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INFLUENCE OF FERTILIZATION ON LEAF BLADE AREA AND YIELD OF TWO GRASS SPECIES

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Abstract. In this paper assessed effects of fertilization on leaves blade area and yield of two grasses: cocksfoot (*Dactylis glomerata* L.) and timothy (*Phleum pretense* L.). The evaluation was carried out in 12-days intervals during the first regrowth. Elements of the assessment were: number of leaves, leaves blade area, and yield. During the research cocksfoot created 5 leaves and timothy 7 leaves. Timothy leaf blade area was almost 2 times higher than the cocksfoot. In both species found positive correlation between fertilization, the total area of blade leaves and yielding. However, there was no such correlation in the case of differences in the total area of leaves and yielding between species. Timothy was characterized by almost 2 times higher leaf blade area compared with cocksfoot, however their yielding was similar.

Key words: *Dactylis glomerata, Phleum pretense*, cocksfoot, timothy, leaf area, yield

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Introduction

It is widely known that the plants productivity depends on the size of assimilation area, especially of the leaf blade area. Therefore, nitrogen fertilization effect is attributed to the most yield-forming because influence on the development of assimilation area. However, some studies (Filek *et al.* 2000; Kulig 2004) showed that the excessive expansion of the photosynthetic apparatus is not always providing maximum yield. The reason for this is shadow on some elements of the photosynthetic apparatus and reduction their efficiency at relatively high consumption of energetic components for breathing. According to Kasperczyk & Szewczyk (2010) in the case of the grass the optimal total area of leaves considered to be 4-6 times larger than the area occupied by the plant.

The purpose of this paper was to assess the impact of the fertilization on the number of leaves, leaves blade area and yield two grass species: cocksfoot (*Dactylis glomerata* L.) and timothy (*Phleum pretense* L.).

Material and methods

The study was conducted in the farm which belongs to the High School of Agriculture in Nowosielce near Sanok (Poland). On the experimental field soil was of average features. Characterized by the following chemical properties: $pH_{(KCl)}$ – 7.10, assimilable P – 133.8, K – 263.0, Mg – 109,0 mg · kg^{-1} of soil, organic matter – 3.15%.

Studied grass species, *D. glomerata* and *Ph. pretense*, were grown in monoculture and cut on third year from time of seeding, in conditions without fertilization and with fertilization (Tab. 1). Assessment of development of these grasses was carried out during the growing season on first regrowth from the beginning of vegetation till the phase of flowering, four times in 12-day intervals. The first assess of cocksfoot was carried out on 4th May 2010, and the last – on 6th May 2011. Timothy grass was assessed on 11th May in each year.

About 10 main shoots were randomly selected and next features were analyzed on them: number of leaves, leaves blade area, and yield. Leaves measurements were made by caliper, its length and width at half of length have been measured. The data contained in the tables represent the average results for 8-9 cocksfoot shoots and 8 timothy shoots.

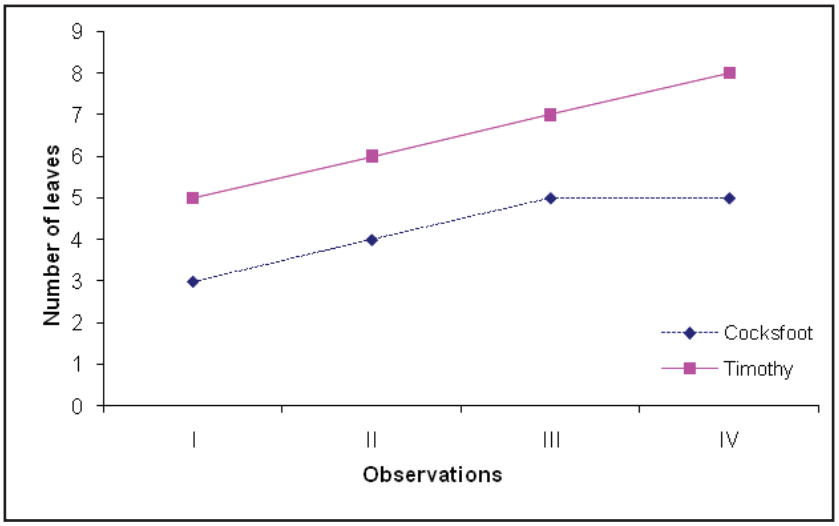

Fig. 1. The number of leaves of cocksfoot (*Dactylis glomerata*) and timothy (*Phleum pretense*) during the time of study.

Results

Number of leaves

During the grass growth in the first regrowth till flowering phase cocksfoot produced 5 leaves and timothy – 8. In the first assessment cocksfoot had 3 leaves and timothy – 5. Assessment carried out in the next three times at intervals of 12 days showed that timothy in each of them enriched by another leaf. In contrast, in cocksfoot this relationship appeared only in the second and third period of the assessment and in the last period has not produced another leaf. In cocksfoot during the second assessment were first leaf but dries and this state continued until the end of the observation (Fig. 1).

On the other hand, in timothy during the third assessment there were two dried leaves, and in next observation were already three dried leaves.

Leaf blade area

In both species of grasses leaf blade of the first leaf was characterized by the smallest area (Tab. 1). Leaves form the objects without fertilization reached the area of 4.18-4.50 cm^2 in cocksfoot and 2.08-2.65 cm^2 – in timothy grass. In turn, in plants under fertilization leaves' area reached 4.74-4.98 cm^2 in cocksfoot and 2.98-3.38 cm^2 – in timothy grass.

Areas of leaf blades from the next leaves were successively increased. In cocksfoot maximum leaf area without fertilization was in 4^{th} leaf while under fertilization – in 4^{th} or 5^{th} leaves. The largest leaf surface of timothy grass in the absence of fertilization was in 6^{th} leaf, while under fertilization – in 6^{th} and 7^{th} leaves.

The maximum area comparing to the area of first leaf blade was larger almost 4 times in cocksfoot and up to 8 times larger – in timothy grass. Average total area of leaf blade during the growth without fertilized was 41.12 cm^2 and with fertilization – 63.00 cm^2 for cocksfoot grass, and 68.19 cm^2 and 103.90 cm^2 – respectively for timothy grass.

Attention deserve following facts: a) in timothy grass blades of 3 first leaves were significantly reduced comparing cocksfoot leaves; b) sizes of the 4^{th} leaf blade in both species were similar; c) areas of blade of next leaves in timothy grass were larger than maximum area of cocksfoot leaves.

Dry matter yield

In the first regrowth yields of both species were similar (Tab. 2). In conditions without fertilization average yields for 2 years were 4.93 $t \cdot ha^{-1}$ for cocksfoot and 4.81 $t \cdot ha^{-1}$ for timothy. Under the influence of fertilization yields increased up to 6.61 $t \cdot ha^{-1}$ for cocksfoot

Table 1. The number of leaves and leaf blade area of *Dactylis glomerata* and *Phleum pratense*.

Leaf number	*Dactylis glomerata*		*Phleum pratense*	
	control	+$P_{20}K_{60}N_{60}$	control	+$P_{20}K_{60}N_{60}$
	Surfach area (cm2)			
	2010			
1	4.18	4.74	2.65	3.38
2	8.74	10.56	3.92	8.91
3	10.12	14.22	6.91	10.88
4	10.51	16.77	11.00	14.80
5	8.09	15.98	11.21	17.99
6	-	-	16.2	20.00
7	-	-	11.10	19.88
8	-	-	-	9.81
Σ	41.64	62.27	63.00	105.65
	2011			
1	4.50	4.98	2.38	2.98
2	7.00	11.97	4.12	7.92
3	8.98	14.43	7.12	11.00
4	11.01	16.28	10.82	14.12
5	9.12	16.07	12.12	16.98
6	-	-	15.21	18.92
7	-	-	12.88	19.12
8	-	-	8.72	11.12
Σ	40.61	63.73	73.37	102.16

and up to 6.78 t · ha^{-1} for timothy. In relation to control plants yield have been increased on 34% for cocksfoot and and on 41% – for timothy. Slightly higher yields were observed in the first year of the study.

Table 2. Dry matter yield of I regrowth (t · ha^{-1}).

Variant	Years		$\overline{X}$
	2010	2011	
Dactylis glomerata	5.05	4.81	4.93
D. glomerata + $P_{20}K_{60}N_{60}$	6.82	6.4	6.61
Phleum pratense	4.93	4.69	4.81
P. pratense + $P_{20}K_{60}N_{60}$	7.05	6.52	6.78
$LSD_{0,05}$	0.81	0.53	0.67

Conclusions

The differences between grasses in the number of leaves and the size of their leaf blade should be combined with genetic features (Lardner *et al.* 2002; Kozłowski & Goliński 1993). Consideration deserves the following facts: a) smallest leaf blade area is in the initial leaf; b) similar number of leaves in a single shoot at each harvest; c) lack of correlation between assimilation area and yield in case of different species.

The first fact allows explaining study Koncewicz & Lewak (2000). They showed that each appearance of a new leaf is limited by growth of previous leaf and accelerates second one aging. Thus, appearance in a relatively short initial period dominant number of leaves which was observed at the first assessment has been combined with a short period of growth of each leaf.

However, at the time of harvest the number of leaves in both grasses was similar and it is a phenomenon difficult to explain. Apparently, in cocksfoot during the first regrowth should be more dried leaves than in timothy grass, because it creates more compact leaf bunch limiting the access of light to the lower leaves.

In both species found positive correlation between fertilization, the total area of leaves and yielding. However, there was no such correlation in the case of differences in the total area of leaves and yielding between species. Timothy was characterized by almost 2 times higher leaf blade area compared with cocksfoot, however their yielding was similar.

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