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*Letter to Editor*

# Persistency of *Poa pratensis* in Long-Term Pasture Sward on Peat-Muck Soil

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## Abstract

Persistency of grass associations is one of the way to counteract degradation of grasslands. The objective of the investigations carried out in 9-11 years of pasture use was to evaluate *Poa pratensis* persistence in sward. In the years 2005-07 *Poa pratensis* made 22.3-47.6% in the first regrowth of grass-clover sward and 39.3-52.1% of grass sward. The last two years were marked by a clear decrease of the studied species amount in the pasture association, irrespective of sward type and N fertilization dose. However, it was noted that the further increase of *Poa trivialis* and *Deschampsia caespitosa* share in spring sward, while *Trifolium repens* and *Dactylis glomerata* in summer. The higher competitiveness of *Dactylis glomerata* under conditions less suitable for Kentucky bluegrass development induced pasture productivity stabilization. Yet a higher abundance of this species in summer, like the growing *Poa trivialis* contribution in spring sward regrowth, has not ensured stabilization of pasture association in a marshy habitat.

**Keywords:** persistency, *Poa pratensis*, pasture sward, peat-muck soil

## Introduction

Plant associations of meadows and pasture development as a consequence of grassland cultivation, show low stability due to the homeostatic mechanisms that are insufficient to provide phytocoenosis resistance to temporal, disadvantageous effects of various agents and to protect the grassland from degradation [13]. The obvious indication of progressing plant cover degradation on organic soils is decreased sward species diversity as well as an increasing tendency toward *Poa pratensis* dominance, which has been observed in a few studies (3, 6, 7, 8, 9, 11). Therefore, concern about the persistence of grass associations occurring in the typical meadow habitats appears to be one of the ways to counteract grassland degradation. Kentucky bluegrass (*Poa pratensis*) has proven to be one of the most persistent components of the meadow and pasture sward [4] in a marshy habitat [1], especially under conditions of sufficient access to light and soil of medium fertility and moisture [14]. However, multi-year research and studies indicate serious fluctuations in this species' presence in sward over the vegetative season and the successive years of the plant association structure development [14, 15]. Besides habitat conditions, the floristic diversity of sward and persistence of *Poa pratensis* in the pasture association depend on zoogenic factors, in those excrements left by grazing animals [12].

The objective of the research conducted in the years 2005-07 (9-11 years of pasture use) was to evaluate the persistency of *Poa pratensis* in the pasture sward on peat-muck soil.

## Experimental Procedures

The pasture trials were commenced by Krzywiec [10] in 1996. The experiment was set up with randomized block

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Table 1. Soil acidity (pH), concentration of organic matter and basic nutrients in peat-muck soil in 1999.

| Treatment | pH 1 mol in KCL | Organic matter (%) | P | K | Mg |
|---|---|---|---|---|---|
| | | | mg 100 $g^{-1}$ soil | | |
| Tr + T | 5.5 | 77.6 | 32.6 | 32.1 | 39.8 |
| $T_{N-40}$ | 5.7 | 78.6 | 54.8 | 25.6 | 35.5 |
| $T_{N-80}$ | 5.8 | 79.0 | 52.6 | 29.5 | 31.8 |
| $T_{N-120}$ | 6.5 | 76.0 | 57.9 | 35.3 | 44.5 |

Tr – *Trifolium repens*, T – sown grasses, N – 40, 80, 120 – nitrogen fertilization

design, in four replications and located on peat-muck soil (Mt II – middle decayed peat) with low pH value. Contents of basic nutrients in the soil were low, except the phosphorus concentration (Table 1). Plot size was 40 $m^2$.

The sown seed mixtures included *Poa pratensis* cv. Bona (35%), *Phleum pratense* cv. Skala (20%), *Dactylis glomerata* cv. Areda (10%) and *Trifolium repens* (35%). The studies included the following seven white clover cultivars: Anda, Armena, Astra, Rema, Romena, Alice, Santa and a mixture of its Polish cultivars. Additionally, a grass mixture was sown in which a percentage of clover was substituted and equally distributed between the grass species mentioned above.

In the years of full pasture utilization the clover-grass sward was top dressed with 40 kg N (dose divided into three parts – after I, II and III grazing), 35 kg P (single dose – in spring) and 100 kg K $ha^{-1}$ $year^{-1}$ (in two doses – in spring and after II grazing). The grass sward N-fertilization was performed at three rates: 40, 80 and 120 kg N $ha^{-1}$ (doses divided into three parts and applied as on the plots with clover-grass sward).

Four sward grazings by Limousine cattle were conducted over each grazing season. The average stocking rate ranged 3.6-4.0 LU $ha^{-1}$. The pre-grazing SSH (sward surface height) was 23 (±2) cm. The sward on a paddock was grazed down for 3-4 days every grazing cycle to an average height of 6.8 (±0.5) cm. Sometimes residual herbage was cut, particularly after the first sward grazing, when a rate of plant growth in spring was high or after a long period with rainy weather, causing some difficulties in grazing organization. Before the animals were admitted to the pasture quarter, the sward of the first and the third regrowth was sampled to determine the sward species composition using the botanical-weight method. The studies on species persistence in perennial pasture swards have continued.

Characteristics of the climatic conditions were made on the grounds of the temperature and precipitation readings supplied by the automatic meteorological station, as well as measurements of ground water level in the observation well, localized on the experimental plot (Fig. 1).

The research period was characterized by low precipitation amounts and high air temperatures at the vegetative season, which caused serious fluctuations of the groundwater mirror. The most disadvantageous weather conditions were observed in 2007, when a negative significant relationship between precipitation total and the temperature course and groundwater level was confirmed as expressed by the correlation coefficients (r) = -0.43 and -0.62, respectively.

## Results and Discussion

The research results showing *Poa pratensis* behavior in the sward until year eight of pasture utilization were presented in earlier reports [15, 16]. Persistency of species (which at that time composed the pasture sward on the peat-

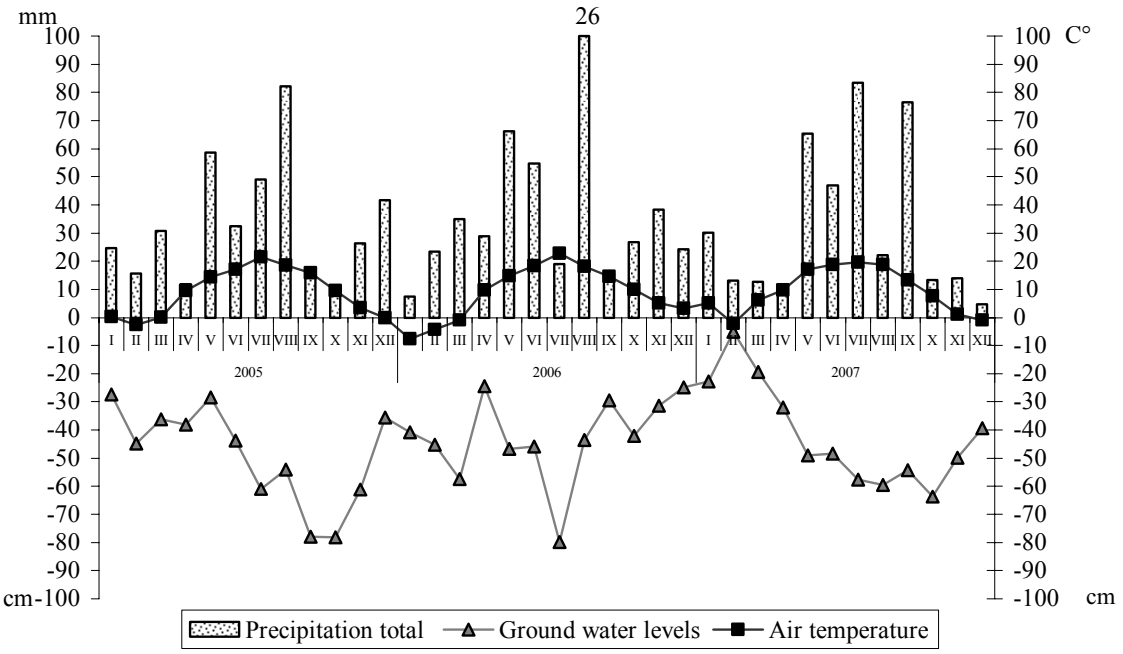


Fig. 1. Monthly precipitation total (mm), average air temperatures (°C) and ground water levels (cm) in Sosnowica in 2005-07.

Table 2. Share of *Poa pratensis* (%) in the first regrowth of pasture sward on peat-muck soil.

| No. | Treatment | Mean in the years 2000-04 | 2005 | 2006 | 2007 | Mean in the years 2005-07 |
|---|---|---|---|---|---|---|
| 1 | T + Tr Anda | 58.0 | 57.7 | 29.6 | 19.3 | 35.5 |
| 2 | T + Tr Armena | 54.2 | 44.1 | 20.1 | 38.7 | 34.3 |
| 3 | T + Tr Astra | 61.5 | 21.0 | 16.0 | 29.8 | 22.3 |
| 4 | T + Tr Rema | 56.1 | 44.4 | 16.8 | 17.9 | 26.4 |
| 5 | T + Tr Romena | 47.5 | 36.3 | 44.5 | 21.0 | 33.9 |
| 6 | T + Tr Alice | 70.0 | 72.0 | 17.7 | 23.6 | 37.8 |
| 7 | T + Tr Santa | 58.5 | 73.8 | 52.0 | 17.1 | 47.6 |
| 8 | T + Tr mix | 56.7 | 65.2 | 34.3 | 17.5 | 39.0 |
| 9 | $T + N_{40}$ | 56.8 | 72.4 | 45.88 | 25.46 | 47.9 |
| 10 | $T + N_{80}$ | 58.9 | 77.6 | 46.12 | 32.69 | 52.1 |
| 11 | $T + N_{120}$ | 59.4 | 45.3 | 37.81 | 34.8 | 39.3 |

Table 3. Behaviour of *Dactylis glomerata* and *Deschampsia caespitosa* in the pasture sward in 2005-07.

| Treatment | Species | 2005 | | 2006 | | 2007 |
|---|---|---|---|---|---|---|
| | | I | III | I | III | I |
| $Tr + T_{N-40}$ | *Dactylis glomerata* | 15.5 | 19.0 | 10.6 | 19.2 | 13.9 |
| | *Deschampsia caespitosa* | 4.4 | 1.1 | 6.2 | 0.6 | 3.5 |
| $T_{N-40}$ | *Dactylis glomerata* | 8.6 | 15.6 | 19.6 | 37.7 | 22.4 |
| | *Deschampsia caespitosa* | - | 0.5 | - | - | 12.6 |
| $T_{N-80}$ | *Dactylis glomerata* | 12.2 | 18.5 | 6.4 | 33.0 | 24.6 |
| | *Deschampsia caespitosa* | - | 3.9 | 1.8 | - | 9.7 |
| $T_{N-120}$ | *Dactylis glomerata* | 43.0 | 45.8 | 23.1 | 27.8 | 14.4 |
| | *Deschampsia caespitosa* | - | 0.1 | 1.7 | 0.3 | 19.7 |

Tr – *Trifolium repens*, T – sown grasses, N – 40, 80, 120 – nitrogen fertilization

muck soil) was dependent on sward age, sward regrowth order in the pasture season and the climatic conditions course in each experimental year of the studied period. Until the eighth year of sward pasture use, *Poa pratensis* quantity in the first regrowth increased along with sward age progression [15]. In the following three years, such behavioral regularity in the species under investigation was not recorded. In the years 2000-04, a mean contribution of *Poa pratensis* in the first sward regrowth ranged between 47.5-70.0%, whereas over 2005-07 Kentucky bluegrass was shown to account for 22.3-47.6% of grass-clover sward and 39.3-52.1% of grass sward (Table 2).

In the ninth year of pasture use (2005), grasses sown in the mixtures still prevailed, while *Poa pratensis* was a dominant species (36.3-77.6%) only in the first regrowth sward. Throughout the two subsequent years, there was observed a marked decrease of the studied species share in the pasture association, independently on the type sward and dose of nitrogen fertilization (Figs. 2-5). The research results presented by Rogalski et al. [12] showed that excrement from grazing animals affected the botanical composition of sward and bovine faeces decidedly limited *Poa pratensis* domination in sward of Kentucky bluegrass type. Other factors affecting the content of *Poa pratensis* in the sward at summer can be drought and heat stress. High air temperatures and water deficit during the summer months of the studied period were a reason for soil drought, sometimes lasting for a long time. According to Jinrong et al. [5], these two major factors limited the growth of cool-season grasses like Kentucky bluegrass and were associated closely with water deficit and physiological parameters of this plant species.

Besides, the spring regrowth showed the presence of numerous unstable other species emerging in the plant association as a result of various changes of habitat conditions. In the next spring's regrowth of sward, we noted the progressing amount of other grasses, especially *Poa trivialis* and *Deschampsia caepitosa*; this was confirmed by Czyż et al. [2] and Kiryluk [7]. Important increase of *Deschampsia caespitosa* content in the grass pasture sward was confirmed in 2007 spring regrowth (Table 3). *Poa trivialis* – grass with low thermal requirements and drought-sensitive, was shown to make a serious contribution to sward at the beginning of plant vegetation period. Under the conditions of higher temperatures and insufficient precipitation at the end of spring or in summer, the plants of this species often dried up and their sites were invaded by *Trifolium repens* and *Dactylis glomerata*. Like in earlier years, *Poa pratensis* was shown to decrease its contribution to the sward regrowth phase in summer. At that time, the *Trifolium repens* and *Dactylis glomerata* (Table 3) species became more numerous in the sward. The behavioral changes of the species were a consequence of the weather conditions, in that precipitation deficiency and average air temperatures rising in following years (Fig. 1). Under conditions of multiyear pasture utilization, *Trifolium repens* spread out through the sward by branching stolons and in that way was present even in the grass sward. Increasing competitiveness of *Dactylis glomerata* to *Poa pratensis* promoted stabilization of pasture productivity [15] and signed particularly in the sward fertilized with higher doses of nitrogen. However, the enhanced presence of this species in summer, just like a growing share of *Poa trivialis* in the spring regrowth of sward, was not beneficial for pasture association persistency in the marshy habitat.

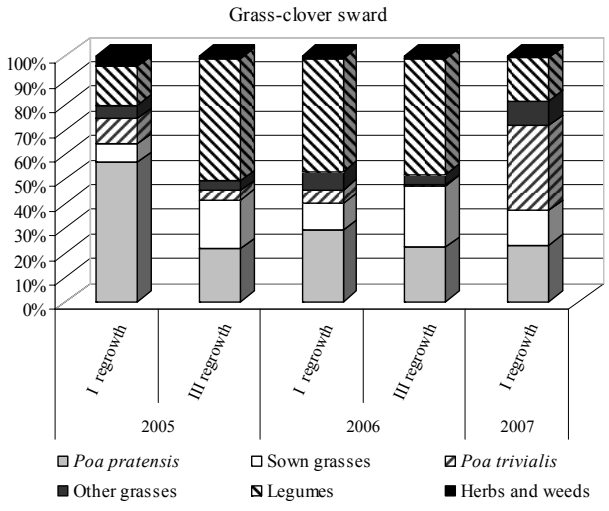


Fig. 2. Botanical composition of grass-clover pasture sward (%) in 2005-07.

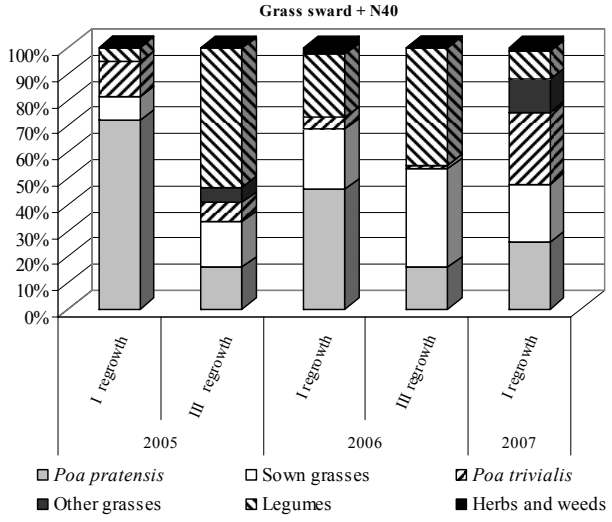


Fig. 3. Botanical composition (%) of grass pasture sward, fertilized with 40 kg N $ha^{-1}$, in 2005-07.

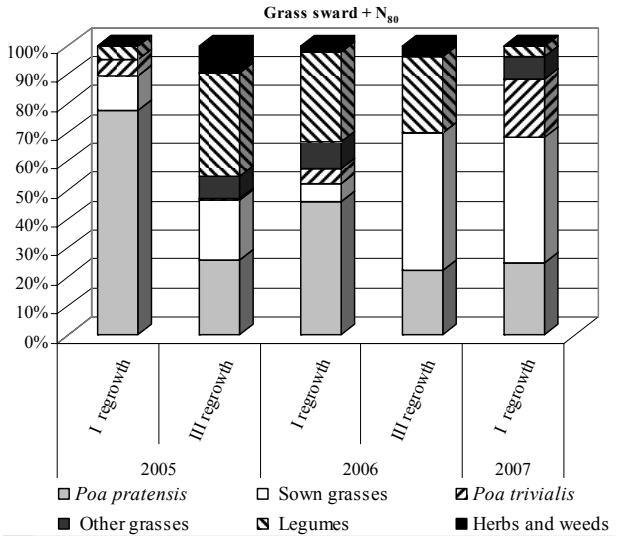


Fig. 4. Botanical composition (%) of grass pasture sward, fertilized with 80 kg N $ha^{-1}$, in 2005-07.

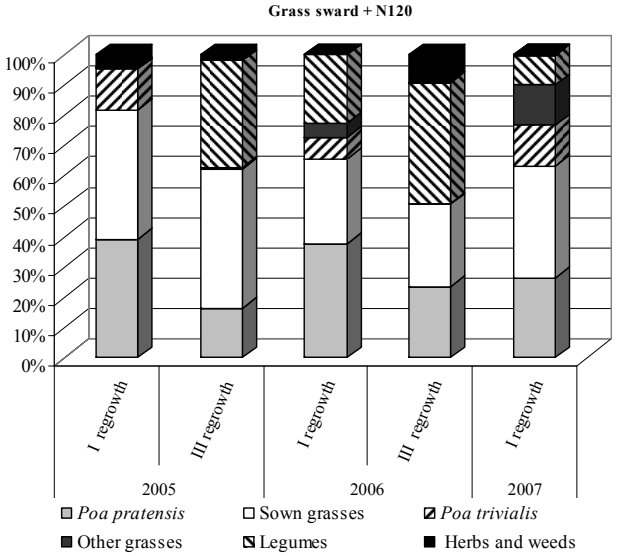


Fig. 5. Botanical composition (%) of grass pasture sward, fertilized with 120 kg N $ha^{-1}$, in 2005-07.

## Conclusions

1. Persistency of *Poa pratensis* in the perennial pasture sward on peat–muck soil is affected by variable habitat conditions and grazing animals which determine competitive abilities of species creating pasture association and also by sward regrowth sequence.
2. *Poa pratensis* has decreased its share in the spring sward since the tenth year of pasture use. The highest ranges of its presence between the first and third regrowth were confirmed in the grass sward, fertilized with 40 kg N $ha^{-1}$.
3. *Poa trivialis* and *Deschampsia caespitosa* were the species increasing their content in spring sward, and *Trifolium repens* and *Dactylis glomerata* in summer. However, the high variability of their share in the sward during a vegetative season has not been favourable to persistency of pasture association under postboggy habit.

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