ŽEMĖS ŪKIO MOKSLAI. 2008. T. 15. Nr. 2. P. 46–52

Effects of pasture improvement measures on sward productivity, botanical and chemical composition

Elvyra Butkuvienė,

Rūta Butkutė

Lithuanian Institute of Agriculture,
Vėžaičiai Branch, Gargždų 29,
LT-96216 Vėžaičiai,
Klaipėda district, Lithuania
E-mail: elvyra@vezaiciai.lzi.lt,
ruta@vezaiciai.lzi.lt

The paper presents data of the research carried out in 1999–2003 in the Vėžaičiai Branch of Lithuanian Institute of Agriculture (LIA). The effect of different pasture improvement measures (fertilisation, oversowing and resowing) on botanical, chemical sward composition and productivity were investigated on pastures non-sprayed and sprayed with a herbicide. Three different studies were carried out on an old pasture, which differed by the proportion of forbs and dry matter (DM) yield. All measures used for sward improvement changed the botanical and chemical composition of the pasture, forage quality and also significantly increased the pasture's yield. Spraying with MCPA (3.7 L ha^{-1}) and fertilisation with N_{120} considerably decreased the proportion of forbs (by 1.9–10.5% and 6.8–7.9% respectively) and legumes (by 0.3–2.3% and 14.7–16.7% respectively) in pasture swards. Additional oversowing and resowing also resulted in a decrease of forbs (by 2.4–4.7% and 0.8–9.4% respectively). However, the proportion of legumes in oversown and resown pastures increased and was 27.2–28.9% and 24.8–26.3% respectively. Nitrogen fertilisation, additional oversowing and resowing increased the content of crude proteins in the pasture sward. The content of crude fibre in the pasture sward was less under additional oversowing and resowing. No considerable changes in crude ash and crude fat amounts under the impact of different improvement measures were determined. All the considered pasture improvement measures significantly increased sward DM yield (by 0.97–1.75 t ha^{-1} on average). A similar tendency for metabolisable energy amount was determined. However, the increase of metabolisable energy accumulated in pasture sward after additional oversowing was insignificant.

Key words: N_{120} fertilisation, oversowing, resowing, botanical and chemical composition

INTRODUCTION

Pasture swards are usually improved by two methods: main and surface. Old pasture sward is ploughed up and the mixture is resown when using the main improving method. Long-term studies carried out in the Vėžaičiai Branch of LIA show that a higher DM yield is obtained on resown pastures than on old, untreated pastures (Butkuvienė, 2006; Daugėlienė, 2002). The surface improvement method includes different agromeasures, such as liming, fertilisation, spraying with herbicides and additional oversowing. Investigations in different locations of Lithuania (Dotnuva, Vėžaičiai, Dūkštas and Kaltinėnai) with the aim to improve pastures suggest that it is not necessary to resow pastures with 50–60% of good grasses. It is possible to improve them by surface treatments (Butkuvienė, Zableckienė, 2001; Paukštė, 1997; Zimkus, 1992).

The findings on pasture improvement rather differ. To ensure quality pasture swards, the best way is to combine several measures. Slovakian researchers suggest that selection of the improvement methods should be applied in response to sward's state (Tišliar et al., 2000). The renovation of degraded pastures in south-west Poland by two methods, namely herbicide used in combination with direct drilling and full tillage, has proven to be suitable (Wolski, Stypinski, 2001). In Belgium (De Vliegher et al., 2002), Scotland (Stewart, 2002) and Czech Republic (Kohoutek et al., 2002; Komarek et al., 2007), preference is given to the surface improvement method. The renovation of permanent pastures by overdrilling results in incorporation of valuable grass and legume species and leads to the improvement of herbage quality and yield (Goliński, Kozlowski, 2000; Komárek, Kohoutek, 1998; Novak, 1998). Additional oversowing of legumes into old, weedy swards or into thick pure grasses swards is more successful when pastures are sprayed with a herbicide before oversowing. MCPA Herbicide is worth applying to decrease a high dandelion proportion in swards (Butkuvienė, Butkutė, 2004; Harker et al., 2000).

Legumes are considered as a basic component of pastures in numerous European regions. Legumes accumulate biological nitrogen and thus partly provide plants with nitrogen (Gutauskas, 2003; Porqueddu et al., 2003). If additional legume oversowing is successful, improved pastures equate with pure grass pasture fertilised with 60–120 kg N ha^{-1} annually (Zimkus, 1995). In addition, legumes ensure an uncontaminated environment and enrich forage with proteins (Goliński, 2003; Zableckienė, 2001).

Some researchers have noted that pasture productivity is usually maintained by applying a mineral fertiliser, especially nitrogen (Gałka et al., 2005; Palmborg et al., 2004; Scotton et al., 2003). Nitrogen fertilisers applied on limed pastures considerably increase their productivity irrespectively on the phosphorus and potassium fertiliser rates. However, nitrogen fertilisation is less efficient on pastures arranged on acid, non-limed soils. Limed pasture fertilisation with $N_{120–240}$ results in pasture productivity increase by 2.19–3.38 t ha^{-1} and forage quality improvement (Daugelienė, 2002; 2005). Non-limed pasture's DM yield increases only by 1.72–1.91 t ha^{-1} (Butkuvienė, Butkutė, 2005).

Z. Zimkus (1995) claims that increasing the nitrogen fertilisation rate from 60 to 180 kg N ha^{-1} on pastures used for 8–16 years results in a yield higher by 37–97% DM. White clover oversowing into old pasture swards and pasture resowing increases pasture DM yields by 25–40% and 25–75% respectively. The highest amount of legumes has been determined in oversown and resown pastures, so the amount of crude proteins in DM yield also increases. Higher nitrogen fertiliser rates lead to a gradual increase of yield and crude protein content. Z. Zimkus' results (Zimkus, 1995) and those of others (Butkuvienė, Butkutė, 2005; Goliński, 2003) are in full agreement.

Analysis of scientific literature shows the urgency of studies on different pasture improvement issues. Therefore, the aim of the present study was to detect changes of pasture botanical and chemical composition, as well as on productivity in response to different improvement measures in Western Lithuania.

MATERIALS AND METHODS

The research soil was *Haplic-Albic Luvisol* (*LVh*), light on medium loam. Table 1 illustrates its agrochemical properties of different field trials. The soil differed in acidity: soil of trial No. 1 was slightly acidic, trial No. 2 acidulous and trial No. 3 of low acidity. The content of mobile phosphorus varied and the soil was phosphorus-rich (trial No. 1) or low in phosphorus content (trials Nos. 2 and 3). However, soil of all trials was medium rich in mobile potassium. Soil of trial No. 1 was medium rich, but in trials Nos. 2 and 3 it was rich in humus.

Different improvement measures were investigated on a pasture of 15–18 years of use. Trials were arranged on pastures that differed in age, productivity, scarceness and weediness. Grasses dominated (45–70%) in all pastures:

trial No. 1 – meadow-grass (*Poa pratensis* L.), meadow fescue (*Festuca pratensis* Huds.) and perennial ryegrass (*Lolium perenne* L.);

trial No. 2 – meadow-grass (*Poa pratensis* L.), meadow fescue (*Festuca pratensis* Huds.) and cocksfoot (*Dactylis glomerata* L.);

trial No. 3 – ~50% of cocksfoot (*Dactylis glomerata* L.), meadow-grass (*Poa pratensis* L.) and meadow fescue (*Festuca pratensis* Huds.).

Table 1. **Agrochemical properties of soil arable layer in the year of experiment installation**
Vėžaičiai, 1999–2000

Trial No.	pH_{KCl}	N_{total} %	P_2O_5	K_2O	Humus content, %
			mg kg^{-1}		
1	6.2	0.15	184	104	2.90
2	5.9	0.24	65	117	3.73
3	5.2	0.22	60	122	3.22

White clover (*Trifolium repens* L.) accounted for 15–20% on all the pastures. The proportion of forbs was 30–35% in pasture swards of trials Nos. 2 and 3. However, sward of trial No. 1 contained less forbs (20–25%). Mainly such species as common dandelion (*Taraxacum officinale* L.), common yarrow (*Achillea millefolium* L.), fall hawkbit (*Leontodon autumnalis* L.) and creeping buttercup (*Ranunculus repens* L.) prevailed.

Research was carried out on different pastures: i) sprayed with MCPA herbicide (3.7 L ha^{-1}) in autumn, at the beginning of the research and ii) not sprayed with herbicide. On both pastures, four treatments were compared (Table 2). Each treatment had four replications and was fertilised annually with 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} in spring.

Meteorological conditions during the study period varied and were not sufficiently suitable for grass growth (Fig. 1). Thus, research data were partially determined by meteorological conditions.

In 2000, moisture conditions in trials Nos. 1 and 2 were not suitable for mixture seed germination, and permanent grasses did not rooted properly. Plants lacked moisture already in the end of April, and in mid-May wilting moisture was reached. On plots of the third treatment where additional oversowing was performed, germinated white clover plants started to wither and part of them died out. The undercrop was poor.

In 2001, conditions for grass germination and development on plots of trial No. 3 were more suitable than in 2000. In May, a lack of moisture for additionally oversown grasses occurred but did not reach the critical point. On plots of the third treatment, mixture seeds germinated well, but plants were weak because of

Table 2. **Experimental design**

Treatment	Improvement measure	Details
1 (control)	–	–
2	Fertilisation with 120 kg N ha^{-1}	Fertilisers were applied in two portions: after 1st and 2nd grazing
3	Oversowing	Legume–grass mixture was sown with a disk drill straight into the pasture sward. It contained 70% of white clover cv. 'Atoliai' + 30% of timothy cv. 'Gintaras II'
4	Resowing	Legume–grass mixture which contained 25% of white clover cv. 'Atoliai', 40% of timothy cv. 'Gintaras II', 25% of meadow grass cv. 'Danga' and 10% of meadow fescue cv. 'Dotnuvos I' was resown The mixture was sown with a cover crop – spring barley (*Hordeum vulgare* L.) cv. 'Roland' for grain

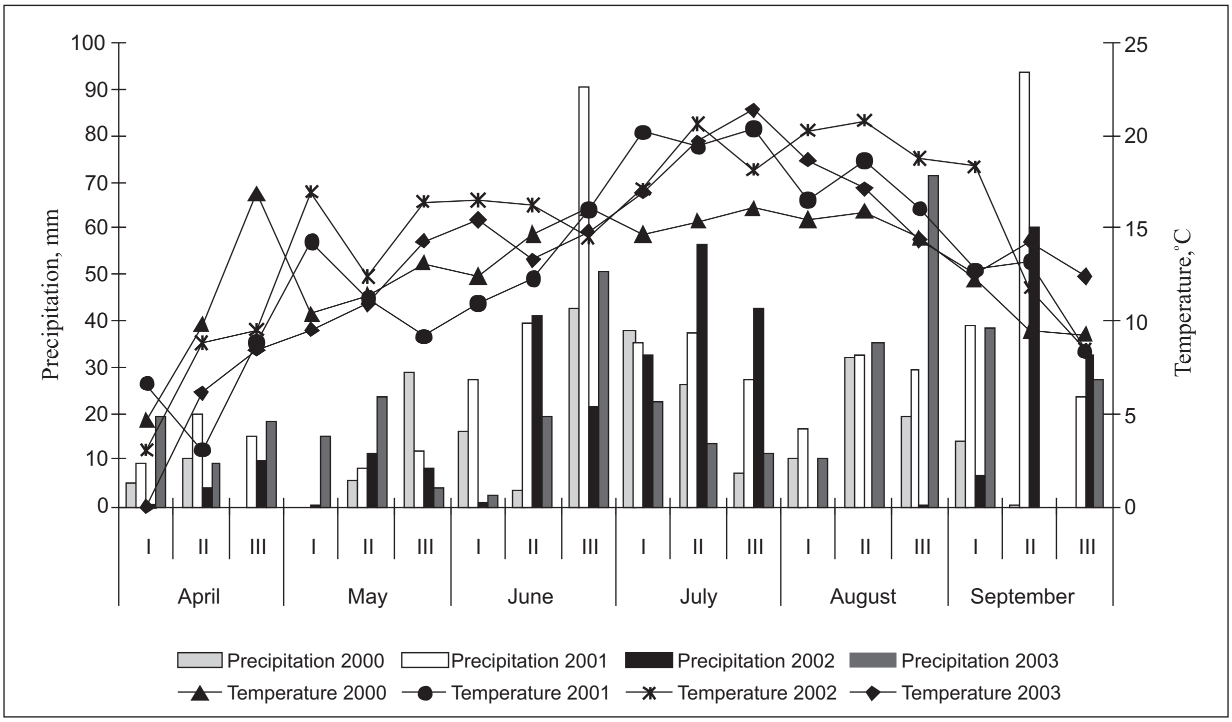

Fig. 1. Meteorological conditions over the growing period in 2000–2003

the lack of moisture. Moisture conditions in June and July were better than in spring, so oversown grasses revived.

Meteorological conditions in 2002 distinguished themselves by low precipitation, and 2003 was favourable for permanent grass growth.

Methods of laboratory analysis. Joint samples for soil chemical characteristics were taken on the year of arrangement from the 0–20 cm soil layer. Soil chemical samples were analysed using the following methods: pH_{KCl} potentiometrically (GOST 26483-85, 1986); total nitrogen (N_{total}) by the Kjeldahl method (GOST 26107-84, 1985; ISO 11261, 1995); mobile phosphorus (P_2O_5) and potassium (K_2O) extracted with lactate-acetate-ammonium mixture by the Egner–Riem–Domingo (A–L) method (GOST 26208-91, 1993); humus content by the Tyurin method.

Permanent grass dry matter (DM) yield and sward botanical composition of all four cuts were determined annually. Samples for sward botanical composition were collected from several places of each plot. Later on, two 0.5 kg samples were taken from each treatment, and three botanical groups – grasses, legumes and forbs – were separated and air-dried. The botanical composition was established by weighing. Grass samples (0.5 kg) were taken from each plot for determination of DM content (%) and were dried at 105 °C. DM yield was determined on the basis of total DM content per plot and calculated as t ha^{-1}. Analogically, samples for determining the chemical composition were collected and air-dried.

Analyses for determining grass chemical composition were performed using the following methods: crude protein – according to the amount of nitrogen (determined by the Kjeldahl method), multiplying it by 6.25 (GOST 13496.4–84); crude fat with a Soxlet apparatus by Rushkovski (GOST 13496.15–85); crude fibre by the Kurshner–Hanek method (GOST 13496.2-91) and crude ash by weighing after dry combustion (GOST 26226-84).

Metabolisable energy (ME) was calculated according to the formula (Зинченко, Погорелова, 1985): $ME = (53.53 - 0.15 \times CF + 0.093 \times CP) \times 0.086 \times E_{total}$, where ME is metabolisable energy, MJ kg^{-1}; CF is crude fibre content, g kg^{-1}; CP is crude protein content, g kg^{-1} and E_{total} is total energy, MJ kg^{-1}. Total energy (E_{total}) calculation: $E_{total} = 0.238 \times CP + 0.0397 \times CFat + 0.0188 \times CF + 0.0175 \times NFE$, where CP, CFat, CF and NFE are % of crude protein, crude fat, crude fibre and nitrogen-free extractives in DM yield respectively. For recalculating ME to GJ ha^{-1} we multiplied it by DM yield (t ha^{-1}).

Mathematical-statistical data evaluation. The data were computed by analysis of variance using SELEKCIJA software package, programme ANOVA for EXCEL vers. 4.0 (Tarakanovas, Raudonius, 2003).

RESULTS AND DISCUSSION

Sward botanical composition. As indicated in Table 3, grasses prevailed on all the study pastures. The proportion of grasses on the pasture sprayed with the herbicide was higher by 9.9–11.7% on average as compared to the non-sprayed one. In spite of that, the amount of grasses on the resown pasture was similar both on pastures non-sprayed and sprayed with MCPA.

The fact is that moisture deficit in 2000, when additional oversowing was performed, resulted in poor grass seed germination and plant development. As a result, the increase of legume proportion in trials Nos. 1 and 2 was 2.1–4.5 times less than in trial No. 3, but significant. Favourable meteorological conditions in the 2nd year of study led to legume increase – to 34.0–40.0% and 37.3–46.3% in trials Nos. 1 and 2 respectively, but in the 3rd year of study legume percentage insignificantly decreased. Resowing increased legume proportion in the swards of trials Nos. 1 and 2, but this increase was insignificant. However, annual

Table 3. **Influence of improvement measures on pasture sward botanical composition**
Vėžaičiai, 2000–2003

Measure of improvement	Plant group	Non-sprayed background				Sprayed background			
		1st trial	2nd trial	3rd trial	mean	1st trial	2nd trial	3rd trial	mean
Control	Grasses	54.4	50.7	53.4	52.8	64.9	69.4	56.4	63.6
	Legumes	20.4	16.0	18.8	18.4	17.3	17.3	19.8	18.1
	Forbs	25.2	33.3	27.8	28.8	17.8	13.3	23.8	18.3
Fertilisation N_{120}	Grasses	73.0	76.9	76.0	75.4	89.3	89.5	82.5	87.1
	Legumes	5.0	2.4	3.9	3.7	0.7	1.4	2.1	1.4
	Forbs	22.0	20.7	20.1	20.9	10.0	9.1	15.4	11.5
Oversowing	Grasses	48.4	48.8	43.9	47.0	63.1	63.7	43.9	56.9
	Legumes	27.4	23.9	35.3	28.9	20.9	24.8	35.9	27.2
	Forbs	24.2	27.3	20.8	24.1	16.0	11.5	20.2	15.9
Resowing	Grasses	54.8	57.8	54.9	55.8	52.4	61.2	54.8	56.2
	Legumes	22.8	21.6	29.9	24.8	24.6	23.4	31.0	26.3
	Forbs	22.4	20.6	15.2	19.4	23.0	15.4	14.2	17.5
LSD_{05}		grasses 4.59; legumes 5.75; forbs 5.45				grasses 9.41; legumes 6.59; forbs 7.46			

Note. Average data of 2000–2002 (1st and 2nd trials) and 2001–2003 (3rd trial) are presented in the table.

data showed that after spraying with MCPA the amount of legumes increased, but in the next two years after resowing their proportion in sward tendentiously decreased.

Trial No. 3 was distinguished for more favourable meteorological conditions, therefore additionally oversown white clover seeds germinated well both on pastures non-sprayed and sprayed with a herbicide. Legume proportion in the year of installation considerably increased and accounted for 41.0–49.6%, but later on, in the 2nd and 3rd years of study, legume amount slightly decreased. Resown grasses germinated well and together with cover crop (barley) developed well. Legume proportion in the resowing year was about 30% and later on remained similar.

The amount of forbs in swards of different trials varied. Spraying with MCPA (3.7 L ha^{-1}) before installation of trials led to a decrease of forbs 3.2 and 5.0 times in the swards of trials Nos. 1 and 2 respectively in the 1st arrangement year. Later on, in the 2nd year of arrangement, the proportion of forbs remained considerably less on the pasture sprayed with the herbicide than on the non-sprayed one. However, in the 3rd year the amount of forbs was similar in both non-sprayed and sprayed pastures. Herbicide use in trial No. 3 was hardly effective.

According to average data, spraying with MCPA decreased the proportion of forbs in pasture sward of all three trials. Consequently, the amount of grasses increased. A considerable increase (by 9.9–11.7%) was determined on pastures of all treatments, except resowing. Spraying with the herbicide considerably decreased the amount of forbs in the sward (1.1–1.8 times or by 1.9–10.5% on average) and insignificantly decreased the amount of legumes (by 0.3–2.3%). Legumes suffered from spraying.

Fertilisation with 120 kg N ha^{-1} considerably increased the amount of grasses (by 22.6–23.5%) and decreased the amount of forbs by 6.8–7.9%. Nitrogen fertilisation not only decreases sward weediness, but also has a negative effect on white clover proportion (Alibegowic-Gribs et al., 2005, Vaičiulytė, Bačėnas, 2004). The study showed that the nitrogen fertilisers significantly decreased the amount of legumes (by 14.7–16.7%) and legumes almost died out. Therefore, grasses spread. Despite unfavourable meteorological conditions for permanent grass seed germination (in trials Nos. 1 and 2), the amount of legumes after pasture oversowing increased. Oversown mixture seeds germinated rather well in trial No. 3, and plants persisted during the study period. The average data of three experiments showed that oversowing with a legume–grass mixture increased the amount of legumes in the sward by 9.1–10.5%. Our results and those of others (Butkuvienė, Zableckienė, 2001; Goliński, Kozlowski, 2000; Tišliar et al., 2000; Zimkus, 1992) are similar. The amount of forbs was insignificantly less in oversown swards.

Pasture resowing had an effect in all our trials. As a result, pasture botanical composition improved and productivity increased. The sward was enriched with legumes by 6.4–8.2% after pasture resowing. After the non-sprayed pasture had been resown, the amount of forbs significantly decreased (by 9.4%), however, the sward weediness decrease was insufficient (by 0.8%) on the pasture sprayed with MCPA.

Chemical composition of pasture DM yield. Table 4 summarises data on changes of sward chemical composition depending on the pasture improvement measures. Additional oversowing and resowing resulted in an increase of legumes in the pasture sward and thus positively influenced the accumulation of crude proteins. The data of experiments carried out in Lithuania (Zableckienė, 2001; Zimkus, 1995) and abroad (Komárek, Kohoutek, 1998; Komárek et al., 2007) confirm this finding. The same tendency was determined in a pasture fertilised with nitrogen. Average data showed that a considerable increase of crude protein content in the non-sprayed pasture sward was obtained only when oversowing had been used. However, all measures had no considerable influence on crude protein content when the pasture was sprayed with the herbicide.

Crude fibre content in the sward changed slightly after improving the pasture non-sprayed with the herbicide by the considered measures. According to average data, the increase of crude fibre content was significant only when the pasture sprayed with MCPA was fertilised with nitrogen. The accumulation of crude fibre in the pasture sward was inconsiderably less using additional oversowing and resowing measures.

Table 4. **Effect of improvement measures on pasture sward chemical composition**
Vėžaičiai, 2000–2003

Measure of improvement	Non-sprayed background				Sprayed background			
	1st trial	2nd trial	3rd trial	mean	1st trial	2nd trial	3rd trial	mean
Crude protein g kg^{-1} DM								
Control	151	136	148	145	150	130	144	141
Fertilisation N_{120}	154	153	149	152	151	145	147	148
Oversowing	168	161	153	161	147	158	150	152
Resowing	154	139	160	151	149	146	163	153
LSD_{05}	20.3	23.2	10.0	14.2	18.6	15.5	16.3	15.8
Crude fibre g kg^{-1} DM								
Control	215	226	230	224	216	251	227	231
Fertilisation N_{120}	230	228	248	235	240	252	251	248
Oversowing	215	220	219	218	229	234	220	228
Resowing	212	235	224	224	213	233	225	224
LSD_{05}	11.4	22.2	18.2	14.5	21.8	11.9	21.8	15.6
Crude fat % in DM								
Control	4.64	4.94	4.64	4.74	4.41	4.13	4.54	4.36
Fertilisation N_{120}	4.94	4.86	4.48	4.76	4.16	4.20	4.54	4.30
Oversowing	4.50	4.93	4.50	4.64	4.23	4.12	4.60	4.32
Resowing	4.25	4.35	4.74	4.45	4.24	4.52	4.44	4.40
LSD_{05}	0.720	0.808	0.358	0.481	0.604	0.669	0.660	0.300
Crude ash % in DM								
Control	8.35	9.49	8.86	8.90	8.13	9.28	9.21	8.87
Fertilisation N_{120}	7.76	8.51	7.82	8.03	7.39	8.91	8.64	8.31
Oversowing	8.82	9.40	8.92	9.05	8.31	9.04	8.88	8.74
Resowing	9.42	8.74	8.20	8.79	8.41	9.09	8.50	8.67
LSD_{05}	1.015	1.084	0.889	0.890	1.012	1.305	0.960	0.567

Note. Average data of 2000–2002 (1st and 2nd trials) and 2001–2003 (3rd trial) are presented in the table.

No considerable changes in crude ash and crude fat content depending on different improvement measures were determined.

For supplying cattle with valuable forage, the latter must satisfy qualitative feeding value requirements (Juraitis, Kulpys, 1995; Tamulis, 1995; Апените, 1983). The data on sward chemical composition illustrate that all the considered measures of improvement increased the feeding value of sward, and the content of crude proteins, crude ash, crude fat and crude fibre in pasture sward was sufficient.

Pasture productivity. According to the average data, different improvement measures significantly increased pasture DM yield (Fig. 2). The highest yield increase (by 1.68–1.75 t ha^{-1}) was obtained when fertilising with nitrogen in both sprayed and non-sprayed pastures. Pasture resowing also significantly increased DM yield (by 1.45–1.56 t ha^{-1}), as did. oversowing (by 0.97–1.09 t ha^{-1}).

Significantly higher amounts of metabolisable energy (Fig. 3) were obtained when improving a pasture by fertilisa-

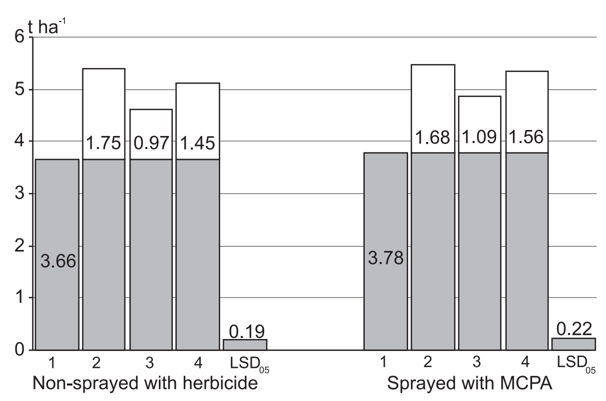

Fig. 2. DM yield of pasture swards improved by different measures.
☐ – extra DM yield, t ha^{-1}. Treatments: 1 – control, 2 – fertilisation with N_{120}, 3 – oversowing and 4 – resowing
Vėžaičiai, 2000–2003

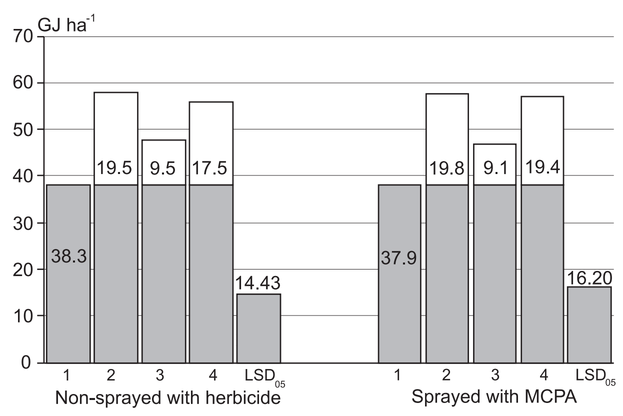

Fig. 3. Metabolisable energy of pasture swards improved by different measures.
☐ – extra metabolisable energy, GJ ha^{-1}. Treatments: 1 – control, 2 – fertilisation with N_{120}, 3 – oversowing and 4 – resowing
Vėžaičiai, 2000–2003

tion with 120 kg N ha^{-1} and resowing with a legume–grass mixture in both sprayed and non-sprayed pastures. The highest metabolisable energy yield (57.7–57.8 GJ ha^{-1}) was obtained in the treatments where nitrogen fertilisers were applied. However, oversowing resulted in an insignificant metabolisable energy increase (by 5.0–12.1 GJ ha^{-1}) in pasture sward.

The present field study has indicated that the efficiency of pasture improvement measures arrange in the rank of priority as follows: fertilisation with 120 kg N ha^{-1}, resowing, and additional oversowing.

Summarising data on the effect of different improvement measures on pasture productivity, botanical and chemical compositions and basing on resowing experience, the fact is that pasture resowing expenditures are rather high, but the effect is not necessarily positive. Therefore, surface improvement measures, i. e. sufficient mineral, especially nitrogen, fertilisation and legume oversowing sometimes are more suitable as compared to resowing.

CONCLUSIONS

1. According to productivity data of a pasture arranged on *Haplic-Albic-Luvisol*, the most effective improvement measure was fertilisation with N_{120} when 1.68–1.75 t ha^{-1} extra DM yield was obtained. Fertilisation with 120 kg N ha^{-1} changed sward botanical composition as follows: considerably decreased the amount of forbs (by 6.8–7.9%), legumes almost died out therefore grasses spread.

2. Additional oversowing was the most suitable measure for sward enrichment with legumes. In the study pasture, sward proportion of legumes increased by 9.1–10.5%. However, this improvement measure was efficient only under favourable meteorological conditions. Also, additional oversowing significantly increased pasture DM yield (by 0.97–1.09 t ha^{-1}).

3. Scarce and low-productive old pastures should be resown. Resowing resulted in 6.4–8.2% of legume increase, and 1.45–1.56 t ha^{-1} of extra DM yield was obtained.

4. Spraying a herbicide (MCPA 3.7 L ha^{-1}) on an old pasture before improvement significantly (by 1.9–10.5%) decreased the proportion of forbs in the swards of untreated, fertilised with N_{120} and oversown pastures.

5. Fertilisation with nitrogen at a rate 120 kg N ha^{-1}, additional oversowing and resowing had no considerable influence on pasture sward chemical composition. Oversowing and resowing resulted in an increase of legume proportion in pasture sward, therefore, crude protein content tended to increase and crude fibre content to decrease.

Received 19 February 2008
Accepted 25 April 2008

References

1. Alibegowic-Gribs S., Bezdrob M., Gataric Dj. 2005. Effect of low-rate application and cutting frequency on botanical composition of short-term natural grassland // Grassland Science in Europe. Vol. 10. P. 360–363.
2. Butkuvienė E. 2006. Ganyklų pagerinimo būdai ir jų įtaka žolyno produktyvumui // Gyvulininkystė. Mokslo darbai. T. 47. P. 101–114.
3. Butkuviene E., Butkute R. 2004. Effect of different surface improvement measures on yield and quality of pastures in Lithuania // Grassland Science in Europe. Vol. 9. P. 556–558.
4. Butkuviene E., Butkute R. 2005. Fertilization – the effective measure of pastures improvement // Grassland Science in Europe. Vol. 10. P. 617–620.
5. Butkuvienė E., Zableckienė D. 2001. Ganyklinių žolynų pagerinimas ankštinėmis žolėmis // Žemės ūkio mokslai. Nr. 1. P. 67–71.
6. Daugeliene N. 2005. Effect of liming and fertilization on the productivity of a long-term pasture // Grassland Science in Europe. Vol. 10. P. 122–124.
7. Daugėlienė N. 2002. Žolininkystė rūgščiuose dirvožemiuose. Akademija. 261 p.
8. De Vliegher A., Grunert O., Carlier L. 2002. The effect of grassland resowing on yield and quality under grazing conditions // Grassland Science in Europe. Vol. 7. P. 370–371.
9. Gałka A., Zarcycki J., Kopeć M. 2005. Effect of different fertilisation regimes on species composition and habitat in a long-term grassland experiment // Grassland Science in Europe. Vol. 10. P. 132–135.
10. Goliński P. 2003. Effectiveness of pasture overdrilling with *Lolium perenne* using different methods of sod preparation // Grassland Science in Europe. Vol. 8. P. 134–137.
11. Goliński P., Kozlowski S. 2000. Role of grassland overdrilling in the increase of feed economical efficiency and protection of meadow soil // Grassland Science in Europe. Vol. 5. P. 191–193.
12. Gutauskas J. 2003. Biopotential of long-term pasture: botanical diversity and advantages for sustainable farming // Grassland Science in Europe. Vol. 8. P. 37–40.
13. Harker K. N., Baron V. S., Chanasyk D. S. et al. 2000. Grazing intensity effects on weed populations in annual and perennial pasture systems // Weed Science. Vol. 48. Iss. 2. P. 231–238.
14. Juraitis V., Kulpys J. 1995. Pašarai. Vilnius. 307 p.
15. Kohoutek A., Komárek P., Odstrčilova V. et al. 2002. The influence of sowing technology on success of strip seeding establishment // Grassland Science in Europe. Vol. 7. P. 378–379.
16. Komárek P., Kohoutek A. 1998. The influence of non-tilling slot seeding of legumes and grasses into grassland on the improvement of nutritional quality of feed // Grassland Science in Europe. Vol. 3. P. 765–768.
17. Komárek P., Nerušil P., Kohoutek A. et al. 2007. The effect of repeated direct sowing of grass – legumes seed mixtures into grasslands on forage production and quality // Grassland Science in Europe. Vol. 12. P. 39–42.
18. Novak J. 1998. Changes in grassland after additional sowing of grass mixture with dominance of valuable herbs // Roslinna Vyroba. Vol. 44. Iss. 3. P. 123–131.
19. Palmborg C., Carlsson G., Huss-Danell K. 2004. Biomass production following N–fertilisation in experimental grassland communities differing in plant species richness and composition // Grassland Science in Europe. Vol. 9. P. 183–185.
20. Paukštė V. 1997. Kalvotų ganyklų atnaujinimo turtingais ankštinių žolių mišiniais būdų palyginimas // Žemdirbystė. LŽI, LŽŪU mokslo darbai. T. 58. P. 175–181.

21. Porqueddu C., Parente G., Elsaesser M. 2003. Potential of grasslands // Grassland Science in Europe. Vol. 8. P. 11–20.
22. Scotton M., Macolino S., Ziliotto U. 2003. Effect of low-rate of nitrogenous and phosphate fertilisation on the characteristic of a permanent meadow in Veneto mountain. 2. Quantitative aspects of yield // Grassland Science in Europe. Vol. 8. P. 167–169.
23. Stewart T. A. 2002. Over-sowing as a means of introducing white clover into existing pastures // Grassland Science in Europe. Vol. 7. P. 390–391.
24. Tamulis T. 1995. Pašarų cheminė sudėtis ir maistingumas. Vilnius. 301 p.
25. Tarakanovas P., Raudonius S. 2003. Agronominių tyrimų duomenų statistinė analizė taikant kompiuterines programas ANOVA, STAT, SPLIT-PLOT iš paketo SELEKCIJA ir IRRISTAT. Akademija. 57 p.
26. Tišliar E., Zimkova M., Citarova E. et al. 2000. Grassland renovation by slot over drilling // Grassland Science in Europe. Vol. 5. P. 122–124.
27. Vaičiulytė R., Bačėnas R. 2004. Daugiamečių svidrių, eraičinsvidrių bei jų mišinių produktyvumas paprastajame išplautžemyje // Žemės ūkio mokslai. Nr. 1. P. 10–18.
28. Wolski K., Stypinski P. 2001. The use of white clover in seed mixtures of sward renovation of degraded pastures on private farms in South-West Poland // Grassland Science in Europe. Vol. 6. P. 86–89.
29. Zableckienė D. 2001. Kokybiniai pokyčiai šienaujamuose ir ganomuose kalvų žolynuose papildomai įsėjant ankštinių žolių // Žemdirbystė. LŽI, LŽŪU mokslo darbai. T. 75. P. 169–181.
30. Zimkus Z. 1995. Baltųjų dobilų ir trijų azoto trąšų normų efektyvumas varpiniame žolyne // Žemdirbystė. LŽI mokslo darbai. T. 46. P. 56–61.
31. Zimkus Z. 1992. Baltųjų dobilų įsėjimas herbicidais purkštoje ganykloje // LŽI mokslinių straipsnių rinkinys. Nr. 69. P. 31–37.
32. Апените Р. О., Латвиетис Я. Я. 1983. Пастбищная трава и подкормка коров. Рига. С. 74–184.
33. Зинченко А., Погорелова И. 1985. Приготовление объемистых кормов. Ленинград. С. 126–127.

Elvyra Butkuvienė, Rūta Butkutė

SKIRTINGŲ GANYKLŲ PAGERINIMO BŪDŲ ĮTAKA ŽOLYNO PRODUKTYVUMUI, BOTANINEI BEI CHEMINEI SUDĖČIAI

Santrauka

Straipsnyje pateikiami 1999–2003 metais Lietuvos žemdirbystės instituto Vėžaičių filiale vykdytų ganyklos žolyno pagerinimo būdų tyrimų duomenys. Nepurkštoje ir purkštoje herbicidu ganykloje tirta seno žolyno tręšimo azoto trąšomis N_{120}, papildomo daugiamečių žolių įsėjimo bei persėjimo įtaka žolyno botaninei ir cheminei sudėčiai bei produktyvumui. Tuo tikslu vykdyti trys lauko bandymai skirtingo piktžolėtumo ir derlingumo ganyklose.

Nustatyta, kad visos tirtos žolynų pagerinimo priemonės pakeitė žolyno botaninę ir cheminę sudėtį ir patikimai didino produktyvumą. Nupurškus herbicidu (MCPA 3,7 L ha^{-1}) patikimai sumažėjo įvairiažolių kiekis (1,9–10,5%) ir nežymiai (0,3–2,3%) sumažėjo ankštinių žolių kiekis. Tręšiant N_{120} patikimai sumažėjo įvairiažolių kiekis (6,9–7,9%), kartu sumažėjo ir ankštinių žolių kiekis. Tačiau šiuo atveju ganyklinio žolyno derlingumas buvo didžiausias. Dėl papildomo įsėjimo patikimai padidėjo ankštinių žolių kiekis (9,1–10,5%) ir 2,4–4,7% sumažėjo įvairiažolių kiekis. Po ganyklų persėjimo žolynas pagerėjo, nes 6,4–8,2% pagausėjo ankštinių žolių ir 0,8–9,4% sumažėjo įvairiažolių kiekis.

Dėl tręšimo N_{120}, papildomo daugiamečių žolių įsėjimo bei ganyklų persėjimo daugiau žalių baltymų susikaupė žolėje. Po papildomo įsėjimo ir persėjimo žolyne pagausėjo ankštinių žolių, sumažėjo žalios ląstelienos kiekis. Žymių žalių pelenų ir žalių riebalų susikaupimo pokyčių žolėje nenustatyta.

Įvairiais būdais pagerinus ganyklinius žolynus, pagerėjo ne tik botaninė ir cheminė sudėtis, bet ir pašaro kokybė. Visos tirtos žolynų pagerinimo priemonės patikimai didino žolyno sausųjų medžiagų derlių 0,97–1,75 t ha^{-1}. Panaši tendencija nustatyta ir apykaitos energijos pokyčiams, išskyrus taikant papildomą įsėjimą, kai apykaitos energijos padidėjimas buvo nežymus.

Raktažodžiai: tręšimas N_{120}, papildomas įsėjimas, persėjimas, botaninė ir cheminė sudėtis