

Study of the Photosynthetic Ability of Perennial Legume Species in the Floristic Structure of Permanent High-Altitude Pastures

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Abstract

To point out the photosynthetic ability of perennial legume species, we measured the following parameters: chlorophyll content and soluble sugar content. Sampling was done on permanent pastures at different altitude levels: 90 m, 330 m, 900 m, and 1,800 m. Soluble sugar content was measured in samples from variants fertilized with mineral nitrogen and with organic fertilizers (through animal folding). Results showed that, as far as chlorophyll content is concerned, there is a negative relation between this parameter and the altitude level of the pasture. Perennial legume species on the pastures had a lower content of soluble sugars in all the variants fertilized with mineral fertilizers and with organic fertilizers compared to the control variant.

Keywords: altitude, chlorophyll, fertilization, pasture, perennial legumes, soluble sugars

1. Introduction

Fixing nitrogen in perennial legumes is influenced by both external (natural and technological) factors and by the nature of physiological activities such as the processes during photosynthesis. Studies carried out show that over 30% of the products of bio-synthesis are consumed during nitrogen fixation through nitrogen fixing bacteria [1-5].

In this paper we point out the impact of fertilising permanent pastures at different altitude levels on chlorophyll content and on soluble sugar content in the perennial legume species growing on these pastures.

2. Materials and methods

Photosynthesis ability of perennial legume species manifest in chlorophyll content and in soluble sugar content was studied on two types of permanent pastures located at different altitude levels and fertilised in different ways:

- hill pasture, located at 330 m altitude, on which we applied nitrogen mineral fertiliser at the following rates: N₀, N₅₀, N₁₀₀, N₂₀₀;

- sub-Alpine pasture, located at 1,800 m altitude, fertilized through animal folding and over-seeded with a mixture of grass species and of perennial legume species.

Perennial legume sampling was done upon the first harvest, at the beginning of the blooming period.

Green chlorophyll pigments were measured quantitatively through absorption spectrophotometry, and to point out soluble sugar content, we used the usual laboratory methods.

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3. Results and discussion

The amount of chlorophyll pigments accumulated in the plants' chloroplasts absorb a certain amount of light which is the energetic basis for the production of substances biosynthesised through the process of photosynthesis. Chlorophyll content differs from one species to another and it can be influenced by both climate conditions and by technological ones.

Research on chlorophyll content (a+b) in the perennial legumes from the vegetal cover of permanent pastures pointed out the existence of a negative relationship between this parameter and the altitude they are located at.

Thus, in all three perennial legume species, the amount of chlorophyll (both a and b) decreases proportionally with the increase of the altitude level of the pastures. This can be caused by both different climate conditions and by the shortening of the vegetation period at higher altitudes. Thus, if in the species *T. repens* L., present in the floristic composition of the pasture located at 90 m altitude, chlorophyll (a+b) content was 2.85 mg/g, it decreased to 2.42 mg/g at 330 m altitude, and to 1.98 mg/g at 1,800 m altitude. Likewise, there are differences in chlorophyll content between the three perennial legume species, with *T. repens* L. having the highest content (Table 1).

Table 1. Impact of altitude on chlorophyll content in some perennial legume species from permanent pastures (mg/g fresh vegetal material)

Altitude of studied pastures	Existing perennial legume species	Chlorophyll a	Chlorophyll b	Chlorophyll a+b
90 m	<i>T. repens</i> L.	1.89	0.96	2.85
	<i>L. corniculatus</i> L.	1.66	0.92	2.58
330 m	<i>T. repens</i> L.	1.55	0.87	2.42
	<i>L. corniculatus</i> L.	1.63	0.80	2.43
900 m	<i>T. repens</i> L.	1.52	0.78	2.30
	<i>L. corniculatus</i> L.	1.33	0.69	2.02
	<i>T. pratense</i> L.	1.48	0.74	2.22
1,800 m	<i>T. repens</i> L.	1.30	0.68	1.98
	<i>T. pratense</i> L.	1.28	0.64	1.92

Vegetal biomass is the most important resource of grassland; it can supply part of the necessary feed for bovine, sheep, and goats. There is not always a direct relationship between this amount of vegetal feed and the number of cattle. At the beginning of 2012, there were, in Romania, about 2,240,000 bovines (60% less than in 1990) and 11,330,000

sheep and goats (25% less than in 1990). If we take into account the number of big cattle units (BCU), we can see that, among the E.U. countries, Romania has the lowest values in this synthesis indicator (on the average, 0.17 BCU/inhabitant, 0.23 BCU/ha of agricultural land, 0.69 BCU/ha of grassland) (Table 2).

Table 2. Impact of nitrogen fertilisation on hill pastures (330 m altitude) on soluble sugar content of perennial legume species

Nitrogen rate	Perennial legume species	Soluble sugars (% of the fresh vegetal material)	Soluble sugars (% of the dry material)
N ₀	<i>L. corniculatus</i> L.	3.14	9.81
	<i>T. repens</i> L.	3.86	15.36
N ₅₀	<i>L. corniculatus</i> L.	2.89	9.42
	<i>T. repens</i> L.	3.25	14.17
N ₁₀₀	<i>L. corniculatus</i> L.	2.44	8.32
	<i>T. repens</i> L.	2.67	10.87
N ₂₀₀	<i>L. corniculatus</i> L.	1.87	6.73
	<i>T. repens</i> L.	2.23	7.68

While grasslands supply about 40% of the necessary fibrous fodder for the cattle and 80%

fibrous fodder for the sheep and goats (the difference is ensured from the areas cultivated on

arable land with forage plants), the area of permanent grassland necessary to cover this amount of biomass would be 2,200,000 ha, i.e.

56% of the total area covered by grasslands (Table 3).

Table 3. Impact of animal folding and of over-seeding pastures of *Nardus stricta* L. (1,800 m) on soluble sugar content in perennial legumes

Variant	Perennial legume species	Soluble sugars (% of the fresh vegetal material)	Soluble sugars (% of the dry material)
No animal folding	<i>T. pratense</i> L.	4.76	16.09
	<i>T. repens</i> L.	3.39	9.23
Animal folding for 2 nights	<i>T. pratense</i> L.	4.19	15.88
	<i>T. repens</i> L.	3.14	8.77
Animal folding for 4 nights	<i>T. pratense</i> L.	3.74	13.28
	<i>T. repens</i> L.	2.64	8.09
Animal folding for 6 nights	<i>T. pratense</i> L.	3.05	12.72
	<i>T. repens</i> L.	2.55	7.89

4. Conclusions

Chlorophyll content (a+b) decreases, in all perennial legume species on the pastures, proportionally with the altitude of the permanent pastures. In Dutch/white clover (*T. repens* L.), chlorophyll content decreases from 2.85 mg/g fresh vegetal material in the pasture located at 90 m altitude, to 1.98 mg/g in the pasture located at 1,800 m altitude.

Mineral fertilisation with nitrogen or organic fertilisation (through animal folding) has a negative impact on soluble sugar content in the perennial legume species from these pastures. In higher altitude pastures (1,800 m), there was a slight decrease of sugar content compared to the pasture located at 90 m altitude.

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