 cm	Heading	Apex-10 cm	Heading
LAI ($m^2.m^{-2}$)	Regent	1.60	7.20	0.90	1.70	1.00	2.10	1.20	3.70
	Ambassador	1.70	9.5	1.00	3.30	1.20	1.80	1.30	4.90
LAR ($m^2.kg^{-1}$)	Regent	12.31	21.18	6.43	7.17	7.69	6.56	8.81	11.64
	Ambassador	11.33	25.60	7.62	10.90	10.00	514	9.65	13.91
SLA ($m^2.kg^{-1}$)	Regent	17.78	34.29	8.18	17.20	10.00	16.15	11.99	22.55
	Ambassador	15.45	39.58	9.90	20.44	12.63	13.85	12.66	24.62
LWR (%)	Regent	69.00	62.00	79.00	42.00	77.00	41.00	75.00	48.00
	Ambassador	73.00	65.00	77.00	53.00	79.00	37.00	76.00	52.00
NAR $g.m^{-2}$ leave.day^{-1}	Regent	1.63	1.46	3.16	2.94	2.77	4.52	2.52	2.97
	Ambassador	1.76	1,16	2.60	2.65	2.14	6.11	2.17	3.31
CGR ($g.m^{-2}.day^{-1}$)	Regent	2.60	10,50	2.84	5.06	2.77	9.50	2.74	8.35
	Ambassador	3.00	11.00	2.57	8.67	2.57	11.00	2.72	10.22
RGR ($g.kg^{-1}.day^{-1}$)	Regent	20.00	30.88	20.29	21.08	21.28	29.69	20.52	27.22
	Ambassador	20.00	29.73	19.80	28.90	21.43	31.43	20.41	30.02

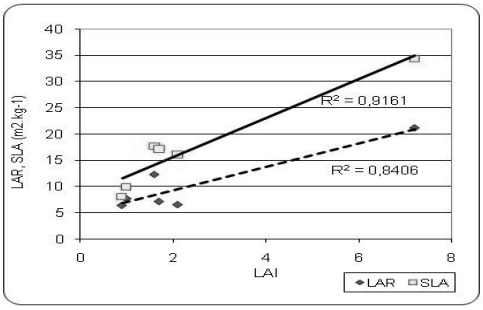

Fig. 1. Correlation between foliar elements on *Dactylis glomerata*, Regent variety, first cycle of harvest, Moara Domnească 2009-2011

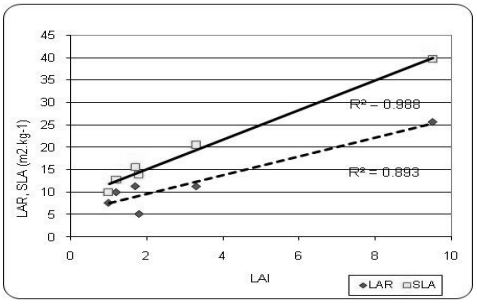

Fig. 2. Correlation between foliar elements on *Dactylis glomerata*, Ambassador variety, first cycle of harvest, Moara Domnească 2009-2011

b) The speed growth indices (net assimilation rate, crop growth rate and relative growth rate) positively correlate with the vegetation stages. The most significant correlation was between the leaf area index and the crop growth rate, determination coefficient being of 0.589 for the variety Regent and 0.416 for the Ambassador variety (Fig. 3, 4).

Correlation between the yield elements and the yield

The most significant correlation with the yield was identified for the leaf area. During the experiments, positive correlations were noticed between the leaf area index and the yield on both varieties of cocksfoot. The dry matter yield was determined by the leaf area index as follows: 54% at the variety of

Cocksfoot Regent and 44% at the Ambassador variety (Fig. 5, 6).

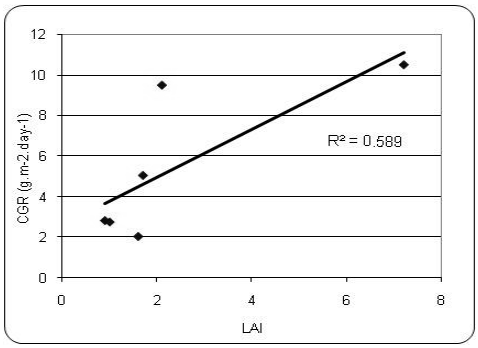

Fig. 3. Leaf area index influence on crop growth rate on *Dactylis glomerata*, variety Regent, first cycle of harvest, Moara Domnească 2009-2011

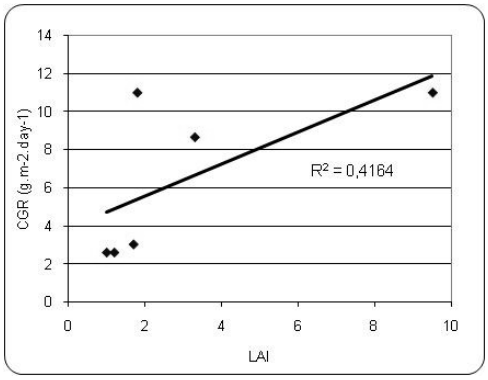

Fig. 4. Leaf area index influence on crop growth rate on *Dactylis glomerata*, variety Ambassador, first cycle of harvest, Moara Domnească 2009-2011

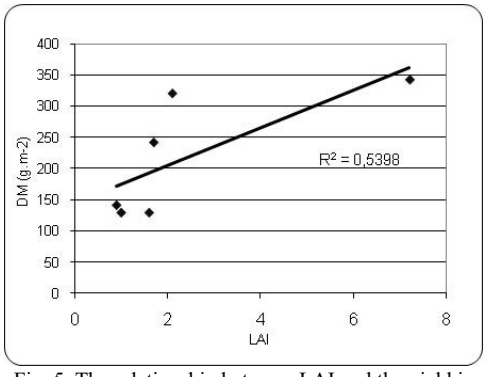

Fig. 5. The relationship between LAI and the yield in *Dactylis glomerata* variety Regent, first cycle of harvest, Moara Domnească 2009-2011

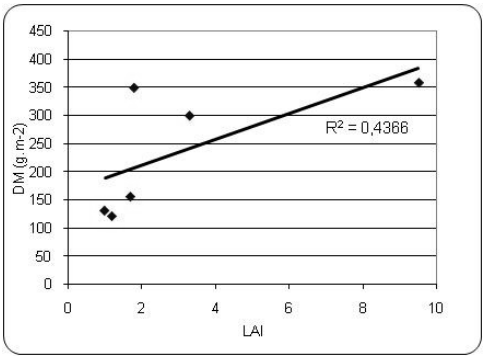

Fig. 6. The relationship between LAI and the yield in *Dactylis glomerata* variety Ambassador, first cycle of harvest, Moara Domnească 2009-2011

Dry mater production

The total dry matter yield produced by the *Dactylis glomerata* species in the three years of experiments, both in pure culture and mixed with *Medicago sativa*, was quite high for the conditions of the Romanian Plain.

In the mixed variants with *Medicago sativa,* the dry matter production was higher than in pure crop.

In pure culture, the dry matter yield ranged from 5.46 to 7.72 t.ha^{-1} DM at the Regent cocksfoot variety and from 5.39 to 8.26 t.ha^{-1} DM at the Ambassador variety (Table 2).

Mixed with *Medicago sativa*, the dry matter yield ranged between 5.85 and 8.90 t.ha^{-1} DM at the Regent variety and between 5.82 and 8.31 t.ha^{-1} DM at the Ambassador variety.

Table 2. Total dry matter production, Moara Domnească 2009-2011

Year	Crop type			
	Pure crop		Mixture with *Medicago sativa*	
	Regent	Ambassador	Regent	Ambassador
2009	7.72	8.26	8.90	8.31
2010	5.50	5.39	5.85	5.82
2011	5.46	5.83	6.17	5.96
Media	**6.23**	**6.49**	**6.97**	**6.70**

In the climate of the Experimental Farm Moara Domnească, during the period 2009-2011, the two experimental cooksfoot varieties do not differ significantly in terms of dry matter production from their average or each other (Table 3).

Table 3. Influence of the *Dactylis glomerata* variety on dry matter production (2009-2011)

Variety	Dry matter production		Diference		Semnification
	t.ha^{-1}	%	t.ha^{-1}	%	
Regent	6.60	100.00	-	-	
Ambassador	6.59	99.94	0.01	-0.06	
Average	6.60	Mt			

Dl 5% = 0.24 t.ha^{-1}
Dl 1% = 0.45 t.ha^{-1}
Dl 0.1% = 0.99 t.ha^{-1}

Based on the results obtained, we can say that, under the experimental conditions, any of the varieties of *Dactylis glomerata* can be grown in a mixture with *Medicago sativa*, without affecting significantly the dry matter production, the potential production of vegetation being determined by the weight of the alfalfa in the mixture structure.

CONCLUSIONS

Under the climate conditions at Moara Domnească Experimental Farm, the main elements that contributed to the yield of the *Dactylis glomerata* species were: the leaf area index, the leaf area and the indices of growth rate.

During the experimental period, the leaf area index was positively correlated with the leaf area expressed in m^2.kg^{-1}, the crop growth rate, the dry matter yield and negatively correlated with the specific leaf area.

The production potential of *Dactylis glomerata* species, averaged over the three years (2009-2011), both in pure culture and mixed with *Medicago sativa*, was decreased by deficient rainfall during the vegetation.

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