The Remnant Effect of Treatments Applied on Subalpine Grasslands Grazed by Dairy Cows on Milk Production

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Abstract
In the last three experimental years (2010-2013), the mean milk production ranged between 1140 l/ha (in the control variant) and 2556 l/ha (in the variant in which fertilisation and amendment treatments were applied during the period 1995-2007). The maximum milk production (4509 l/ha) was in 2010 in the variant fertilised, amended, and re-sowed, i.e. 3144 l/ha more than in the control variant.

Keywords: Nardus stricta improved grassland; rational grazing; milk production; remnant effect.

1. Introduction

Nardus stricta grasslands in the sub-Alpine and Alpine areas of Romania are valorised exclusively through direct grazing by sheep and cattle, though the grazing period is relatively short (about 100 days per year). They have carried out research to point out the effect of some technological improvement measures on these grasslands on animal productivity during grazing [1-7].
The paper presents the influence of the remnant effect of some improvement works of Nardus stricta grasslands on milk production in cattle.

2. Materials and methods

Research results presented in this paper were produced by the Grassland Research-Development Institute (G.R.D.I.) of Braşov, Braşov County, Romania, in an experiment organised on Nardus stricta grassland in the Bucegi Mountains, at an altitude of 1800 m.

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The experimental variant lasted 18 years and encompassed the following improvement treatments:
- A – natural grassland, not improved, and constantly grazed by cattle for 80 days/year on the average;
- B – natural grassland, improved with the following technology: $N_{150}P_{75}K_{75}$ (during 1996-1998) and cow folding (5 nights, 1 cow/6 m^2) in 2004 and 2010;
- C – natural grassland, improved with the following technology: amendments with CaO (7 t/ha) in 1995, fertilisation with $N_{150}P_{75}K_{75}$ (during 1996-1998) and cow folding (5 nights, 1 cow/6 m^2) in 2003 and 2009;
- D – natural super-sowed grassland improved with the following technology: super-seeding with a mixture of gramineae and perennial legumes (1995), fertilisation with $N_{150}P_{75}K_{75}$ (during 1996-1998) and cow folding (5 nights, 1 cow/6 m^2) in 2002 and 2008.

The area of each experimental plot was 0.75 ha; the plot was surrounded by a fixed fence.
All experimental variants were grazed by dairy cattle (the Brună de Maramureş breed), adapted to the harsher mountain conditions, in good health state and with even milk production (12-14 l/dairy

cow 3.5% fat); primiparous cows and old cows were excluded. The grazing system was linear (continuous), with a load of four UVM/ha (three dairy cows/lot) in the variants B, C and D, and one UVM/ha in the variant A. This paper presents milk productions from the years 2010-2013 – the post-treatment period where there were no more improvement treatments on these grasslands.

3. Results and discussion

Improving sub-Alpine Nardus stricta grasslands through fertilisation, amendments and super-seeding has a long lasting effect on milk production due to the increase of the vegetal production, of the positive alterations in the floristic composition of the grassland, and of the increase of the nutritious value of the fodder.

Table 1. Milk production and significance of experimental variants (2010)

Variant	Milk		Difference	Significance
	l/ha	%	l/ha	
A	1365	100	Mt	
B	4074	298	2709	***
C	4128	302	2763	***
D	4509	330	3144	***

DL5% = 588 l/ha DL 1% = 890 DL 0.1% = 1430

In the conditions of 2010, milk production ranged between 1365 and 4509 l/ha, depending on experimental variant (Table 1). Compared to the control variant, production in the variants improved was 3-3.3 time larger. Maximum milk production (4509 l/ha) was in the variant D (sowing – fertilising – amendment) with an increase of 230% compared to the control variant, of 11% compared to the variant B and 9% compared to the variant C.

Table 2. Milk production and significance of experimental variants (2011)

Variant	Milk		Difference	Significance
	l/ha	%	l/ha	
A	1242	100	Mt	
B	3773	304	2531	***
C	3965	319	2723	***
D	3739	301	2497	***

DL5% = 769 l/ha DL 1% = 1165 DL 0.1% = 1873

After 2010, milk production in the improved variants did not go above 4000 l/ha; yet, the differences compare to the control variant kept constant, which shows the remnant effect of these treatments. Results of the year 2011 point out a mean production of only 1242 l/ha in the control variant and between 3739 and 3965 l/ha in the variants improved. Among these variants, to note the variant C, with the largest yield and with increases of 219% (2723 l/ha) compared to the control variant, 5% (192 /ha) compared to the variant B, and 6% (226 l/ha) compared to the variant D (Table 2).

Table 3. Milk production and significance of experimental variants (2012)

Variant	Milk		Difference	Significance
	l/ha	**%**	**l/ha**	
A	1013	100	Mt	
B	2864	283	1851	***
C	3368	332	2355	***
D	2753	272	1740	***

DL5% = 605 l/ha DL 1% = 917 DL 0.1% = 1474

Milk production in 2012 oscillated between 1013 l/ha in the control variant and 3368 l/ha in the variant C. that year, milk production in the variants improved was 3 times larger than in the control variant (A), that was only grazed rationally

by dairy cows. All the differences between the variants are very significant statistically (Table 3).

Table 4. Milk production and significance of experimental variants (2013)

Variant	Milk		Difference	Significance
	l/ha	%	l/ha	
A	943	100	Mt	
B	2824	299	1881	***
C	3322	352	2379	***
D	3606	382	2663	***

DL5% = 767 l/ha DL 1% = 1161 DL 0.1% = 1867

In 2013, there was the lowest milk production particularly in the control variant (A). in general, the variation limits ranged between 943 l/ha in the control variant and 3606 l/ha in the variant D. however, the remnant effect of the treatments was obvious producing 3-4 times more milk (Table 4).

To better study the remnant effect of improvement treatments 15 years after application, we made a statistical calculus for the period 2010-2013 to better emphasise the influence of the interactions between experimental variants and the last experimental years on milk production.

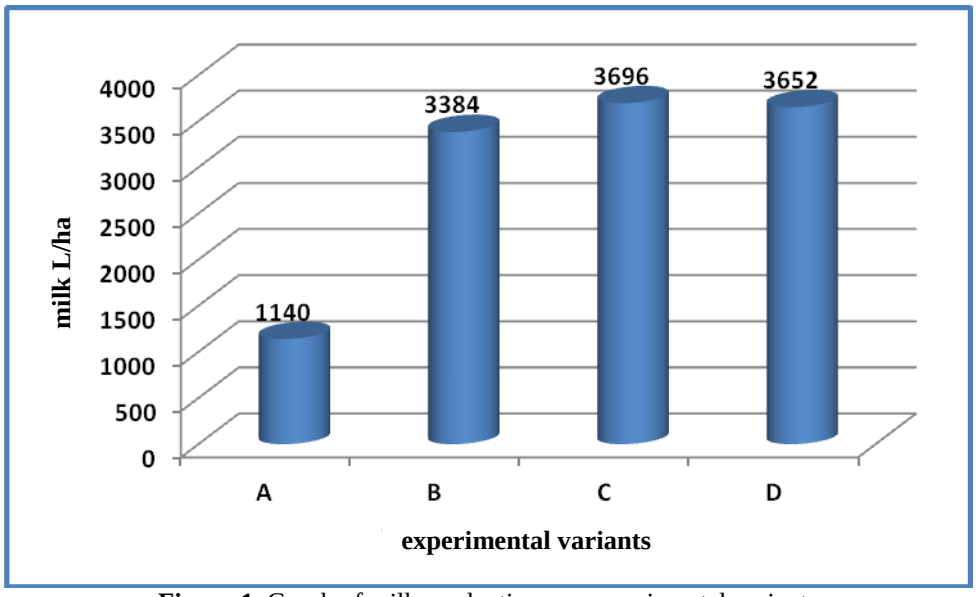

Figure 1. Graph of milk production per experimental variants (remnant effect of treatments, mean 2010-2013)

During 2010-2013, mean milk production ranged between 1140 l/ha in the control variant and 2556 l/ha in the variant C. All the differences between the control variant and the variants improved are very significant statistically. As we can see, at that time, milk production was 2.2-2.5 times larger (2244-2556 l/ha) than in the control variant (not improved). The differences between the variants improved are relatively low: the highest one, 312 l/ha, was between the variants C and B. In the variants C and D, the productions were, practically, equal (Figure 1). Mean results per production years lead to the conclusion that, starting with 2010, milk production recorded a significant decrease until 2013, i.e. from 3519 l/ha in 2010, 2500 l/ha in 2012 and 2674 l/ha in 2013. On the average, each year the decrease was of 735 l/ha (Figure 2).

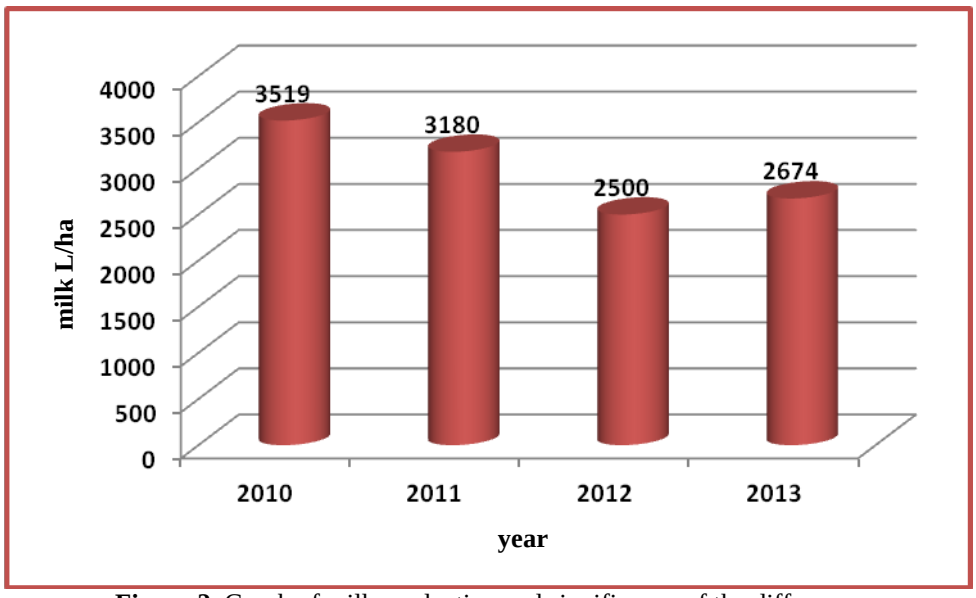

Figure 2. Graph of milk production and significance of the difference (for the last production years) as remnant effect of treatments applied

4. Conclusions

During 2010-2013, mean milk production reached values ranging between 1140 l/ha in the control variant and 2556 l/ha in the variant C. The differences between the control variant and the improved variants are very significant statistically. As we can see, during this period, milk production was 2244-2556 l/ha (i.e. 2.2-2.5 times) larger than that of the control variant. The differences between the improved variants were relatively low, with the largest one (312 l/ha) between the variants C and B. In the variants C and D, the productions were practically equal.

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