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Ruta Butkute

*Lithuanian Institute of Agriculture, Lithuania*

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## Effect of liming and mineral fertilisation on soil properties and long-term sward agroecosystem productivity

R. Butkute

Lithuanian Institute of Agriculture, Veizaiciai Branch, Gargzdų 29, LT-96216, Veizaiciai, Klaipėda District, Lithuania, E-mail: ruta@veizaiciai.lzi.lt

**Key words:** permanent meadow, liming, fertilisation

**Introduction** Long-term mowed sward ecosystems are the least affected anthropogenically. Soil under sward ecosystems is not tilled and the influence of agricultural implements is only superficial. Mineral fertilisers not only increase the productivity of sward phytocenosis (Daugeliene, 2002; Butkuvienė, Butkute, 2004), but also result in changes of soil chemical properties and biogenic elements migration to deeper soil layers (Daugeliene, 2002; Gutauskas, Slepetiene, 2002). Little information has been available in Lithuania so far on the processes which occur in sward ecosystem soils and influence soil chemical indicators under fertilisation with natural substances. Considerable attention has to be paid to: (1) the amounts of biogenic elements, which influence soil chemical properties; (2) the productivity of sward phytocenosis.

**Materials and methods** Soil chemical indices were determined on 12-14 years of used sward agroecosystem situated in Western Lithuania. The soil was *Haplic-Luvisol (LVh)*, medium on light loam. Two soil  $pH_{KCl}$  levels: 5.1-5.5; 6.6-7.0 and two fertilisation backgrounds:  $P_{60} K_{60}$  and  $N_{120} P_{60} K_{60}$  were formed by liming and fertilisation. Two different sward types had formed: (1) white clover (*Trifolium repens L.*) + meadow-grass (*Poa pratensis L.*) sward—when fertilising with  $P_{60} K_{60}$  and (2) uniform meadow-grass (*Poa pratensis L.*) sward—fertilising with  $N_{120} P_{60} K_{60}$ . Applied fertilisers: ammonium nitrate, bonemeal and potassium magnesium. Samples for soil chemical characteristics were taken from the upper 0–10 cm depth annually after grasses vegetation has finished. Soil samples were analysed using the following methods:  $pH_{KCl}$  ionometrically;  $N_{total}$  by Kjeldal method; mobile  $P_2O_5$ ,  $K_2O$ , Ca and Mg by Egner-Riem-Domingo (A-L) method. Permanent grass dry matter (DM) yield of three cuts was determined.

**Results and discussion** The data from Table 1 shows that amounts of mobile Ca and Mg accumulated in the soil were the highest of all considered biogenic elements. Amounts of Ca in the soil with different  $pH_{KCl}$  levels differed by 2.3-3.0, Mg—by 1.6-1.9 times. It was determined by liming. The amounts of all considered elements in 5.1-5.5  $pH_{KCl}$  soil were similar under both fertilisation cases. However, in soil limed to 6.6-7.0  $pH_{KCl}$  lower amounts of mobile P, K and Mg were determined in  $N_{120} P_{60} K_{60}$  background. 6.6-7.0 soil  $pH_{KCl}$  is more suitable for grasses growth, the availability of nutrients is better; therefore, the observed differences occurred.

However the standpoint to agriculture would change, meadow yields still remain the main farming outcome. Even after 12-14 years, liming affected DM yield, but only on meadow fertilised with  $P_{60} K_{60}$  (DM yield higher by 22%). When balanced NPK rates were applied, DM yield was similar (difference only 3%) on both meadows arranged on 5.1-5.5 and 6.6-7.0  $pH_{KCl}$  soil. Meadow was less productive under  $P_{60} K_{60}$  fertilisation than under  $N_{120} P_{60} K_{60}$ . The study showed that N fertilisation still is the key factor providing higher DM yields.

**Table 1** Effect of liming and fertilisation on biogenic element amounts in the soil and grass DM yield, 2003-2006.

Soil $pH_{KCl}$	$N_{total}$ , %	$P_2O_5$ , mg $kg^{-1}$	$K_2O$ , mg $kg^{-1}$	Ca, mg $kg^{-1}$	Mg, mg $kg^{-1}$	DM yield, t $ha^{-1}$
<b><math>P_{60} K_{60}</math></b>						
5.1-5.5	0.14±0.01	95±18	142±5	1584±63	184±11	2.64±0.33
6.6-7.0	0.15±0.01	145±14	157±14	4765±145	358±27	3.23±0.46
<b><math>N_{120} P_{60} K_{60}</math></b>						
5.1-5.5	0.14±0.00	107±26	146±10	2094±125	200±23	4.84±0.61
6.6-7.0	0.15±0.02	129±14	133±10	4760±328	313±33	4.98±0.72

**Conclusions** Comparing the amounts of biogenic elements the present study showed, that ~30% of legumes in meadow on soil adjusted to 6.6-7.0  $pH_{KCl}$  and fertilised with  $P_{60} K_{60}$  can substitute  $N_{120}$  rate. However, application of balanced rates of NPK fertilisers provides comparatively higher DM yield. Liming significantly improved soil chemical properties, nutrient availability in all cases and DM yield of meadow fertilised with  $P_{60} K_{60}$ .

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