ŽEMĖS ŪKIO MOKSLAI. 2008. T. 15. Nr. 3. P. 22–28

Utilizing palm-leaf geotextiles to control soil erosion on roadside slopes in Lithuania

Benediktas Jankauskas[1],

Genovaitė Jankauskienė[1],

Michael Augustine Fullen[2],

Colin Anthony Booth[2]

*[1] Kaltinėnai Research Station
of the Lithuanian Institute
of Agriculture, Varnių 19,
LT-75451 Kaltinėnai,
Šilalė distr., Lithuania
E-mail: kaltbs@kaltbs.lzi.lt*

*[2] The University of Wolverhampton,
Wulfruna Street,
Wolverhampton WV1 1SB,
United Kingdom
E-mail: m.fullen@wlv.ac.uk*

Soil erosion is a global environmental problem. There are many potential soil conservation measures suitable for arable soils in Lithuania. However, specific strategies are required on industrial slopes, where plant cover is often destroyed by machinery, and soil truncation may occur. Problems may arise due to exposure of deeper soils deficient in soil organic matter, which are especially vulnerable to water and wind erosion. Geotextiles are one of the methods identified suitable for soil stabilization on such engineered industrial slopes.

Geotextiles are potentially excellent biodegradable and environmentally-friendly materials useful for soil conservation. The application of geotextile mats, constructed from the palm leaves of *Borassus aethiopum* (Borassus) and *Mauritia flexuosa* (Buriti), has been investigated at the Kaltinenai Research Station of the Lithuanian Institute of Agriculture which is participating in the EU-funded BORASSUS Project. Field studies on a steep (21–25°) roadside slope demonstrate that cover of Borassus and Buriti mats improved the germination and growth of sown perennial grasses. The biomass of perennial grasses significantly increased (by 52–63%) under cover of Borassus mats and by 19–28% under cover of Buriti mats. The geotextiles (Borassus and Buruti, respectively) decreased soil losses from bare fallow soil by 91 and 82% and from plots covered by perennial grasses by 88 and 79%, respectively. This illustrates that geotextiles have a notable potential as a biotechnical soil conservation method for slope stabilization and protection from water erosion on steep industrial slopes and may be integrated with the use of perennial grasses to optimize protection from water erosion.

Key words: soil erosion, roadside slopes, geotextiles, vegetation cover

INTRODUCTION

Soil degradation by erosion is one of the world's most serious environmental problems causing extensive loss of cultivated and potentially productive soil and crop yields (Fullen, Catt, 2002; Morgan, 2006). It has been estimated that some 4000 million tonnes of soil per year have been eroded in the continental USA since the 1930s (Fullen, Catt, 2002). The extent and severity of erosion on European soils has markedly increased over the last 50 years, particularly on arable land. Unfortunately, soil conservation in Europe has not generally received sufficient attention, until recently (Fullen et al., 2006). Set-aside is a scheme designed to provide farmers with a subsidy to leave land uncultivated and, in doing so, act as a possible soil conservation measure (Chisci, 1994; Fullen, 1998). Major causes of water and wind erosion include deforestation, overgrazing and mismanagement of arable land. By removing vegetation cover the erosion-resisting capacity of the soil becomes disturbed. The kinetic energy of raindrop splash increases, resulting in increased soil detachment. Hydraulic surface flow increases with the lack of vegetation cover, which also increases soil susceptibility to erosion, by reducing cohesion and shear strength (Rickson, 2001). About 17% of Lithuania's agricultural land is eroded, increasing to 43–58% in hilly regions. Water and wind erosion occurs mostly on arable soils, and wind erosion occurs on the Baltic coast (Jankauskas et al., 2004). Investigations of water erosion on 5–7° slopes of the Baltic Uplands (Eastern Lithuania) show that runoff and losses of clay loam soil due to water erosion ranged markedly: from 6.6 mm of runoff water from wasteland to 151 mm from bare fallow, or from 4.5 t ha^{-1} yr^{-1} of soil under cereal grain crops to 46.6 t ha^{-1} yr^{-1} on bare fallow (Bundinienė, Paukštė, 2002). Heavy losses of *Eutric Albeluvisols* occur due to water erosion on the Žemaičiai Uplands (Western Lithuania). On the long-term monitoring sites, soil losses were 3.2–8.6 t ha^{-1} under winter rye, 9.0–27.1 t ha^{-1} under spring barley and 24.2–87.1 t ha^{-1} under potatoes, on slopes of 2–5° (3.5–8.3%), 5–10° (8.3–17.7%) and 10–14° (17.7–24.5%), respectively, increasing with slope steepness. Perennial grasses completely stabilized soil erosion (Jankauskas et al., 2004). However, there are many inexpensive potential soil conservation measures on arable soils in Lithuania (Jankauskas, Fullen, 2006; Jankauskas et al., 2004; Jankauskas et al., 2008).

Special attention is required on industrial slopes where plant clover is often destroyed by machinery, and soil truncation may occur. Special difficulties arise due to exposure of deeper soils deficient in soil organic matter, which are thus especially vulnerable to water and wind erosion.

Different geotextiles are one of the methods suitable for soil conservation on engineered industrial slopes. Geotextiles constructed from indigenous tropical / subtropical leaves have a potential as a biotechnical soil conservation method. The results of investigations indicate that geotextiles constructed from palm leaves effectively reduced soil erosion. If harvested correctly, these resources are highly sustainable and readily available. They are biodegradable, providing organic content matter to stabilize the soil, and their permeability makes them suitable for use on cohesive soils (Booth et al., 2007; Fullen et al., 2006). Geotextiles are used for many engineering applications to improve soil properties. On steep erodible slopes, where the vegetation growth is limited by erosive forces of rain and runoff, geotextiles can serve as a temporary replacement of vegetative cover (Smets et al., 2007).

Geotextiles have contributed to the erosion control industry for over 50 years (Dayte, Gore, 2004; Mitchell et al., 2003) and are mainly used in civil engineering projects, such as dam retaining walls and for road and reservoir slope stabilization (Davies et al., 2006). Despite synthetic geotextiles dominating the commercial market, geotextiles constructed from organic materials are highly effective in erosion control and vegetation establishment (Davies et al., 2006; Ogobe et al., 1998). Palm-leaf geotextiles could be an effective soil conservation method with enormous global potential. They can be installed on steep erodible slopes, as a replacement or supplement to vegetative cover, to reduce the erosive forces of rain and runoff (Smets et al., 2007).

Geotextiles constructed from *Borassus aethiopum* and *Mauritia flexuosa* leaves are being investigated as a potential erosion-resisting measure for the stabilization of soil erosion processes on industrial slopes in Lithuania. Cover by straw-coir carpet and coir carpet are investigated for comparison with the suitability of cover by palm-leaf geotextiles.

The European Commission is funding the BORASSUS Project (Contract No INCO-CT-2005-510745) for over three years (2005–2009) to investigate "The Environmental and Socio-economic Contribution of Palm Geotextiles to Sustainable Development and Soil Conservation". Project objectives are deliverable to both "developing" and "industrialized" countries. The BORASSUS Team, based in 10 countries in Europe, Africa, South-East Asia and South America, are scientifically testing four hypotheses, one of which is that biogeotextiles efficiently and economically conserve soil. Palm geotextiles will be especially beneficial for complex engineering problems, particularly in the building and road construction industries. Temporary application of geotextiles will allow sufficient time for plant communities to stabilize engineered slopes. Palm geotextiles will decrease water evaporation, increase topsoil moisture, improve conditions for plant growth, and they will be a refuge for wildlife and soil fauna. Furthermore, they are environmentally friendly because of their excellent biodegradability.

MATERIALS AND METHODS

To test the stated hypothesis, the suitability of two types of palm leaf mats for stabilization of soil erosion processes on steep industrial slopes (roadside slopes) are being investigated in the Šilalė District of Lithuania (55°31'N, 22°19'E). These include Borassus mats constructed from *Borassus aethiopum* (Black Rhun palm) leaves in Gambia, and Buriti mats constructed from *Mauritia flexuosa* (Buriti Palm) in Brazil. Manufactured straw-coir and coir carpets are also investigated for comparison. The field experiments were conducted using runoff plots (width 2 m and length 7.5–6.2 m) on a steep (21–25°) roadside slope on the Kaltinėnai–Šilalė road.

Borassus mats, coir carpet and straw-coir carpet were used in the first set of field experiments in May 2006 (Fig. 1, second replication). A multi-species mixture of perennial grasses (Pg) consisted of 20% each of orchard-grass (*Dactylic glomerata* L.), red fescue (*Festuca rubra* L.), Kentucky bluegrass (*Poa pratensis* L.), white clover (*Trifolium repens* L.) and alfalfa (*Medicago sativa* L.). The mixture was sown into topsoil (0–5 cm). Randomly located treatments were cover by straw-coir carpet (Pg + straw), Borassus mats (Pg + Borassus), perennial grass control without geotextile cover (Pg) and coir carpet (Pg + coir). Weather conditions were very dry in the following three months. The monthly precipitation in June and July 2006 was lower than the long-term average (1960–2004) 3.6 and 4-fold, respectively. The second set of field experiments was initiated at the end of the long dry period, on 04 August 2006 (Fig. 1, 3rd and 4th replications). The design of investigations was changed and included Buriti mats instead of coir carpet. The specified Pg mixture was sown before covering the soil with selected geotextiles. The third set of field experiments was conducted in early spring (14 April 2007; Fig. 1, 1st replication). In addition to four treatments, as in August 2006, three additional plots (Fig. 1, bare soil) were constructed on bare soil: control without geotextile cover and covered with Borassus and Buriti mats with collectors to receive runoff and sediment

Bare soil			1st replication				2nd replication				3rd replication				4th replication			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
IIIa	Ia	IIa	I	III	II	IV	IV	II	I	III	II	III	IV	I	III	II	I	IV

Fig. 1. Scheme of field experiment on a roadside slope (21–25°), April 2007

1–19 – numbers of the plots; I–IV – numbers of treatments under perennial grasses; Ia–IIIa – numbers of treatments with bare soil.

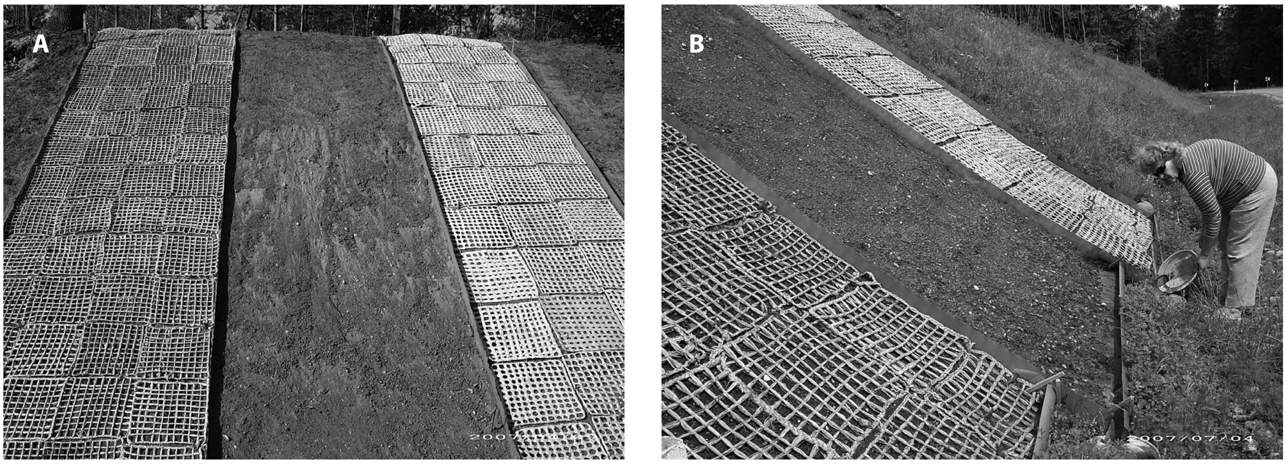


Fig. 2. Third set of field experiments, April 2007
A – cover with Buriti (left) and by Borassus mats (right); B – Sediment control, 04 July 2007.

(Fig. 2). Dry conditions in April (only 35.9% of precipitation compared with the long-term average) prolonged the germination of sown perennial grasses. Weather conditions improved in May: total precipitation in May was slightly above the long-term average, but high air temperatures caused high evaporation rates and, therefore, there was a moisture deficit from late spring to early summer (i. e. mid-June).

Soil sampling for soil moisture was determined by drying soil samples in the laboratory in 2006. Soil samples were collected every 10 days from the upper part of the slope (three individual samples) and from the basal slope (3 individual samples). Soil moisture (% by volume) was determined using a Delta-T soil moisture meter type HH2 in 2007. Measurements (six individual measurements from each plot) were performed every 10 days in the topsoil (0–6 cm).

Data were analysed using the computer programs ANOVA, STAT and SPLIT-PLOT from the package SELEKCIJA and IRRISTAT (Tarakanovas, Raudonius, 2003).

RESULTS AND DISCUSSION

Soil physical properties on the roadside slope are different in the topsoil (0–10 cm) and in the deeper (11–20 cm) soil. The road cutting soil represents the top of a mechanically-truncated soil profile, and hence external topsoil was added to improve plant growth. Particle size analysis (Table 1) showed topsoil to be sandy loam and deeper soil to be loamy sand. Both these soil textures are light, having a high water permeability, but are erodible (Morgan, 2006).

Table 1. **Particle size analysis* of soil samples from a roadside slope**

Soil layers (cm)	Washing** losses (%)	Fractions (%)*:		
		sand (1.0–0.05 mm)	silt (0.05–0.001 mm)	clay (<0.001mm)
0–10	6.5	67.6	12.7	13.2
11–20	6.9	79.0	7.0	7.0

Notes. * Particle size analysis by the Kachinskiy method (Мичманова, Долгов, 1966), mean of 5 soil samples.
** Dissolution losses in HCl which removes soluble soil matter, mostly $CaCO_3$.

Mean soil chemical characteristics on the roadside slope (Table 2) show alkaline properties, base-saturation was >99%, and there was no detectable available Al. As the engineered soil was truncated, it had a low soil organic matter content compared with the applied topsoil which was rich in available P and moderately rich in K.

Dry weather conditions induced low soil moisture contents (2.8–5.2%) and unfavourable conditions for the germination and growth of sown perennial grasses in May–June and the first ten days of August 2006. The increased soil moisture in August corresponded to intense rains in the second decade of August. Therefore, the air and soil moisture (11.0–14.1%) conditions were quite favourable for the germination of perennial grasses in August 2006. Soil moisture was 4.52% before enlarging the roadside field experiment on 4 August 2006. The lowest mean soil moisture (12.04%) was found on the plots not covered with geotextiles during the moist period in 14 August – 15 September. Under Borassus and Buriti mats and straw-coir carpet, mean soil moisture contents were 15.10, 13.28 and 13.21%, respectively.

Dry weather conditions in April 2007 caused a low soil moisture (only 3.7–5.0%) for the germination of perennial grasses in early spring 2007. At the end of the first decade of May, conditions for germination became more favourable (soil moisture varied within 18.6–20.0%), but in mid-May there were 13 hot days without precipitation, which desiccated plants in the early stages of germination.

According to results from field experiments conducted in August 2006, perennial grasses under the Borassus and Buriti geotextile mats had a higher productivity. Alfalfa and orchard grass prevailed among the sown grasses. There was evidence that

Table 2. **Mean* chemical soil properties on roadside slope before field experiments**

Soil layers (cm)	pH_{KCl}	Available			Organic matter (g kg^{-1})
		Al	P	K	
		(mg kg^{-1})			
0–10	7.7	0	66.9	84.7	24.5
11–20	8.1	0	32.3	56.4	8.0

Note. * Mean of 50 individual samples.

the cover of Borassus and Buriti mats increased soil moisture storage. Coir and straw-coir carpets also decreased the evaporation of soil moisture, but they impeded normal plant growth. The sprouts of grasses unsuccessfully tried to penetrate the carpet and even raised the carpet above the soil surface.

Slightly higher soil moisture contents were evident under the cover of Borassus and Buriti mats in April–May and especially in August–October 2007, but soil moisture contents were fairly uniform, irrespective of treatment, from the 2nd decade of June to the last decade of August. Soil moisture conditions influenced the germination and productivity of newly sown grasses and the growth of perennial grasses sown in 2006 (Table 3). The density of sown cereals and leguminous grasses was evidently higher under the cover of Borassus and Buriti mats compared with uncovered soil, and also compared with the straw-coir cover. Soil moisture and the density of grasses influenced the significantly higher productivity under the cover of Borassus and Buriti mats.

An evaluation of erosion rates is an important component of these investigations. There was no runoff or soil loss during the dry summer period in 2006. The 1st runoff and soil loss was after the 11.7 mm rainfall event on 14 August 2006. Erosion was not high, even from the control plots, because sown perennial grasses had germinated and covered the slope surface. There were 11 runoff events (only 6 of them contained sediment) during August–November 2006. The summarized data indicate higher soil losses from the field experiment laid out in May 2006 compared with data from the field experiment laid out in August 2006 (Fig. 3), because the scant plant cover was under the first set of field experiments in May 2006. Most runoff was from the plots covered with straw-coir carpet, but these experienced least soil losses. The explanation is that part of water flew down from the surface of the straw-coir carpet and decreased water available for soil erosion processes. The largest soil losses (0.26 Mg ha^{-1}) from field experiments conducted in August 2006 were from the control plots not covered with geotextiles. Geotextiles decreased soil losses by 19.8 and 15.4%, respectively, from the plots covered with Borassus and Buriti mats.

The first soil erosion loss from the field experiment established in April 2007 was from the 18.2 mm rainfall event of 09 May 2007. The damage was not high even from the control (bare) plots, because most precipitation penetrated to dry permeable soil. Highest soil losses (0.68–0.2 Mg ha^{-1}) were from plots not covered with geotextiles. Young and weak sprouts of perennial grasses were unable to prevent runoff from uncovered plots. Soil losses were least from the plot covered with straw-coir carpet, because some runoff occurred from the carpet surface. Borassus mats stabilized runoff more effectively than Buriti mats. Later there were 30 other events with soil losses until 01 December 2007, but there was no evident relationship between daily precipitation and soil losses (linear $R^2 = 0.002$, power $R^2 = 0.178$, modified power $R^2 = 0.182$) (Fig. 4).

Table 3. **Density and productivity of grasses under different soil covers on roadside slopes in 2007**

Treatments[†]	Productivity, dry biomass, Σ of 3 harvests (Mg ha^{-1})			Density of grasses in (1 m^2)	
	*May 2006	*August 2006	*April 2007	cereals	legumes
Pg	5.20	4.56	3.47	575	375
Pg + Bor	6.69	6.93	5.67	1100	650
Pg + Bur	4.87[!]	5.41	4.45	800	475
Pg + Str	5.40	4.45	3.54	725	350
LSD$_{05}$	0.319	0.442	0.222	22.5	27.0

Note: * Means "field experiment carried out"; [†]treatments: Pg means "a multi-species mixture of perennial grasses without cover", Bor – cover with Borassus mats Bur – cover with Buriti mats, Str – cover with straw-coir. [!] – this one specific result comes from coir carpet cover.

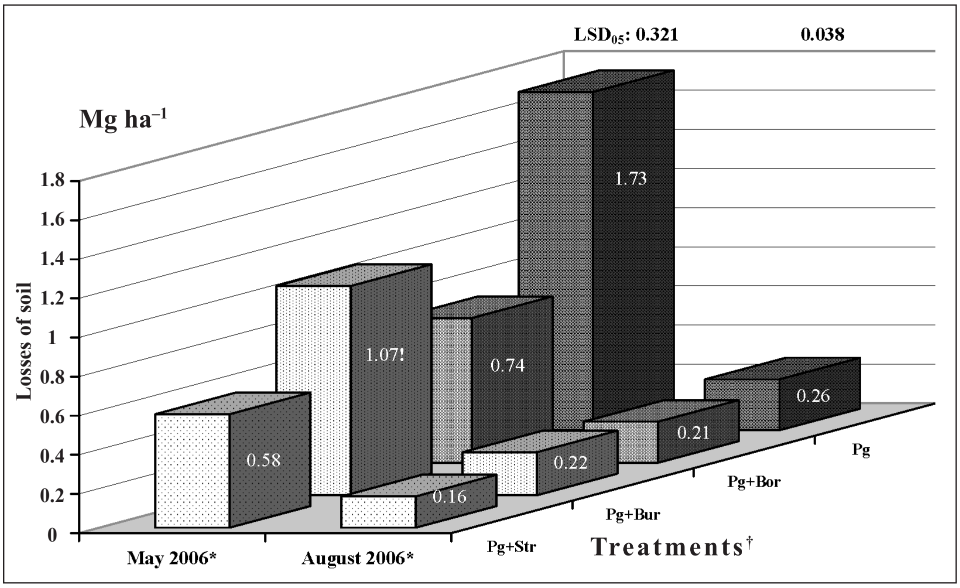


Fig. 3. Losses of dry soil under different treatments from the roadside experiment

Only six events caused water + sediment loss between 16 August – 11 September 2006. *, † and ! mean the same as in Table 3.

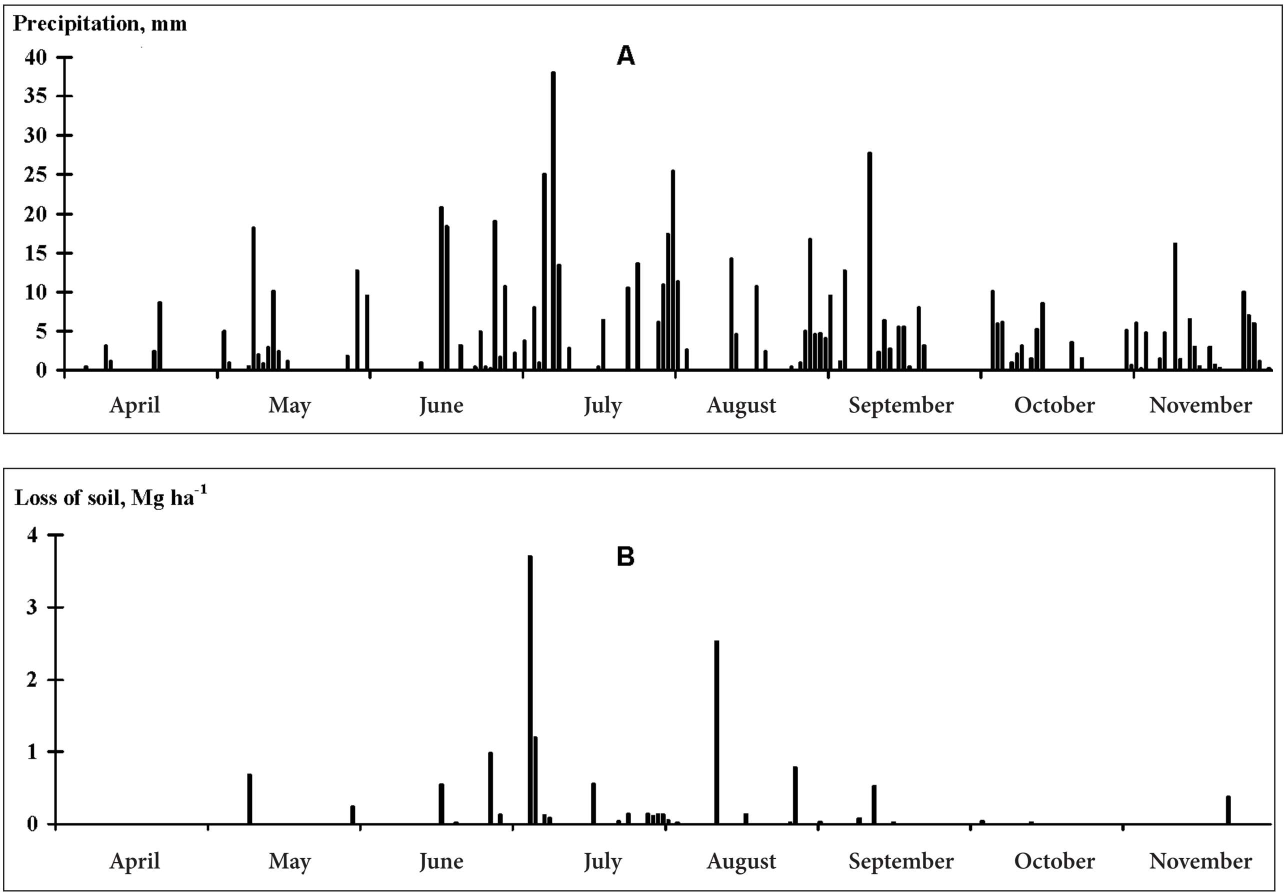
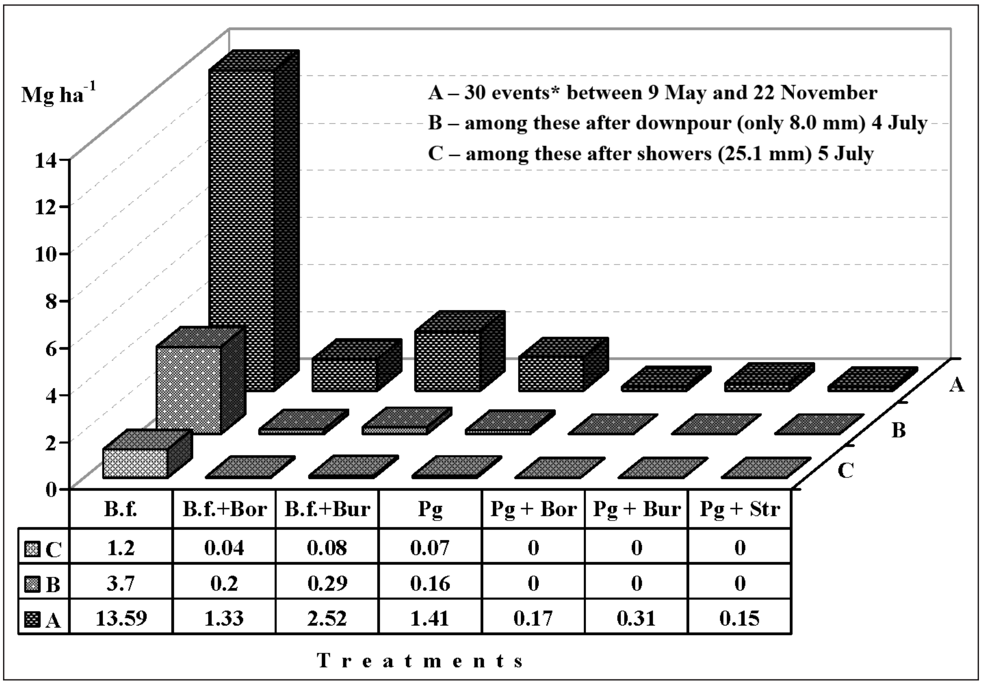


Fig. 4. Daily precipitation (A) during the 2007 vegetative period and soil losses (B) from the bare fallow roadside slope

The highest soil loss from the uncovered bare fallow plot (3.7 Mg ha^{-1}) occurred on 04 July 2007, after a short very intense shower of only 8.0 mm, and on 05 July 2007, after a more prolonged but less intense rainfall of 25.1 mm (1.2 Mg ha^{-1}) (Fig. 5). The contrary case was 07 July 2007, when after 38 mm of daily rainfall there was only 0.12 Mg ha^{-1} of soil loss. Erosion rates were 13.6 Mg ha^{-1} from the plot without geotextile cover, 1.3 Mg ha^{-1} from Borassus cover and 2.5 Mg ha^{-1} from Buriti cover (Fig. 5). The cover of Borassus mats deceased soil losses from bare fallow soil by 90.8% and the cover of Buriti mats



	B.f.	B.f.+Bor	B.f.+Bur	Pg	Pg + Bor	Pg + Bur	Pg + Str
▧ C	1.2	0.04	0.08	0.07	0	0	0
▧ B	3.7	0.2	0.29	0.16	0	0	0
▧ A	13.59	1.33	2.52	1.41	0.17	0.31	0.15

Fig. 5. Soil losses from the roadside slope, May–November 2007
* – days with runoff and soil loss.
B. f. means bare fallow; other treatments according to Fig. 2.

by 82.5%. Quite scant perennial grasses on plots not covered with geotextiles limited the protection from water erosion, where 1.41 Mg ha^{-1} of soil was lost, compared with plots covered with different geotextiles, where losses were only 0.15–0.31 Mg ha^{-1}. These results accord with the hypothesis that geotextiles constructed from organic materials are highly effective in erosion control and vegetation establishment (Davies et al., 2006).

CONCLUSIONS

1. Field investigations indicate geotextiles constructed from palm leaves to have effectively stored soil moisture on a steep (21–25°) roadside industrial slope.

2. Improved soil moisture conditions encouraged a better germination, density and productivity of perennial grasses and thus effectively conserved soil.

3. Cover of Borassus and Buriti mats increased the density of legumes and cereals by 73.3–91.3% and 26.7–39.1%, respectively.

4. The biomass of perennial grasses increased by 52.0–63.4% under the cover of Borassus mats and by 18.6–28.2% under the cover of Buriti mats.

5. Borassus and Buriti mats reduced water erosion rates from bare fallow soil by 90.8% and 81.5%, respectively, and from plots covered by perennial grasses by 87.9% and 79.0%, respectively.

ACKNOWLEDGEMENT

The authors acknowledge and thank the European Commission for financial support of the BORASSUS Project (INCO-CT-2005-510745).

Received 18 April 2008
Accepted 15 May 2008

References

1. Booth C. A., Fullen M. A., Sarsby R. W. et al. The BORASSUS Project: aims, objectives and preliminary insights into the environmental and socio-economic contribution of biogeotextiles to sustainable development and soil conservation // Proceedings of the Sustainable Development and Planning III (2), 2007. WIT Press, 2007. P. 601–610.
2. Bundinienė O., Paukštė V. Lietuvos žemdirbystės instituto Dūkšto bandymų stoties veikla 1960–2000 m. // Žemės ūkio mokslai. 2002. Nr. 4. P. 45–53.
3. Chisci G. Perspectives on soil protection measures in Europe. In: Rickson R. J. (ed.). Conserving Soil Resources: European Perspectives. CAB International, Wallingford, England. 1994. P. 339–353.
4. Davies K., Fullen M. A., Booth C. A. A pilot project on the potential contribution of palm-mat geotextiles to soil conservation // Earth Surface Processes and Landforms. 2006. Vol. 1. P. 561–569.
5. Dayte K. R., Gore V. N. Application of natural geotextiles and related products // Geotextiles and Geomembranes. 1994. Vol. 13. P. 371–388.
6. Fullen M. A. Effects of grass ley set-aside on runoff, erosion and organic matter levels in sandy soils in East Shropshire, U.K // Soil & Tillage Research. 1998. Vol. 46. P. 12–26.
7. Fullen M. A., Catt J. A. Soil Management: Problems and Solutions. London: Arnold, 2002. 269 p.
8. Fullen M. A., Arnalds A., Booth C. A. et al. Government and agency response to soil erosion risk in Europe. In: Boardman J., Poesen J. (eds.). Soil Erosion in Europe. Chichester: John Wiley & Sons Publishers Ltd., 2006. P. 805–828.
9. Fullen M. A., Booth C. A., Sarsby R. W. et al. The potential contribution of palm mat geotextiles to soil conservation and sustainable development // Soil and Water Conservation under Changing Land Use. Universitat de Lleida Press, 2006. P. 303–306.
10. Jankauskas B., Fullen M. A. Lithuania. In: Boardman J., Poesen J. (eds.). Soil Erosion in Europe. John Wiley & Sons Publishers Ltd, Chichester, England, 2006. P. 57–66.
11. Jankauskas B., Jankauskiene G., Fullen M. A. Erosion-preventive crop rotations and water erosion rates on undulating slopes of Lithuania // Canadian Journal of Soil Science. 2004. Vol. 84(2). P. 177–186.
12. Jankauskas B., Jankauskienė G., Tiknius A. The contribution of quality assessment of eroded agricultural soil on hilly-undulating landscapes to sustainable community development. In: Petrosillo I. et al. (eds.). Use of Landscape Sciences for the Assessment of Environmental Security. Springer, 2008. P. 431–451.
13. Mitchell D. J., Barton A. P., Fullen M. A. Effects of jute geotextiles on runoff and sediment yield: field experiments in the UK // Soil Use and Management. 2003. Vol. 19. P. 182–184.
14. Morgan R. P. C. Soil Erosion & Conservation. 3rd edn. Oxford: Blackwell Publishing, 2006. 304 p.
15. Ogobe O., Essien K. S., Adebayo A. A study of biodegradable geotextiles used for erosion control // Geosynthetics International. 1998. Vol. 5. P. 545–553.
16. Rickson R. J. The best is yet to come // Ground Engineering. 2001. Vol. 34. P. 13–14.
17. Smets T., Poesen J., Fullen M. A. Effectiveness of palm and simulated geotextiles in reducing run-off and inter-rill erosion on medium and steep slopes // Soil Use and Management. 2007. Vol. 23. P. 306–316.
18. Tarakanovas P., Raudonius S. Agronominių tyrimų duomenų statistinė analizė taikant kompiuterines programas ANOVA, STAT, SPLIT-PLOT iš paketo SELEKCIJA ir IRISTAT. Lietuvos žemės ūkio universitetas, Akademija. 2003. 57 p.
19. Мичманова А. И., Долгов С. И. Методы механического и микроагрегатного анализа почв. Агрофизические методы исследования почв. Москва: Наука, 1966. С. 5–41.

Benediktas Jankauskas, Genovaitė Jankauskienė,
Michael Augustine Fullen, Colin Anthony Booth

PALMIŲ LAPŲ GEOTEKSTILĖS PANAUDOJIMAS PAKELĖS ŠLAITŲ DIRVOŽEMIO EROZIJOS KONTROLEI LIETUVOJE

Santrauka

Dirvožemio erozija yra globalinio masto aplinkosauginė problema. Lietuvoje yra paruošta daug potencialių būdų, tinkamų ariamų dirvožemių apsaugai. Tačiau specifinė strategija reikalinga industriniams šlaitams, kur įvairiais mechanizmais sunaikinta augalinė danga, nuimtas viršutinis dirvožemio sluoksnis. Problemos kyla dėl organinės medžiagos neturtingų, ypač jautrių vandens ir vėjo erozijai gilesniųjų dirvožemio sluoksnių atidengimo. Geotekstilė laikoma viena industrinių šlaitų ardymo stabilizavimo priemonių. Tai lengvai biologiškai suskaidomos, aplinkai saugios medžiagos, tinkamos dirvožemio apsaugai.

Lietuvos žemdirbystės instituto Kaltinėnų bandymų stotis, vykdydama ES finansuojamą BORASSUS projektą, tyrinėja iš *Borassus aethiopum* (Borassus) ir *Mauritia flexuosa* (Buriti) palmių lapų padarytą geotekstilę. Stačiame pakelės šlaite daryti lauko bandymai parodė, kad geotekstilės pynės yra efektyvi, ekologinę pusiausvyrą išlaikanti antierozinė priemonė. Geotekstilės naudojimas yra potencialus stačių industrinių šlaitų apsaugos nuo vandens erozijos metodas, kurį derinant su daugiamečių žolių auginimu pasiekiama optimali dirvožemio apsauga. Tyrimais nustatyta, kad Borassus ir Buriti pynių dangos pagerino pasėtų daugiamečių žolių sudygimą ir augimą. Daugiamečių žolių biomasė padidėjo dėl Borassus pynių dangos (52–63%) ir dėl Buriti pynių dangos (19–28%). Per dvejus tyrimų metus dėl Borassus ir Buriti pynių dangų sumažėjo dirvožemio nuostoliai nuo juodojo pūdymo šlaitų atitinkamai po 91 ir 82%, nuo daugiametėmis žolėmis apsėtų šlaitų – po 88 ir 79%.

Raktažodžiai: dirvožemio erozija, pakelės šlaitai, geotekstilė, augalų danga