ECOLOGY

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THE EFFECT OF CHANGES IN SOIL MANAGEMENT METHODS ON THE EXPANSION OF *AMBROSIA ARTEMISIIFOLIA* IN THE AREA NEARBY LAKE VELENCE

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Abstract: The magnitude of *Ambrosia artemisiifolia* has been increasing notably in the last years, both economically and medically too. Hungary and Croatia are countries in Central Europe, where this plant occures, so dealing with this question is a principal aim. The area nearby Lake Velence is residential and resort zone as well, so as it is worth considering. We started with this issue, at the Agricultural Office of County Fejér Plant Protection and Soil Conservation Directorate Velence, the position of Ambrosia artemisiifolia in this area. Our measurements are covering the monitor of this kind of weed, the prevalance of appearence and the time pattern of it. Further more the special reason of appearance driven by field distinctivenesses, just as the possibilities of controll and the opportunities given by legal regulation.

Keywords: Ambrosia elatior, landuse, weediness, expansion

Introduction

The applied tillage and soil management methods have a significant impact on soil development processes first of all the productivity of soil that has a remarkable feedback for farming. We have collected data during decades and by data processing we have been looking for answers about how soil managment has been changed in the last 30 years nearby Lake Velence's catchment area and how these effects have influenced the composition of weed species particularly the spreading of the ragweed. (Szabóné et al., 2009).

The ragweed (*Ambrosia artemisiifolia*) belongs to the Compositae family. It is an annual plant of 20-200 cm size. Their roots grow into the deep soil. Seed production of one single plant may reach 62000 pieces. The stored seeds may keep their germinating-power for more than 50 years. It causes problems on the wheat stubble and by means of good competition in the intertilleds (such as sunflower, corn). Everywhere the soil is used, the ragweed is a dominant species. After leaving off the cultivation in the first two years, occasional 6-8 years, it may appear in mass-produce on the wasteland. Later the perennial weeds may oversome that. It was taken into Hungary roughly in 1922 via wheat grain shipment's contaminations. The spreading started from Somogy county after the second world war, and the spreading increased continuously. The property of land has been changed since the fall of the eastern block. The system of growing has been changed by splitting of the large-size fields as well as the technology of growing and the method of plant protection. (Szabóné et al., 2009).

- The size of non-arable land and untreated set-asides and ruderalia increased significantly, just as the minimum tillaged areas.
- After harvesting early crops the untreated stubbles and inadequate soil management enhance the propagation of weeds.

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- Mostly at bigger-row-distance planted crops the lack of knowledge in weed control drives to use incorrect technology, to spray inadequately or in bad quality, and all of them done on an inefficient level.
- Important technological elements disappeared after the agent re-examination and the pesticide pulls out from trade by the European Union.
- The inadequately shallow or bad quality tillage is recently appears.
- High weed coverage on site edges.

Regarding **edaphiqual** factors, the spreading of ragweed have been helped by the inadequate nutrient supply, the low level nutrient service, the low amount of mould and organic material content, the bad soil structure and the increasing area of erosion. The sunflower fields have been rising out of the way, not suitable ground-clearance (rugged or soo dustied soil) leaving out the within the row or poor quality's doing, missing out of the protection of wheat's diseases, neglecting of wasteland favours from the **agricultural** technics factors for the ragweeds' headway. Shortage of sloshed rain can cause problem in using **herbicides**. In case of slow weed germination the early post hebicides about the efficiency decreases especially the protection ineffectives against in the later germination wave of ragweed (Szabóné et al., 2009; Tarnawa et al., 2009).

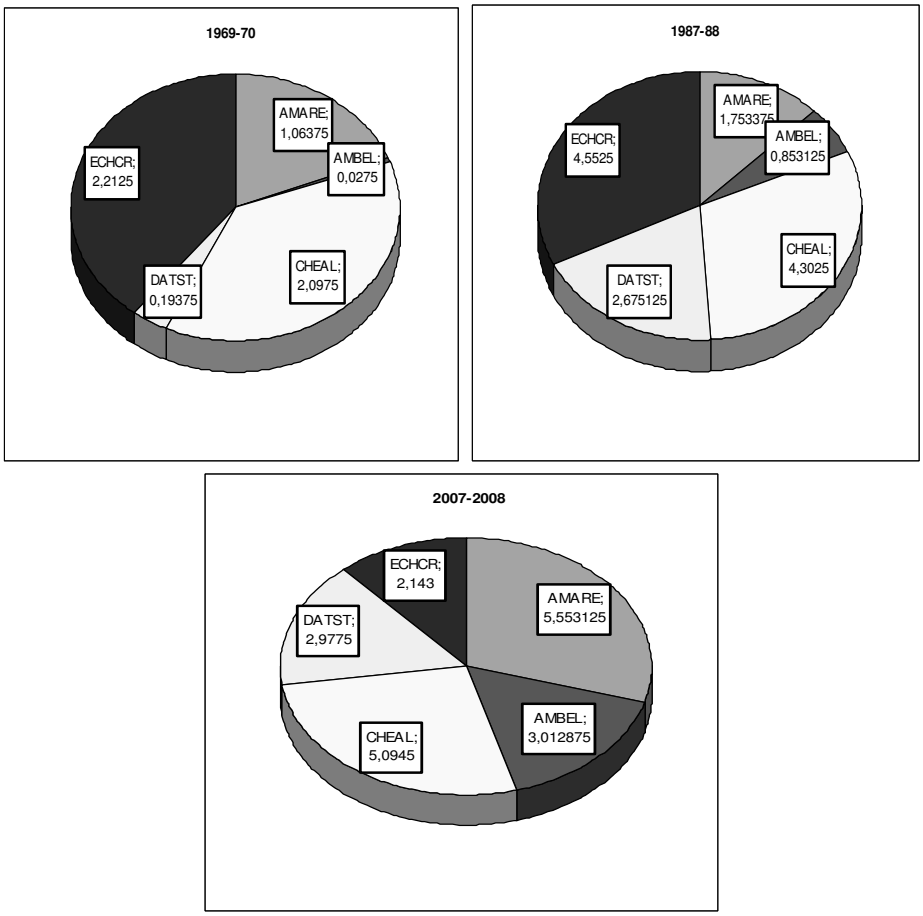
Materials and methods

The study of ragweed in the area of Lake Velence that has a high priority as it is a living and resting area.
From this way this area is well balanced by climate, weather and belongs to rich sunshine zones of this country. Its agriculture can be labelled by growing orchards and vineyards (viticulture) as well. Field crop production is mainly specialized for few assortment of plants (for instance cereals, maize, sunflower, rape). In this area the arable ratio is 80%, the forestation is subaverage than nationwide. From the Hungarian Central Statistical Office's data says a huge changing between 1989 to 2009 in the elapsed 30 years. The industrial, residential and infrasrtucure area have been increased the detriment of tillage and gardens. The meadows and pastures have been decreased dramatically by 55% and above this the orchards and uncultivated area increased by 77%.

We have studied and evaluated data obtained from 1969-70, 1978-1988 and 2007-2008 years from the nationwide weed surveying system. In the national weed survey the area of Baracska and its outskirt has the number 51 and the area of Nadap-Sukoró has the 52. The dominant soil type is characteristically calcic chernozem and most widespread weed species are: Amaranthus retroflexus, Chenopodium album, Datura stramonium, Echinochloa crus-galli, Shorghum halepense. These weeds specifically need huge places, light and nutrient substances so they strongly compete each other as well. We got more important information about weed covering from wheat stubbles. We analysed the August's recording's results from maize fields.

Results and discussion

On diagrams below the changes in the rate of dominant weeds, including ragweed, can be seen in the studied period from 1969 to 2008 on model plots.



Figures 1-2-3. Changes in the rate of dominant weeds in the studied period (1969-2008).

Legend: DATST: Datura stramonium, ECHCR: Echinochloa crus-galli, AMARE: Amaranthus retroflexus, CHEAL: Chenopodium album, AMBEL: Ambrosia artemisiifolia

In the tables it can be seen that ragweed is an important weed in the studied area. In the series of survey 2007-2008 it was ranked into the second place although in the whole country it has the first place.

It can be stated that weediness is influenced by numerous factors so not only edafic parameters cause the expansion of ragweed. The meteorological aspect of given year, the level of agrotechniques and weed control has significant impact on it. In the area of

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lake Velence it can be seen from collected data that in this situation ragweed has an important role between dominant weeds.
Thanks for long term survey the expansion of ragweed can be tracked definitely from the 0.03% in 1969/70 through 0.8% in 1987-88 until 3% in 2007/2008!

Conclusions

In the 30 years of studied period soil management changed seriously, after the decline of big estates plenty of small farms started to work. The changes in soil management methods, namely changing to non-arable land enhanced the expansion of ragweed in accordance with many other environmental factors.
After computing data gained in the national weed survey it can be stated that due to the changes in the structure of agricultural production the coverage rate of ragweed raised significantly in total weed canopy.
A solution should be found to retard and finally stop harmful processes started in last years to change profoundly the bad Hungarian practice. That should be tried to produce in agriculture with "good farmer practice" and we must to use the system of agricultural subventions diplomatically. The most important for the participants in agriculture is to make relations clear in farm ownership and to give much more and up to date practical information for farmers with more emphasis on prevention (Pálmai, 2009; Karácsony et al., 2010).

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ENVIRONMENTAL IMPACT OF COAL ASH DEPOSITION

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Abstract: In the city of Tuzla, located in Bosnia and Herzegovina, a thermo electric power plant provides heat and electricity to private households and industry. The power plant is fed with coal excavated from mines near Tuzla. One of the by-products of energy generation from coal is huge amounts of combustion residues which need to be disposed of. In Tuzla, residues are pumped into settlement ponds in natural valleys bordered by dams. Five coal ash disposal (CAD) sites, covering an area of approximately 170 ha, with more then 40 million m^3 have been established around Tuzla. Due to the fact that residual ash from coal combustion is generally known to contain a wide variety of potentially toxic trace elements – in the Tuzla case particularly Ni, Cr, As and B –, it must be assumed that ash disposal of that magnitude constitutes a serious environmental problem. The surface of coal ash landfills may be subject to uncontrolled use by local people as it is the case in Tuzla. People living nearby have been using the sites for food and fodder production, grazing, recreation and as waste dumps. Coal combustion residues are very heterogeneous substrates. Multi-element analysis has to be performed at least on a representative number of samples. However, in this research has been identified other risks associated with the disposal sites, particularly the high concentrations of Arsenic, Chromium, and Boron in the substrate, water and the uptake of pollutants by plants on the disposal sites.

Keywords: coal, ash, toxic trace elements, plants uptake

Introduction

In the city of Tuzla, located in Bosnia & Herzegovina, there is a thermo electric power plant (Termoelektrana „Tuzla“), which provides heat and electricity to private households and to the industry within this area. The power plant is fed with hard coal excavated from mines in the vicinity of Tuzla.

The combustion of coal poses a potential hazard to air and soil quality. Apart from SO_2, NO, and fine dust emissions (Lighty et al., 2000) slag and ashes are generated during the combustion process.

So far, the total amount of deposited material have been established around Tuzla is 40.000.000 m^3 and covers the area of more then 500 ha.

Besides the significant loss of agricultural land, there are more important negative impacts of the landfills on the environment, as distinct pollutants, such as: potential sources of excessive radiation, increased content of heavy metals and radionuclides, excessive alkalinity of the substrate and leachate (pH 10-12), high content of soluble salts, physically and chemically adverse impacts on the environment by fly ash, air and groundwater pollution, content of toxic, physiologically active substances in the food chain, etc.

To achieve the goal of remediation of the landfills, a more broad, comprehensive and multidisciplinary set of scientific research are needed. This paper focuses on the content of toxic elements in ash and soil, and their uptake by plants.

Materials and methods

Planned research subject was:

a) Application of the cover soil at the landfill surface with different thicknesses (10, 20 and 30 cm). From the aspect of substrate research, there were four experimental plots, as follows: pure slag and ashes without covering (variant "A"), covered with

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soil thickness of 10 cm (variant "B"), covered with soil thickness of 20 cm (variant "C"), covered with soil thickness of 30 cm (variant "D")

b) To investigate the substrate – deposited slag and ash, as a product of coal combustion, as well as the soil used as cover.
The total concentration of heavy metals was measured in aqua-regia extract, according to DIN Methods for DIN-method for garbage classification. Reading of results was performed after 24 h of shaking ash/soil extracts on AAS instrument.
The obtained results were compared with maximum tolerable values for researched elements in soil (Scheffer and Schachtschabel, 1992; Adriano, 2001)

c) In order to measure the uptake of metals by plants, the elemental content of experimental plant tissues was analyzed. Samples taken from the field were dried at 40 °C for 24 h and were subsequently digested after grinding in a Teflon coated rotary mill with nitric acid (HNO_3 65 %, suprapur) for 7 h at 170 °C. The elemental contents of the digest were detected by atom adsorption spectrometry or inductive coupled plasma spectrometry.

This work was done as part of the FP6 RECOAL project (Reintegration of coal ash disposal sites and mitigation of pollution in the West Balkan area.

Results and discussion

Extraction in aqua regia has shown that deposited ashes are enriched with As, B, Cr, Ni and to a lesser extent with Co and Cu (*Figure 1.* and *2.*). Other standard inorganic pollutants such as Cd, Pb and Zn were within normal ranges for soils.

The sample analysis of the cover soil reveals that the soil used for covering the ash and slag in landfills is largely contaminated with Cr and Ni and to a lesser extent with As, Co and B. The average content of Cr in landfills soils was 228 mg kg^{-1} at the site of Plane, Drežnik 323 mg kg^{-1} and Divkovići I 177 mg kg^{-1}. A similar situation was with Ni and Co, reaching an average concentration of Ni 418 mg kg^{-1} and Co 35 mg kg^{-1} at the site Drežnik. According to the general analysis, the content of elements such as B, Cr, Ni is above threshold, B and As are found mostly in ashes, while Cr and Ni are originally in soil, but also in the ashes. Co, Zn, Pb are more present in soil, but elements such as Cu, Se, Mo were more present in the ash.

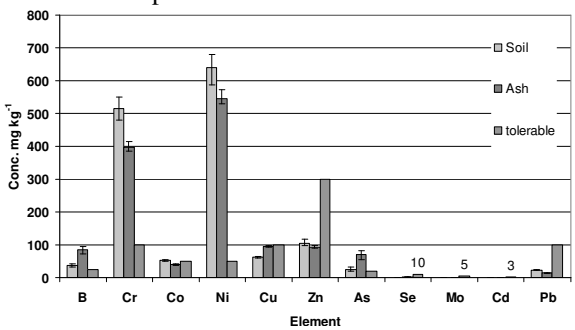

Figure 1. Average contents of researched elements in soil and ash

In the experimental field research, we analyzed two agricultural crops on the four variants – soil and ash condition: potato and maize.

Plant analyses of selected agricultural crops and their parts at the experimental sites gave evidence that metal found in soil and ash has, in some of them, been transferred to the plants.

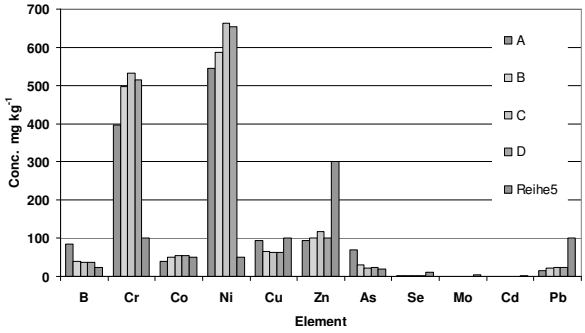

Figure 2. Contents of researched elements under diferrent variants

Table 1. Average element content in Potato (dry mater, mg kg-1)

Element	Variants								Normal range* mg kg-1
	A - ash only		B - 10 cm soil		C - 20 cm soil		D - 30 cm soil		
	leaves	edible	leaves	edible	leaves	edible	leaves	edible	
B	21,83	3,77	23,13	4,39	23,24	4,6	20,38	4,99	5 - 100
Cr	**1,83**	0,23	1,09	0,17	**1,16**	0,22	**1,06**	0,44	0,1 - 1,0
Co	0,57	0,11	0,3	0,07	0,42	0,08	0,44	0,08	0,04 - 1,0
Ni	**15,99**	2,83	**13,52**	**3,01**	**14,42**	**4,04**	**15,38**	**5,02**	0,1 - 3,0
Cu	4,97	4,5	8,03	6,98	7,07	7,16	5,52	7,76	2,0 - 20,0
Zn	14,69	15,04	16,48	15,92	22,12	27,38	27,86	17,01	5 - 100
As	0,97	0	0,21	0	0,16	0	0,08	0	0,1 - 1,0
Se	**0,34**	**0,15**	**0,27**	0,1	**0,13**	0,04	**0,11**	0,08	0,1**
Mo	**4,31**	0,61	**2,61**	0,66	1,39	0,4	0,74	0,28	0,05 - 1,50
Cd	0,06	0,01	0,18	0,06	0,28	0,1	0,38	0,1	0,05 - 0,40
Pb	0,45	0,01	0,34	0	0,5	0,03	0,26	0,02	0,1 - 6,0

*Normal ranges for plants (Scheffer/Schachtschabel, 1992; Adriano, 2001)
** Normal content of selenium in plants (Grbeša, 2004)

Table 2. Average element content in Maize (dry mater, mg kg-1)

Element	Variants								Normal range* mg kg-1
	A - ash only		B - 10 cm soil		C - 20 cm soil		D - 30 cm soil		
	leaves	edible	leaves	edible	leaves	edible	leaves	edible	
B	2,98	3,4	2,88	3,41	2,21	2,46	1,72	1,55	5 - 100
Cr	**1,02**	**1,12**	0,79	**1,2**	**5,08**	**1,36**	0,85	0,79	0,1 - 1,0
Co	0,09	0,05	0,03	0,07	0,01	0,02	0,02	0,01	0,04 - 1,0
Ni	0,77	0,79	0,59	0,84	0,99	0,28	0,35	0,2	0,1 - 3,0
Cu	9,29	9,62	8,96	8,46	1,88	2,26	2,19	1,61	2,0 - 20,0
Zn	26,81	26,7	15,67	15,7	21,3	21,9	25,3	24	5 - 100
As	**1,05**	0,37	0,41	0,13	0,01	0	0	0	0,1 - 1,0
Se	**0,24**	**0,16**	0,1	0,04	0,06	0,09	0,1	0,07	0,1**
Mo	**2,67**	**1,56**	0,65	0,29	0,29	0,25	0,21	0,25	0,05 - 1,50
Cd	0,03	0,07	0,11	0,19	0	0,02	0,02	0,01	0,05 - 0,40
Pb	0,27	0,15	0,12	0,15	0,06	0,1	0,06	0,02	0,1 - 6,0

*Normal ranges for plants (Scheffer and Schachtschabel, 1992; Adriano, 2001)
** Normal content of selenium in plants (Grbeša, 2004)

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Results (*Table 1.*) show that Potatoes appear to have the highest chrome (Cr), nickel (Ni), selenium (Se) and molybdenum (Mo) uptake. Uptake in leaves is generally much higher than in edible parts. Only molybdenum has higher presence in the variants with only ash (A) and 10 cm cover soil (B) then in other variants. Chromium (Cr) is being accumulated mainly in the leaves, but not in the edible parts. The same occurs with Selenium (Se). Also, Potato took up remarkable amount of nickel (Ni).
As shown in *Table 2.*, the elements above threshold level are Cr in A, B, C variants, As, Se and Mo in variant A. Chromium, selenium and molybdenum are found in edible parts too.

Conclusions

The summary data reflect a relatively high threat of metals entering the food chain. Further investigation into more crops and their varieties will provide even better understanding of this problem and its dynamics.
The total and available value in soil and ash are in close correlation with uptake concentration Cr, Ni and As in crops.
Ashes and even top soils sampled at the investigated sites contain remarkable concentrations of arsenic, boron, nickel and chromium that exceed tolerable thresholds for agricultural land use so far. This does not pose a phytotoxicity problem for the plants (except B in certain plants), but may be potentially harmful for animals which are feeding from these plants as well for humans who consume agricultural products grown on these soils (Keefer, 1993).
Further investigations of the substrates that were used for covering the sites need to be carried out in order to fully understand their actual contamination.
The use of plants or plant products to restore or stabilize contaminated sites, collectively known as phytoremediation, takes advantage of the natural abilities of plants to take up, accumulate, store, or degrade organic and inorganic substances. Processes include using plants that tolerate and accumulate metals at high levels (phytoextraction) and using plants that can grow under conditions that are toxic to other plants (McIntyre, 2003).

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PLANT-SOIL RELATIONS ON GRASSLANDS IN HORSE PASTURES ON NAGYMEZŐ, HUNGARY

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Abstract: Pedological studies were done on pastures of the Nagymező area, in the Bükk Mountains. (NE Hungary). Examinations sites were designated as moving from summer stable of the Lipica stud, to sample sites of coenological examiniations made in 1994 and 2005, on typical soil type of a fluvisol. The area originally was covered by forests. Thickness of the humic layer varied significantly between 60 and 90 cm. In some areas cambisol has become more dominant and even colluvium was generated. Phosphorous and potassium content was high (P_2O_5 321 ppm – 229 ppm, K_2O 537 ppm – 317 ppm) in the upper layer of the soil, as a result of concentrated presence of the horses. Besides accumulations of substances, as a consequence of intensive trampling, above soil layer has become thin, with a decreased humic layer. Excess grazing, especially if associated with excess trampling, has led to significant degradation of vegetation during the observed 14 years. The most serious degradation could be detected near the summer stable of the horses and at area directly its gate. The vegetation thoroughly changed into ruderal. In the grasslands farther from the summer stable number of species has decreased, meanwhile, significant changes in species of less grazed areas could not be detected.

Keywords: grassland, grazing, pasture, brown forset soil

Introduction

Agricultural production basically depends on the protection and rational use of lands. Both botanical and pedological aspects can have key-importance to develop the best management practices. Based on EU standards, both agricultural use and nature conservation aspects could be harmonised on these areas (Várallyay, 2006; Birkás et al., 2006; Tasi, 2007; Szemán, 2007). Besides this, land use has to be managed considering agroecological potential of Hungarian agriculture (Várallyay, 2006), especially on those areas where water supply is a determinative factor (Lacová et al., 2006; Ľubomír-Hallett et al., 2007).

To harmonize agriculture and nature conservation is highly important in these areas (Ángyán, 2000). Observations on vegetation of pastures and its changes have high importance especially grass species (*Poaceae*) since mainly these species ensure the most valuable forage for grazing animals (Vinczeffy, 1998; Barcsák and Kertész, 1986; Szemán, 2003). Organic matter content plays important role as nutrient (Ercoli et al., 2006; Hoyk, 2005) and shallow soils which have extreme water regime (Birkás et al., 2006). Any activity that reduces the soil cover by removing the vegetation is unfavourable, because increases the effect of erosion processes especially the effect of future climate change (Mudri et al., 2005). Their place has been occupied by diverse associations. Forests have not been renewed due to natural (microclimatic) reasons and anthropogenic effects (mowing, grazing) (Bacsó and Zólyomi, 1934; Suba et al., 1982; Vojtkó and Marschall, 1991; Vojtkó, 2001). Natural conditions of Bükk Plateau is similar to the territory breeding area of Lipizzan horses. This is the reason why a Lipizzan stud was planted here in the early 1950's.

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Materials and methods

Sample quadrate groups (1–5, 6–8, 9–10, 11) were designated as follows:

- area close to (0–25 metres away from) the summer stable, heavily trampled and grazed due to daily driving out and in of colts (sample quadrates no. 1–5)
- areas 50–100 metres away from the stable, with average grazing (sample quadrates no. 6–8)
- areas 250–500 metres away from the stable, not too much used (sample quadrates no. 9–10)
- fenced nature conservation area of the Nagymező where neither grazing nor trampling effects natural vegetation (sample quadrate no. 11, 500–600 metres away from the stable).

For evaluation during the data processing cover (D) and species number (n) were chosen from analytical parameters while relative nitrogen demand (NB) (Borhidi 1995) and nature conservation value categories (TVK) (Simon 2000) were chosen from synthetic parameters.

Botanical point of views was considered by taking soil samples. Soil profiles were examined and described at all sites. Laboratory measurements were made on: pH (H_2O, KCl); $CaCO_3$; Al- P_2O_5; Al- K_2O; humus (Turin method); nitrogen availability; nitrogen forms (KCl replaceable ammonium-nitrogen and nitrate) and total nitrogen content (Buzás, 1983).

Results and discussion

Dominant soil type of sample areas near the summer stable is brown forest soil: The dominant soil type of sample area is brown forest soil). Phosphorous and potassium content of surface soil was extremely high (P_2O_5 321 ppm – 229 ppm, K_2O 537 ppm – 317 ppm) (*Table 1a-b*) due to the nutrient enrichment of animals on the site. Soils of the sample area are characterised by a thin (only 50 cm thick) depth of solum.

Table 1a. Results of soil samples

Sample	1/A	1/B	2/A	6/A	6/B	6/E	7/A	7/B
pH H_2O	6.64	6.65	6.47	5.86	5.79	5.40	5.31	6.23
pH KCl	6.03	6.21	6.01	4.97	4.10	4.26	4.56	5.20
humus %	17.85	4.67	13.74	11.56	2.12	3.18	16.17	1.98
P_2O_5	321.20	14.76	229.80	13.60	10.92	9.00	139.40	11.56
K_2O	537.15	143.39	317.80	297.84	79.42	51.33	288.01	69.66
N	very good	very good	very good	very good	adequate	very good	very good	adequate
Texture	clayey loam	clayey loam	clay	Loam	Loam	*no data*	clayey loam	loam
K_A[1]	42-50			38-42		>60		

K_A: plasticity according to Arany

Table 1b. Results of soil samples

Sample	7/E	8/A	9/A	9/B	9/E	10/A	11/A
pH H_2O	5.35	5.70	5.07	5.80	4.92	4.93	4.93
pH KCl	4.01	5.00	4.13	3.94	4.02	4.10	4.09
humus %	4.31	21.11	16.46	9.21	6.47	12.31	16.56
P_2O_5	18.68	96.60	113.00	14.76	2.72	7.60	103.20
K_2O	54.27	280.70	222.06	89.57	86.15	256.75	242.69
N	very good	very good	very good	very good	very good	very good	very good
Texture	sandy loam	clay	clayey loam	loam	loam	clayey loam	clayey loam
K_A[1]	30-38	50-60					

K_A: plasticity according to Arany

Sample areas 6 and 7 are characterised by brown forest soil with clay illuviation. Phosphorous and potassium content can be considered as average (P_2O_5 136 ppm – 139 ppm, K_2O 297 ppm – 288 ppm) in the this soil type. Thickness of depth of solum is quite heterogenic (altering between 60 and 90 cm) and this may highly influence water regime relations of soils.

Depth of solum of the brown rendsina soil type covering sample area 8 is thin, only 35 cm thick. Its parent material is wheachered limestone. Its organic material content is very high (21%) while nutrient content is good (P_2O_5 96 ppm, K_2O 280 ppm) referring to the characteristic of this soil type. Low phosphorous values refer to the undisturbedness (uninterrupting) of the area. Thin depth of solum and compact parent material**,** have significant effect on water management.

Sample area 9, 10 and 11 are situated on the ground of dolinas, in the accumulation zone of the eroding soil. Observed soils are characterised by mixed B-horizons which is deeply lying (below 100 cm) limestone. Typical soil type of these surfaces is brown forset soil with clay illuviation generated on colluvium. Its pH is acidic (pH 4,9). Based on their very poor phosphorous content (7,6 ppm) it is supposed that the redeposited colluvium originated from the B-horizons of nearby soils. In fenced sample area 11 the nutrient supply can be regarded as more favourable probably because of decreasing erosion and less disturbed soil generation processes.

Botanical results of coenological investigations were taken between 1994 and 2005. Several species show significant difference during the period even a new taxa appeared while covering rate of certain plants decreased or certain species disappeared. Several weed species were dominant around the summer stable already in 1994. Besides great stands of *Polygonum aviculare* and *Plantago major*, several grass species (*Festuca rubra, Agrostis capillaris, Dactylis glomerata)* can be found in the relevés. This area has been a rather transformed, ruderal surface in 1994, however during the 11 years passed, the situation has deteriorated. As a consequence of over-grazing and trampling the area around the summer stable could be described as a thoroughly anthropogenic, degraded area. The grassland is poorer in species, even *Festuca rubra, Agrostis capillaris* and *Dactylis glomerata* have disappeared from the sample areas till 2005. Even the nature protected *Alchemilla monticola* was also not found. *Polygonum aviculare* and *Plantago major* weed species became dominant. Among grass species,

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Lolium perenne dominates the area. In 1994, mainly weed species dominated in the first 4 quadrates, however they became dominant even in the 5th quadrate in 2005. Species composition of grasslands away from the summer stable has not changed significantly, but during the past 11 years *Taraxacum officinale, Lolium perenne* and *Trifolium repens* have conquered a bigger area. Based on these investigations it can be stated that the least grazed areas are in a good botanical condition nevertheless stands of several nature protected species became sparse or even disappeared such as *Dianthus deltoides, Carlina acaulis, Gentiana cruciata* and *Prunella grandiflora*. Vegetation of the quadrate in the fenced area which is mowed shows a close-to-natural condition. This area also became poorer in species during the years passed.

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A NEW WAY OF RIPRIAN BUFFER STRIP DIMENSIONING

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Abstract: Localization, width, and vegetation cover of buffer strips depend on their planned purpose. Anti-erosion contour buffer strips, as their name says, are often placed in the direction of contour lines. The distance between them may not exceed so-called critical slope length – L_{cr} , which we calculate with using 3 types of the equations. In the Slovak Republic, we use two equations for the calculation of the minimum width of contour buffer strips – D_{min} . In the first equation (Cablík and Jůva, 1963) is the width of contour buffer strips a function of the L_{cr} , design rainfall intensity, infiltration capacity of soil on adjoining slope and infiltration capacity of soil on contour buffer strips. In the second equation (Antal, 1986) is the width of contour buffer strips a function of L_{cr} , depth of design rain, the value of the CN of adjoining slope and the CN value of contour buffer strips.
Consideration that the localization of riparian buffer strips is already determined by location of the stream, it is necessary to dimension their width, eventually propose vegetative species selection. Currently is used no formula to calculate the width of the riparian buffer strips in Slovak Republic. There are only recommended values of riparian buffer strips width, where a minimum value of riparian buffer strips width is 4.5 m and maximum recommended value of grass riparian buffer strips width is 26 m, depending on the adjoining slope steepness and on the erosion intensity of the adjoining slope (Muchová et al., 2009).

Keywords: buffer strip, pollution of water, CN values, surface runoff

Introduction

Well designed, built and maintained buffer strips can significantly reduce the pollution of water resources and soil erosion losses in agricultural land (e.g. http://files.dnr.state.mn.us/publications/water/buffer_strips.pdf; Cablík and Jůva, 1963; Antal, 1986).
In comparison with technical protective measures (e.g. with antierosion channels and terraces) have buffer strips more advantages. Usually, they are cheaper, rideable for agricultural mechanisms and not least, they have ecological functions as well (Muchová et al., 2009).
According to a function are buffer strips divided into so–called riparian buffer strips and into so–called antierosion (infiltration) strips.
The aim of antierosion buffer strips is to decrease the water erosion intensity on required value in interested area. They are dimensioned so that their width and vegetation cover assure the transformation of surface runoff from design rain on subsurface water (e.g. Cablík and Jůva, 1963; Antal, 2005). Arrangement of them, as far as possible, is in the direction of contour (therefore they are sometimes called "contour buffer strips") but the distance between them – L, should not exceed the so–called critical (allowed) slope length.
The width of antierosion infiltration strip – D is calculated by solving the hydrological balance equation of interested area, which has the following form (*Figure 1.*):

$$Q_{\inf,D} = Q_{R,D} + Q_{s,L} \quad (1)$$

Where:
$Q_{inf,\,D}$ – Volume of infiltrated precipitation´s water during the duration of design rain on infiltration strip with width – D [L^3]

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$Q_{R, D}$ – Volume of design rain, which impinge on an infiltration strip with width – D [L^3]

S_{al} – Volume of surface runoff from design rain, which flow on infiltration strip with width D from adjoining slope with length – L [L^3]

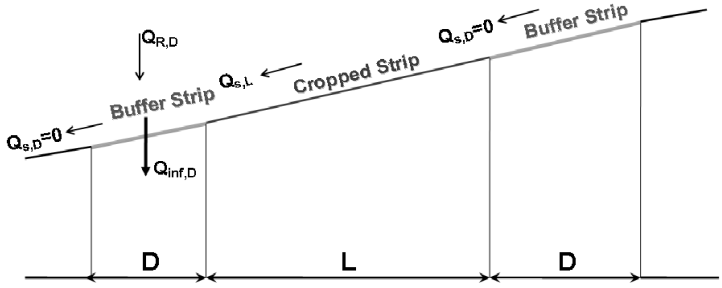

Figure 1. The width of antierosion infiltration strip

The aim of riparian buffer strips is inter alia to intercept surface runoff of rain water from adjoining slope with length – L, intercept soil particles transported by surface runoff, nutritients or at least decrease the pollution. Localization of riparian buffer strips is predestinated by localization of water courses, water reservoirs etc.

In contrast with antierosion infiltration strips, their efficiency in the term of transformation of precipitation water surface runoff does not need to be 100%.

Another difference between antierosion infiltration strips and riparian buffer strips is in the length of adjoining slope, which usually is not constant in the cause of riparian buffer strips, but it depend on localization of distribution board and water course in land – *Figure 2.*

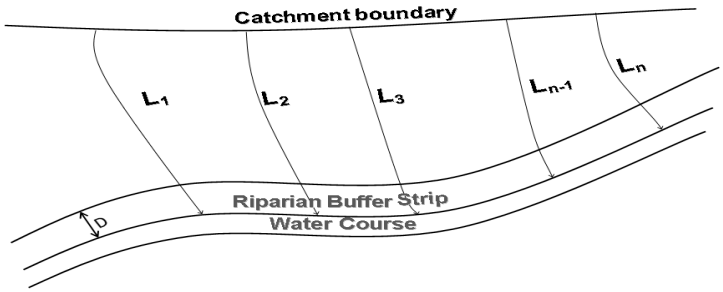

Figure 2. Length of adjoining slope, which depends on localization of distribution board and water course

It means that the width of riparian buffer strip should be also the function of length of adjoining slope and of course must be function of other characteristics of interested area.

Literature introduces (shows) for instance these characteristical values of riparian buffer strips width:

- Minimum grass zone width is 3 m when the surface runoff is not the main problem (Iowa State University)
- Minimum grass zone width is 6-7 m if it has slow down the surface runoff, enable infiltration and sedimentation of erodible particles

- Minimum buffer strip width is 20 m for removing agricultural chemicals and sediment from runoff (Iowa State University)
- Minimum 4-10 m depending on width of water course (Slovak MSPL)
- Maximum 30 m grass zone, if the slope of adjoining area is > 7 % and if the soil erosion losses is > 40 t/ha/y (Slovak MSPL)

As follows from these data, establishing of riparian buffer strips width depends more or less on experiences of projectants and on practices in each regions as well.

Materials and methods

The new way of riparian buffer strips width - D dimensioning which takes into account length and hydrological characteristics of adjoining slope as well as design rain characteristics, required efficiency of riparian buffer strips in term of retaining of surface runoff from precipitation water, comes from solving of equation for calculation of infiltration strips width (Antal, 1989), adjusted on form:

$$D = L.\frac{e.H_R}{0{,}2.A_D - H_R} \quad (2)$$

D – Riparian buffer strip width [m]
L – Adjoining slope length, ergo water course distance from catchment boundary [m]
e – (≤1) design efficiency of riparian buffer strip [-]
H_R – design rain depth [mm]
A_D – riparian buffer strip potencional retention [m]
CN_D – number of runoff curve of riparian buffer strip, which is especially function of soil hydrological characteristics, vegetation cover, eventually soil cultivation, maintained and quality of riparian buffer strip [mm]

Results and discussion

Calculated values of x, as the function of design rain depth H_R for the worst case of soil exploitation of adjoining slope from the point of view of surface runoff depth of rain water for 100% efficiency of riparian buffer strip (e = 1) are for each hydrological categories of soils (*A, B, C* and *D*) pictured on *Figure 3 – 6.* (Antal and Maderková, 2010).

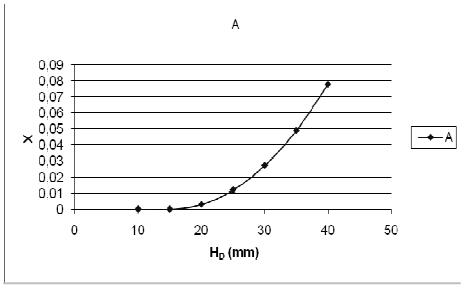

Figure 3. Soil category A

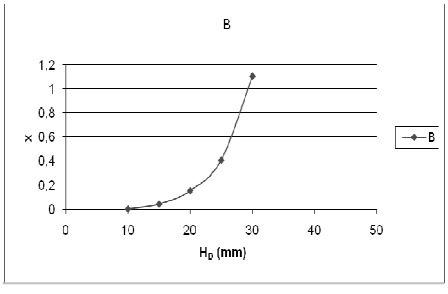

Figure 4. Soil category B

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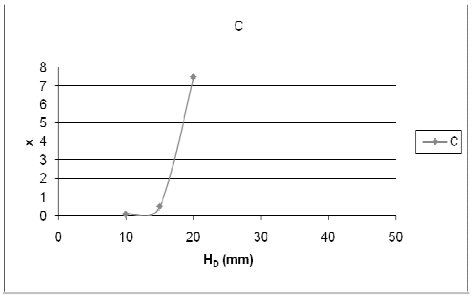

Figure 5. Soil category C

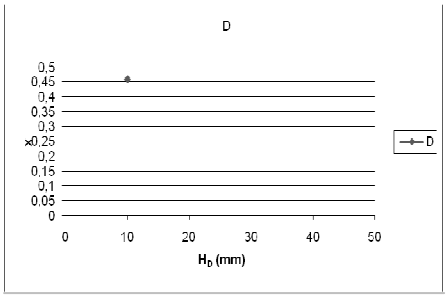

Figure 6. Soil category D

Despite of some simplification at drawing off equation (*2*) or (*3*) enable this relation in calculation of riparian buffer strip width, takes into account more characteristics of interested area as are taken into account until now used ways of dimensioning. Some experiments showed that riparian buffer strips are from the point of view of soil protection and surface water reservoirs less effective on granulity heavier soils, i.e. on hydrological soil categories *C* and *D* (*Figure 5.* and *6.*).

Conclusions

Derived equation for the calculation of riparian buffer strips width takes into account the most important characteristics of interested area, which influence precipitation runoff process, concretely: adjoining slope length, distance between catchment boundary from protected water formation, using of interested area (planted crops, used agrotechnic etc.), soil hydrological characteristics (soil type, drainage characteristics etc.), design rain characteristics (periodicity, duration, etc.) and also the characteristics of riparian buffer strips vegetation cover (vegetation type, vegetation quality etc.) In designing is also possible to takes into account required efficiency of riparian buffer strips especially from the point of view of catching surface runoff of rain water from adjoining slope.

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CROPPING SYSTEMS ADAPTATION IN ENVIRONMENTALLY SOUND TECHNOLOGIES

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Abstract: In a long term trial conducted from 1999 to 2008 in Slovakia, a series of cereal and legume rotations in two cropping systems were analysed. Winter wheat yields after 3 pre-crops were analysed in relation to productivity, nutrient use efficiency and mycotoxin contamination. Higher productivity of integrated system was achieved with significantly lower nutrient efficiency than in the ecological system. No difference in yield between the systems was determined during drier years. Ecological system has the potential to achieve consistent, moderate yields with significantly lower reliance on external inputs. In ecological system the concentration of deoxynivalenol (DON) was lower by 46% compared with integrated, pre-crop effect on DON was determined. More humid and warm weather enhanced the level of DON.

Keywords: cropping systems, productivity, mycotoxins

Introduction

Agriculture in temperate areas is generally characterized by favourable soils, high external inputs allove to obtain high production levels but productivity may be pushed beyond the actual ecosystems capacity. Conversion to organic management usually means considerably drop of yields, during two to three years of conversion. In the medium and long term, when soil fertility recovers, yields are slightly lower or comparable to the pre-conversion yields (Dierauer et al., 2006; Poudel et al., 2002). Other field trials reported organic crop yields to be 5 - 35% lower than conventional ones (Mäder et al., 2002; Macák et al., 2008, 2010). Since resources are always limited in one or another way, it is important to consider the capability of a system to produce high output per unit of resources used rather than absolute productivity. The productivity of organic compared to conventional farming depends strongly on soil and climate conditions and also on choice of crops being compared.

The presence of mycotoxins, especially deoxynivalenol (DON) is a major concern for grain growers using any system. Contamination in feedstuffs can cause serious health problems and diseases. Even at low levels, DON may cause animals to refuse feed or, at higher levels, induce vomiting leading to growth depression, increased susceptibility to infections, diarrhoea and haemorrhage (Hsu et al., 1972). Review of the literature suggests, that the mycotoxin content of cereals is highly variable, regardless of the farming system. This paper reports on the effects of ecological and integrated cropping systems, fertilizer inputs on the yield of winter wheat and mycotoxins contamination in a long-term field trial.

Materials and methods

Rotation and cropping system field experiments were carried out at Dolná Malanta, Western Slovakia (18°07´E, 48°19´N) from 1999 to 2008 on a Haplic Luvisol developed at proluvial sediments mixed with loess. The altitude of the experimental plots is 178 m. The location has a continental climate with an average temperatures 19,7°C in July and - 1,7°C in January, an average annual precipitation is 561 mm. A

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split - plot design was used with two main treatments, Ecological (ECO) and Integrated (INT) cropping systems. The ecological system was composed of a six course crop rotation: beans + lucerne - lucerne - winter wheat - peas - maize - spring barley. The integrated system consisted of the crop rotation: winter wheat - peas - winter wheat maize - spring barley - lucerne (3 years at the same plot).
Subplots were fertilized (+fert.) and unfertilized treatments(-fert.). The +fert. treatment in ECO system was based on 40 t of manure while the INT system also received 40 t of manure plus synthetic fertilizers. Treatments were replicated four times. Sowing and harvesting dates, rainfall and average temperature calculated for vegetative period of the crop, synthetic fertilizer inputs (kg ha^{-1}) applied in the INT system are shown in *Table 1*. Nitrogen fertilizers were applied in three split applications.

Table 1. Crop management data for w. wheat, 1999 - 2008.

Year	Sowing date	Harvest date	Rainfall (mm)	Average temperature (°C)	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})
1999	23/10/98	20/07/99	435	8,1	23,8	15,0	31,6
2000	28/09/99	3/07/00	301	9,5	25,3	5,0	18,3
2001	29/09/00	20/07/01	408	10,4	29,0	5,8	23,3
2002	4/10/01	6/07/02	310	9,0	44,2	15,8	16,6
2003	9/10/02	30/06/03	264	7,7	34,2	21,6	26,6
2004	2/10/03	21/07/04	450	8,2	39,8	19,1	16,6
2005	1/10/04	19/07/05	398	8,2	49,2	22,5	10,0
2006	7/10/05	20/07/06	522	7,9	58,3	22,5	0,0
2007	2/10/06	2/07/07	347	10,0	58,0	28,3	56,6
2008	9/10/07	28/07/08	467	8,9	57,5	28,3	21,6

During 2007 and 2008 the concentration of deoxynivalenol (DON) was detected in the winter wheat samples from ECO and INT systems.
The liquid chromatography WATERS BREEZE equipped with binary pump WATERS 1525, RHEODYNE injector and UV detector WATERS 2487 was used with a stainless steel reverse phase 150x3,9 mm, 4 µm spherical particle C18Nova-Pak column. For evaporating of samples, rotary vacuum evaporator RVO 400 was used.
HPLC chromatography: 50µL of the samples were injected into the HPLC column heated on 35°C and determined by UV detector set to 218 nm for DON. Mobile phase were mix of A: water, B: acetonitrile with using gradient: 0 - 5 min 10% B, 6 - 16 min 10 - 25% B, 17 - 35 min 25 - 60% B, 36 - 40 min 60% B, 41 min 10% B. Flow rate was 0,6 mL min^{-1} mobile phase. Retention time was for DON 13,4 min.

Results and discussion

The effects of years and cropping systems on winter wheat yield and yield parameters were significantly different with the year x system interactions also being significant. Average grain yield was lower in ECO system by about 12%, but when the pre-crop effect is taken into consideration, than equal yields were achieved in integrated and ecological system. In drier years winter wheat grown after lucerne in ECO system slightly outyielded the w. wheat in INT system (*Table 2.*).

Table 2. Yield parameters for winter wheat in response to cropping system and pre-crop effect (1999 - 2008)

System	Integrated			Ecological
Pre-crop	Peas	Spring barley	Lucerne	Lucerne
Yield (t ha^{-1})	6,41b	6,63b	5,46a	5,45a
Kernels per m^2	15 300ab	16 560b	13 015a	12 939a
TGW (g)	42,16a	40,12b	42,73a	42,73a
In drier years				
Pre-crop	Peas	Spring barley	Lucerne	Lucerne
Yield (t ha^{-1})	5,26ab	5,88b	4,86a	5,15ab
Kernels per m^2	13 259ab	15 729b	11 400a	13 376ab
TGW (g)	40,51ab	37,89a	43,47b	39,37ab

The variation in thousand grain weight (TGW) between systems was less influenced by weather conditions, TGW was greater in ECO than in INT system. Pre-crop effect on TGW was significant but no significant differences after leguminous pre-crops were found. The average kernel count was lower in ECO system by 13,5%, but after the same pre-crop, no significant differences were determined. In drier years (four, out of ten) ecological system performed better, with similar yield after comparable pre-crop, and slightly higher kernel count and lower TGW (no significant).
The efficiency of the farming systems was compared by relating yield parameters to fertilizer inputs (*Table 3.*). The ECO system was significantly higher per unit of nutrient added (N, P, K) for yield of w. wheat.

Table 3. Efficiency of fertilizer and manure inputs on w. wheat yield (kg ha^{-1})

System	Integrated			Ecological
Pre-crop	Peas	Spring barley	Lucerne	Lucerne
Nitrogen	89,9	93,3	75,3	168,8
Phosphorus	292,0	347,5	210,7	806,4
Potassium	123,1	133,8	93,8	155,7
In drier years				
Pre-crop	Peas	Spring barley	Lucerne	Lucerne
Nitrogen	75,3	95,8	59,0	161,1
Phosphorus	262,1	355,4	178,2	769,4
Potassium	87,7	103,5	74,4	148,6

The effect of cropping systems, years, fertilization on DON concentration of w. wheat grain were significantly different. Average DON concentration in INT system was 361,6 µg kg^{-1}, in ECO system its concentration was lower by 46% and reached an average of 192,4 µg kg^{-1} (*Table 4*). Fertilization treatments enhanced the level of DON in both systems, in INT also pre-crop effect was significant. Peas, as pre-crop for w. wheat enhance the concentration of DON. Weather conditions during two consecutive growing seasons influenced levels of DON in wheat samples. More humid weather in June, July 2008, together with warm weather caused higher DON production.

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Table 4. Concentration of DON (µg kg^{-1}) in winter wheat samples

Production system	Pre-crop	Fertilisation	Year		Average	Average for system
			2007	2008		
INT	Peas	+fert	553,7	649,2	601,5	431,8c
		-fert	187,9	336,3	262,1	
INT	Barley/Lucerne	+fert	108,4	653,4	380,9	291,5b
		-fert	62,6	341,7	202,2	
ECO	Lucerne	+fert	155,5	402,8	279,2	192,4a
		-fert	124,3	87,0	105,7	
average			198,7a	411,7b		

Conclusions

The greater productivity of the INT system was achieved with significantly lower nutrient efficiency than in the ECO system. No difference in yield between the systems was determined during drier years. The ECO system was able to produce higher yields than integrated per unit of nutrient applied, with significantly higher output/input ratio for nitrogen, phosphorus and potassium. ECO system has the potential to achieve consistent, moderate yields with a significantly lower reliance on external inputs. Mycotoxin contamination (DON) in wheat was below the level considered safe for consumption. In ECO system, the concentration of DON was lower by 46% compared with INT system. Within INT system, pre-crop effect on DON concentration was determined, when peas enhanced the level of DON in w. wheat grain. More humid and warm weather enhanced the level of DON.

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THE IMPACT OF PRODUCTION FACTORS ON THE YIELD FORMATION OF GRASSES OF VARIOUS EXPLOITATION

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Abstract: The lawn – following the forest – is the best manner of land use. 10,75 percent of Hungarian territory is grassland. 90-95 percent of the grass's root system can be found in the upper 10 cm layer of the soil therefore and because of the large evaporating surface the grasses have a great water demand and weather sensitivity. Beside the nutritional ability and some extreme properties of soil (for ex. great salinity) there is an influence on formation of the grass-type and the yield.

In our experiments the sites were utilised 2, 3 and 4 times yearly. At two sites for four years (2006-2009) and at one site for two years (2009-2010) the quantity and the distribution of the yield as well as other parameters were examined, which are not reported in this paper. This experiment is a part of a climate research project run at 27 sites in Austria. The laboratory analyses were carried out uniformly in the LFZ Raumberg-Gumpenstein Research Institute. The most important results of this study are the following:

The productivity of the grass type formed on the Little Cumania lowland is very limited. In case of drought there was the highest yield decrease and at the same time in case of good precipitation there was the smallest increase of yield.

The effect of grass utilization by late first cut at the poorest-soil site was very unfavourable. At the grass sites of better quality, the utilization manner of 3 or 4 growth, resulted in a better adaptation to the climatic extremities.

Keywords: site, intensity of lawn utilization, effects of weather

Introduction

A significant decrease of winter and spring precipitation can be observed in Hungary. This tendency has an unfavourable effect on the yield and the vegetation quality of the lawns (Pajor et. al., 2009). All over the country extremely few husbandry data are available on the pasture and meadow farming (yield by types of lawn and sites, number and ratio of growth). In lack of long data-lines it is not possible to express the correlations with the climatic factors, therefore the gathering of experimental data is essential.

In the previous ten years the countries of Western Europe made trials to clear up the required technological changes of the grassland utilization in order to moderate damages caused by the climate. In Hungary a lot of communications dealing with the effect of the climatic changes on the crop production were published (Jolánkai et al., 2010). In the domain of pasture- and meadow farming at the Szent István University we have started the research work in 2006, dealing with the estimation and the technological possibilities of decreaseing of climatic damages (Bajnok et al., 2008, 2009, 2010).

Materials and methods

The experiment is run at three sites, on nine 4x4 m individual plots, in random block arrangement, with 3 repetitions. The harvesting of lawn-growths is simulated by cutting down. In case of extensive utilization (2 times/year) the first cutting is after 15 of June and the second cutting is in the beginning of October according to the managing

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descriptions of the nature-protecting grasslands. In case of on and off grazing (4 times/year) the harvest begins early in May and continues in 40 days then in ever longer rotations, and it will be finished early in October, too. The 3 times/year variation is suitable to simulate the meadow-utilization of extensive lawns. At this point the first cutting down time is in the middle of May and the rotations are longer than that was at the 4 times-utilization variant. In the experiment the changes of the plant species composition, the quality of forage by laboratory analyses and the examination of the soils was observed. The results obtained were analysed in function of meteorological data.

According to our objectives we examined how large fluctuation of output was caused by the weather, if exist such a grass-type at which the changing of utilization intensity decreases the crop failure. We investigate at two sites, on natural pasture (Bösztör, Kisfüzes – *Festuca pseudovina*), at one site, on a meadow (Mende – *Festuca arundinacea*).

Results and discussion

The formation of the dry matter output can be seen on the *Figure 1*. The yield of the two dry-situated grass was 15-40% of the meadow provided with good ecological conditions. The vintage has a powerful effect. The year of 2006 can be considered as a mean ordinary precipitation year. 2007 was a year of drought, 2008 was rainy, 2009 dry and 2010 very rainy. The yields of lawns formed in compliance with it.

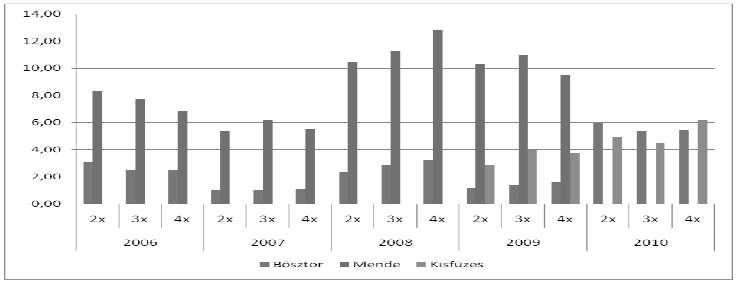

Figure 1. Yields on the investigated sites, t ha^{-1} dry material (2006-2010)

Weather sensitivity of a dry-situated natural lawn and other one with better ecological conditions were compared (*Table 1.*). According to the tendencies, reported by the meteorologists, the volume of winter and spring precipitation decreased yields to great extent. The quantity of summer rain induced no change, however postponed its effects to second half of the summer increasing intensity and the frequency of the extremities.

In case of 2-growth utilization system the dry-situated grass, because of the winter and spring dryness, produce only 35-37 percent of the usual yields of years with average

Table 1. The yields (t ha^{-1}) and their proportion on the basis of mean ordinary precipitation years (Bösztör and Mende, 2006-2009)

	Dry situated natural grass		Fresh situated planted grass	
	Total yield	%	Total yield	%
2006 (mean year)				
2 x/year	3,12	100,0	8,28	100,0
3 x/year	2,51	100,0	7,86	100,0
4 x/year	2,48	100,0	6,93	100,0
2007 (drought)				
2 x/year	1,09	35,0	5,73	69,2
3 x/year	1,04	41,3	6,55	83,4
4 x/year	1,15	46,3	5,80	83,7
2008 (rainy)				
2 x/year	2,37	76,0	10,52	127,1
3 x/year	2,92	116,3	11,32	144,0
4 x/year	3,18	128,2	12,77	184,3
2009 (dry)				
2 x/year	1,16	37,2	10,27	124,0
3 x/year	1,4	55,8	11,01	140,1
4 x/year	1,56	62,9	9,45	136,4

precipitation. The same lawn, similarly in dry and droughty years gave 40-60 percent of the usual yield when the first growth was utilised earlier (in May), so the effect of water stress can be moderated with the technology approximating the phenologically optimal utilization time of grasses. The dry material output increased to a much lesser degree in the rainy year (2008), than it decreased because of the drought on the lawn in bad ecological circumstances. The effect of water stress is much lower on the fresh situated planted lawns. The function of choosing the utilization technology is important at this point since the lawn has about 600 mm water demand in the vegetation period and when the precipitation is higher then the average, the grass still has a little water shortage. The lawn can exploit satisfactorily the favourable water quantity – because of the dispersion of the precipitation – only then if we can moderate the dominance of the first growth in the total yield by the May-first utilization, promoting the rapid forming of the second growth. The data of *Table 1.* prove, that in this case (3 times/year, 4 times/year) the precipitation excesses cause not only 20-30% increment of the yield but quite like 80-90% increment of the output.

The growths have not the same time of development (time of regeneration) that is why the height, the foliation, the protein-, fibre-, energy content and the digestibility of their nutritive materials are the same too. Because of the limitations of this article we present only the results of the fluctuation of the protein content (*Figures 2.* and *3.*). The tendencies are alike in each of the cases. The quality is explicitly poor of the first, aged growth in case of extensive utilization (2 times/year), executed according to the nature-protection rules. The summer growths have significant protein content owing to the pushing over the summer precipitation from May to July-August. In Mende, especially in case of 4 times/year, when the 3. growth is at that time although the herb is young, as well by that time propagate the clovers in it. Although the 4th growthwas young but, there was a lot of wild chicory (*Cichorium intybus*) which had a lower protein content and worse digestibility. In the vegetation of Bösztör pasture the excellent drought resistant *Botriochloa ischemum* and *Cynodon dactylon* decreased the quality of the last

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growth. Taking the all nutritive-content parameters into consideration, the Bösztör *Festuca pseudovina* plant community provide a feeble quality forage in comparison with lawns composed of first class herbs.

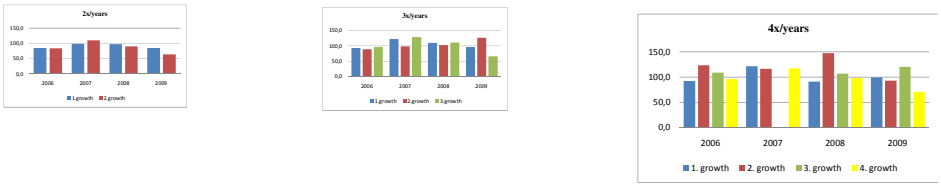

Figure 2. The effect of utilization-frequency on protein content of the Bösztör lawn.

Figure 3. The effect of utilization-frequency on protein content of the Mende meadow.

Conclusions

It is suggested to take into consideration the principles and prescriptions of the lawn management on the nature conservation areas and in the AKG programs. That is reasonable, because these trials justified not only our former knowledge that the quality of late harvested growth is low, but that in case of extensive utilization technology the yearly dry material production decrease as well. The most important consequence is the increase of drought-sensitivity of the lawn, that generate the vegetation to get weedy and thin, namely the degradation of protected lawns may accelerate. However the change in the weather has a very unfavourable consequence for the nature protection, which can be moderate if we don't have to delay the first cutting down to the end of June or more lately in every year on every site.

Acknowledgements

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AGRICULTURAL APPLICATION OF BIOGAS DIGESTATE

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Abstract: Use of agricultural and other organic materials it's not a new way, but in this time it'll be more and more important. We can find lots of different form to use these materials. The fermentation of these materials can be one of the solutions to use and recycle these products. The valuable by-product sometimes is forgotten, which has nearly the same quantity as the fermented materials. The agricultural application of the residual of the fermentation contains significant amount of plant nutrient, is reasonable. When we studied the international literature we got that result to a few researches were carried out investigating the effects of the digestate on soil-plant interactions. In our research the chemical parameters of the digestate, the effects on soil nitrogen content and forms, and the yields were studied. As the results showed the digestate contained significant amount of plant nutrient in solution form which increased the NH_4-N content of the soil. After incubations of the soil, NH_4-N transformed to NO_3-N. The high doses inhibited the germination and root development of the plants. If we mixed the highest concentrate from digestate to the soil we experienced fewer and lower roots, which were different form control and the other treatment.

Keywords: by-product, digestate, plant nutrient

Introduction

Considering national and international trends, it may be predicted that the number of smaller and larger biogas plants are going to increase. There were 16 working agricultural biogas plants in Hungary in 2010 (Kovács, 2010). The main materials that they use are residues and the waste of the food industries, restaurants, agricultural by-products and treated or untreated sewage sludges. The amount of treated materials is growing year by year so the amount of fermentation residues is also increasing. This digestate is perfect for use in agriculture as a plant nutrient. When we studied national and international literature in connection of digestation as a result of it only a few researches were carried out the effects of a possible nutrient. In 2004 a study was published which deal with the effects of digestate. They were examining oyster mushrooms in the experiment. The plant production and protein content grew and the fermentation residue had positive effect for the treatment (Banik and Nandi, 2004). In another experiment the digestate was used in green-houses also feeding pigs in North-China. Significant differences were detected between the control and treatments. Plant production and the C-vitamin content grew. Pigs which got mixed feed gained bigger weight (Qi et al., 2005). The effects of the digestate were examined on soil-plant interactions in Nyírbátor in Hungary. They used a lot of test plants for small plots and open field experiments. They made culture dishes too. In all cases they got positive results. The plants grew bigger and the fermantation residue stimulated the microbes in the soil (Makádi et al., 2007; Tomócsik et al., 2007).

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Materials and methods

We got our samples from Dömsöd. This plant uses agricultural byproducts, sewage sludge and other materials for the fermentation. We determined the *Escherichia coli* with plating method and after we counted. *Coliform* was determined with MPN method in our samples (Oblinger and Koburger, 1975). In the laboratory we prepared a solution and a H_2SO_4 extract. We determinated the chemical parameters of the digestate like dry matter content, organic matter content. The organic carbon content was determined with Tyurin method. We used the Kjeldahl method to determinate the total nitrogen. We applied distillation method to determinate the ammonium and nitrate content. Phosphorous was analysed with SPEKOL 221 spectrophotometer, potassium and sodium with JENWAY PFP7 flamephotometer. Determination of heavy-metals we applied Perkin-Elmer 303 AAS (Buzás, 1988; Buzás, 1993). To get informations from the effects of the digestate on soil - plant interactions we added digestate to the soil. After two weeks we analysed the ammonium and nitrate content of the soil with distillation method. In the experiment we used different treatments:

- Control: 100g soil-13ml distilled water
- 1. 100g soil-3.25 ml digestate+9.75 ml distilled water
- 2. 100g soil-6.50 ml digestate+6.50 ml distilled water
- 3. 100g soil-9.75 ml digestate+3.25 ml distilled water
- 4. 100g soil-13 ml digestate

We made some biotest with *Lepidum sativum* and *Lolium perenne* to observe the effects of digestate on plants. These two plants are very sensitive every toxic impact of the fermentation residue. In the experiments we used the following treatments:

- Control: 200g soil-26ml distilled water
- 1. 200g soil-6.5 ml digestate+19.5 ml distilled water
- 2. 200g soil-13 ml digestate+13 ml distilled water
- 3. 200g soil-19. 5 ml digestate+6.5 ml distilled water
- 4. 200g soil-26 ml digestate

The results were evaluated in MS Excel.

Results and discussion

After the incubation time our microbiological tests showed the following results. We could find only one *Escherichia coli* from the dilution line (*Figure 1*.).

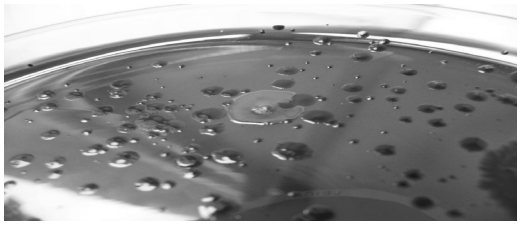


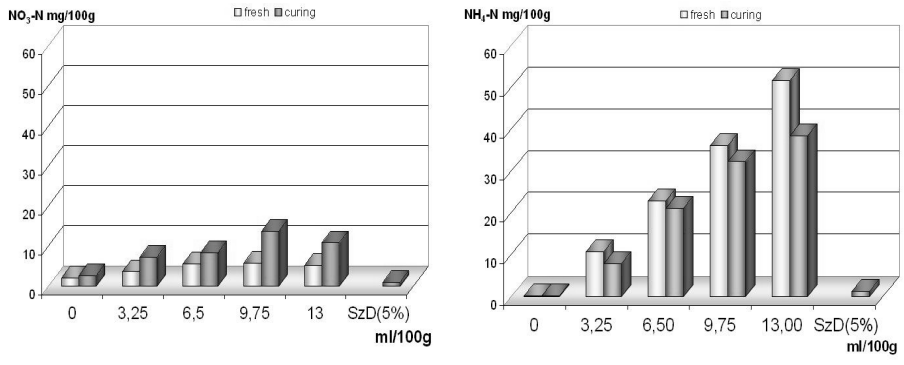
Figure 1. Escerichia coli in the sample

The Coliform analysis showed the following results in all cases. In the three repeats plate count was $4.3*10^4$ cells/cm^3 that we calculated form the Hoskins table.

Table 1. Chemical parameters of digestate

Examination	Concentration	In dry matter
Dry matter %	1.14	100%
Organic matter %	0.58	50.88%
Salt %	2.29	
pH(H_2O)	8.13	
Total C %	0.34	29.82%
Solution C %	0.28	24.56%
Total-N mg ml^{-1}	4.78	4192.9 mg kg^{-1}
Solution NH_4-N mg ml^{-1}	4.619	4051.8 mg kg^{-1}
Solution NO_3-N mg ml^{-1}	0.12	105.3 mg kg^{-1}
Solution NH_4+NO_3-N mg ml^{-1}	4.74	4157.8 mg kg^{-1}
Solution P mg ml^{-1}	0.07	61.4 mg kg^{-1}
Total P mg ml^{-1}	0.42	368.4 mg kg^{-1}
Solution K mg ml^{-1}	0.88	771.9 mg kg^{-1}
Total K mg ml^{-1}	0.89	780.7 mg kg^{-1}
Solution Na mg ml^{-1}	0.87	763.2 mg kg^{-1}
Total Na mg ml^{-1}	0.89	780.7 mg kg^{-1}
Solution Ca mg ml^{-1}	0.035	30.7 mg kg^{-1}
Total Ca mg ml^{-1}	0.093	81.6 mg kg^{-1}
Solution Cu µg ml^{-1}	2.7	236.8 mg kg^{-1}
Solution Zn µg ml^{-1}	0	0
Solution Fe µg ml^{-1}	1.62	142.1 mg kg^{-1}
Solution Mn µg ml^{-1}	0	0
Solution Pb µg ml^{-1}	6.4	561.4 mg kg^{-1}
Solution Cd µg ml^{-1}	0.042	3.68 mg kg^{-1}

The *Table 1.* shows the contains of the soluble elements and nutrients in the digestate so it's easy to absorb.



Figures 2-3. Effect of curing period to the soil NH_4-N andNO_3-N content

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The NH_4-N content of soil increased significantly comparing to control treatment. After 14 days curing period the NH_4-N decreased in each treatment. During incubation process the NH_4-N transformed to NO_3-N without significant N loss (*Figures 2-3.*). When the plants were harvested a depression of roots system was recognized (*Figures 4-5.*). The possible reason of this depression was the toxic effect of NH_3.

Figures 4-5. Roots after harvesting, controll and 4. treat

Conclusions

As the consequence of significant nutrient content of the digestate it could be used as a boifertilze in plant nutrition. Our task for the future is to continue the examination because high dose cause depression by plants. One of the most important aim is to know more about digestates.

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THE STUDY OF THE EFFECT OF DIFFERENT MULCHING TECHNOLOGIES ON WEEDS IN ECOLOGICAL APPLE ORCHARD

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Abstract: These days it is very important to make healthy and safety food without using chemicals in Hungary and all around the world. Because of this claim the farming had to change to ecological approach. This kind of outlook is not the newest one there are a lots of upholders and also people who stand against this type of farming. But we have to lay down that for the healthy safety and for everyone enough food we have to use pesticides. It is necessary because the variability of the vintage can take important influance to the quality and to the quantity of the produce. In the plant pests the weeds are the most dangerous organisms at our fields. In bio- and ecological farming we are not able to use herbicides. To get the weeds under control is a very difficult problem just by using mechanical biological and agricultural technics specially in Hungary. In our research we made differences between the growht of the weeds and the condition of apple trees by using other mulching technologies.
The annual weeds improved in the manure treatment in the best. The straw forced back the annual weeds well, but his effect was small against the perennial ones. We didn't find a justifiable interaction between the leaf areas and the treatments, but the compost yielded the largest leaf areas in all of the rows.

Keywords: weed, mulching, ecological apple orchard

Introduction

However in Europe organic farming has 2-8% of the whole agriculture - or even less in case of fruit growing - but the EU have already recognized the fact that there is an increasing demand from the consumers on those products that are produced under organic growing systems, that's why EU created its rules and regulations on organic production and labelling of organic products, more than a decade ago.
In 2002 there was 995 organic growers in 104.000 ha in Hungary, the 0,1-0,2% were organic of the animal stock, including 193 beekeepers (Balázs, 2004).
Organic apple growing nevertheless showing an increasing tendency, but still take little part of the worlds' apple production. In developed countries from the whole apple growing area 5% or more are producing organic, but in Hungary the ratio of organic apple production is under 0,5%. One of the blocks of spreading organic production can be the small numbers of plant protectional methods, which can be used under such growing systems and the research, aiming these methods are less than needed (Sipos et al., 2010).

The 2. Appendix of 2/2000. (I.18.) FVM-KöM regulation of producing, trading and labelling agricultural products that meet the requirements of organic is reviewing in detail the pesticides, can be used under organic production. In this paper clearly can be seen that no one of the herbicides can be used in organic growing systems for weed management.
Ground covering - well known in horticulture - may be as old as the agriculture itself (Nagy et al., 2006). Ground covering is a widespread weed managing method throughout in the world in organic and integrated orchards, because it has several advantageous properties (Skroch et al., 2006). Groundcover materials affects not only

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the evaporational processes and weed management, but also several processes in the soil. Its advantageous properties including weed suppressing, preserving soil moisture by decreasing evaporation and leaching, decreasing erosion, increasing water permeation, decreasing soil-temperature fluctuation, increasing nutrient availability and nitrification, providing nutrients by decomposition and conserving/amending soil structure (Merwin et al., 1994; Lakatos and Bubán, 2004). Moreover, ground covering have a positive impact on plant nutritional and biological factors. On the one part increasing the nutrient content of the soil by releasing nutrients, at the same time by changing the moisture and heat management of soil ground cover can worsen or amend the conditions of nutrient availability. On the other hand it increasing root density and quantity in the upper soil (Merwin and Stiles, 1994). With the exclusion of the competition of the weeds considerable nutrient and soil moisture can be preserved (Lehoczky, 2004; Lehoczky et al., 2006, 2009a,b).

The temperature of the covered lines are more equable, winter cold is more moderate, but in spring the soil heats some days later, which can be important fact for the germination of weeds. There is no weed growing if black syntethic plastic is used. From natural products 10-15 cm thick bark mulch can provide 4 years weedless. If mulch layer is more thin, or pre-composted bark is used, weed growing will start earlier. Thin (5 cm) bark or straw layer can manage only annual weeds for a shorter period. It is a general observation that mulching from the second year can only be succesfull with extra treatment if perennial weeds occur, or at the edge of the mulch layer (Lakatos and Bubán, 2004).

Materials and methods

Our study was set up in Hungary, Győr-Moson-Sopron county, Mihályi village in the orchard of Horváth Bioalma Kft, in 2010. The effect of four different types of mulching - 3 natural (straw, compost and manure), and one non-natural (black polyethilen plastic) - were studied on weed growing and plant condition. The treatments were compared to non-treated and non-hoed controls. Treatments were carried out in cultivar Gala in three rows, in four replications. The soil was slightly acid, clay soil. The dates of preparing the different covers were: compost - 7. April, black plastic and straw - 23. April and manure - 5. May.

Weed surveys were made three times in the treated rows (5. May, 19 July and 13. October) and one time (19. July) between the rows to assess the efficiacy of the different treatments. The aim was to assess the T1 and T2 weeds during the first, the T4 and perennial weeds during the second and the perennial weeds during the third survey.

No yield measures were made because according to weather conditions in this year the trees couldn't develop fruits. Instead of that from the three treatments leaf samples were taken (21 September) in 3 replications. The average leaf area were measured and the effect of ground covering and weed density on the trees' condition were estimated.

Results and discussion

During the spring survey we experienced that in untreated control perennial weeds were dominated and average weed coverage were high, around 80%. The average quantity of weeds didn't change for the summer, but annual weeds appear, with 30% coverage. For

late autumn warm-philous species disappeared, only a few T1 weed were in the control lines. The dominant species were barnyard grass (*Echinochloa crus-galli*) and wild oat (*Avena fatua*), but common ragweed (*Ambrosia artemisiifolia*) was also present in small numbers. In the perennial group the coverage of creaping thistle (*Cirsium arvense*) and ryegrass (*Lolium perenne*) was significant. As the orchard was planted several years ago, perennial weeds dominated (Szőke and Tóth, 2000; Szőke, 2003) (*Table 1*.).
Straw mulching successfully decreased the number of weeds at the first survey, but from the second survey perennial weeds breached the straw layer and were present at 40% coverage. Straw mulching resulted lower weed coverage, but the difference is not significant. As it was suspected straw mulching blocked the growth of annual weeds, but the development of perennials was almost undisturbed (Racskó, 2002). Quackgrass (*Elymus repens*) had the biggest coverage.

Table 1. Datas of weed surveys in average of 4 replications

TREATMENT	CONTROL									STRAW								
	1st survey			2nd survey			3th survey			1st survey			2nd survey			3th survey		
	A	P	ALL	A	P	ALL	A	P	ALL	A	P	ALL	A	P	ALL	A	P	ALL
1. row	3.3	75.5	78.8	37.3	40.8	78.0	8.9	34.1	43.0	0.0	4.9	4.9	0.8	21.3	22.0	1.8	42.3	44.0
2. row	10.0	78.6	88.6	31.3	52.5	83.8	1.4	53.3	54.6	0.5	4.1	4.6	0.0	21.8	21.8	0.0	29.5	29.5
3. row	3.1	80.5	83.6	30.8	41.5	72.3	5.3	54.5	59.8	0.7	5.1	5.8	1.8	11.5	13.3	0.1	46.4	46.5

TREATMENT	COMPOST									PLASTIC								
	1st survey			2nd survey			3th survey			1st survey			2nd survey			3th survey		
	A	P	ALL	A	P	ALL	A	P	ALL	A	P	ALL	A	P	ALL	A	P	ALL
1. row	4.0	12.0	16.0	10.3	38.0	48.3	15.9	23.1	39.0	0.0	1.9	1.9	0.0	1.5	1.5	0.8	1.1	1.8
2. row	9.5	22.3	31.8	10.6	28.3	38.9	28.0	30.8	58.8	0.0	1.1	1.1	0.3	1.0	1.3	0.8	0.5	1.3
3. row	2.3	11.8	14.0	11.0	21.3	32.3	12.5	40.0	52.5	0.0	1.1	1.1	0.3	1.1	1.4	0.7	1.0	1.7

TREATMENT	MANURE					
	2nd survey			3th survey		
	A	P	ALL	A	P	ALL
1. row	9.3	45.0	54.3	20.0	50.8	70.8
2. row	5.5	57.5	63.0	14.0	42.1	56.1
3. row	8.5	44.5	53.0	11.4	51.8	63.1

A= annual

P= perennial

The efficiacy of compost mulch against annual weeds was also recorded in the first survey, later weeds were developing in great quantity in the compost. The ratio of the annuals were increased. The typical species were field bindweed (*Convolvulus*

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arvensis), creaping thistle (*Cirsium arvense*), common ragweed (*Ambrosia artemisiifolia*) and barnyard grass (*Echinochloa crus-galli*) in the compost mulch.
In case of plastic cover weeds could appear only near trunks and at the edge of the covering material. At minimal coverage rate bindweed (*Convolvulus arvensis*) and dewberry (*Rubus caesius*) appeared (Lakatos and Bubán, 2004).
Manure treatments did not decrease the rate of weed cover, either annuals or perennials have a great coverage percent. All the species, found in the orchard were present in this treatment (Racskó, 2002).

The results of leaf area measures didn't show significant differences between treatments, but in all rows the highest numbers were observed in compost mulch.

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ASSESSMENT OF DIFFERENT SCENARIOS FOR POSSIBLE POINT SOURCE CONTAMINANT FLOWS, IN ARABLE LANDS

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Abstract: There are both industrial and agricultural possible contaminant point sources posing potential risk on the arable lands, such as pools for temporary slurry storage, however, in Hungary, red mud catastrophe represents a sad actuality of a point source contamination, affecting arable lands as well. It is evident, that preparedness for such situations is crucial, for each possible point source, since without assessing different scenarios for point source contaminant flows, the extent of risk for primary contamination as well as secondary one resulting from diffuse transport cannot be quantified. Potential paths of sludge or mud flows from point source in the vicinity of arable lands can be predicted by a series of simulations. For the vicinity of the red mud reservoir as the study area, its terrain model was used to determine the potentially affected area and risk mapping, using GIS techniques, i.e. Idrisi, ArcGIS, and some of its extensions. The model results were validated with real GIS data available for the red mud spill affected area. Such modeling of scenarios provides a basis for estimating the areas and levels of hazard that could be associated with any kind of spill from both industrial and agricultural point sources.

Keywords: risk, mud, flow, soil, surface pollution

Introduction

In October, 2010, a catastrophe in Hungary called the attention of the World to the risk posed by industrial fluid reservoirs. Among other types of catastrophes, such as volcano eruption, fluid chemicals spreading to the environment by accident can cause serious damages, sometimes affecting bigger areas, including arable lands as well. The above mentioned red mud catastrophe, besides several victims and damages in properties, affected circ. 2,000 acres of arable land. Fluid point sources in the vicinity of arable lands include e.g. slurry storage pools, and waste reservoirs for industrial and mining wastes. Though likelihood of catastrophes caused by damage in the structure of these reservoirs is small, risk needs to be evaluated to be aware of the possible consequences; Risk of environmental contamination from fluid reservoirs built at higher elevations cannot be ignored. Though, quite a few modeling techniques to represent the possible future spreading scenarios are available, most papers on risk assessment for surface fluid flow were published focusing on volcanic hazard assessment and hazard maps, based on flow simulations (e.g. Saucedo et al., 2005; Capra et al., 2008); on the other hand, several studies focused on hydrological modeling and flood inundation mapping for rivers (e.g. Merwade et al., 2008; Pregun and Juhász, 2008; Pregun et al., 2008; Saghafian, 2009), watershed modeling for prediction of surplus water, erosion, soil quality degradation, or contamination (e.g. Mars and Crowley, 2003; Tamás, 2005; Tamás and Lénárt, 2006; Kovács et al., 2011), and contaminant transport by streams (e.g. Hwang et al., 2001; Mark et al., 2008). The aim of this study was to present a GIS methodology to determine the possible accidental surface fluid flows from artificial reservoirs. Such methodology can help in predicting the fluid path for an accidental spill for any possible point sources of fluids, and risk maps can provide information on the area of the endangered agricultural lands as well.

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Materials and methods

For modeling of surface flow of a fluid from higher elevation, the watershed including an industrial point source, the red mud reservoir at Ajka, Hungary was used, since the methodology for the estimation of potentially affected arable lands under different circumstances could be validated with real dataset of the red mud spill and flood recently occurred (NASA EO-1 satellite image, 09.10.2010).
Since flow path of a fluid spreading from its reservoir is governed by the topography, a digital elevation model was used as a basis for the surface flow modeling (Turcotte et al., 2001). DEM with grid resolution of 10x10 m for the study area and its surroundings was generated from geo-spatial datasets available on the Internet. For watershed modeling, the IDRISI Antes software was used, while possible flow paths were calculated by using ArcGIS software and its Hec-GeoRas extension. In the flow path model, infiltration into the soil was ignored. The flow path model was validated with the vector map of the area flooded by the red mud.

Results and discussion

Based on the DEM, sub-watershed including the point source was determined by classification. For the study area, two separate sub-watersheds could be identified. Then, with the runoff option, the most probable flow line was identified. For validation, it was compared to the real red mud flow affected area. Visualization showed that where the calculated flow gets close to the border of the two distinct sub-watersheds, the flow path in reality deflected from the calculated one, and followed another way (*Figure 1.*).

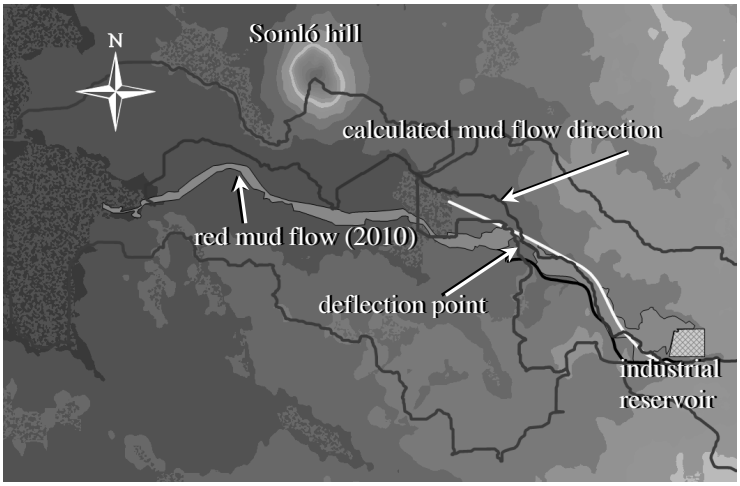

Figure 1. Validation of the flow path model (line of brown: watershed border; white: part of the rails; black: part of the road; purple: calculated mud flow direction; and orange: area affected by the catastrophe)

When analysing the reason and comparing the cross section at the deflection point, it became obvious, that the alternative flow path had almost the same probability, and man-made objects, i.e. rails had considerable effect on the direction of flow. The

identification of topographic obstacles acting as barriers to flow progression depends largely on the resolution of the DEM. Prediction for the possibly affected area can be improved if all man-made barriers are included in the calculation (Gómez-Fernández, 2000).
To analyze further the possible scenarios, paths of fluid flow were modelled from different starting points, including the perimeter of the possible point source, the reservoir. Results proved that the most probable flow line to the border of the sub-watershed including the point source is the same as occurred (*Figure 2.*).

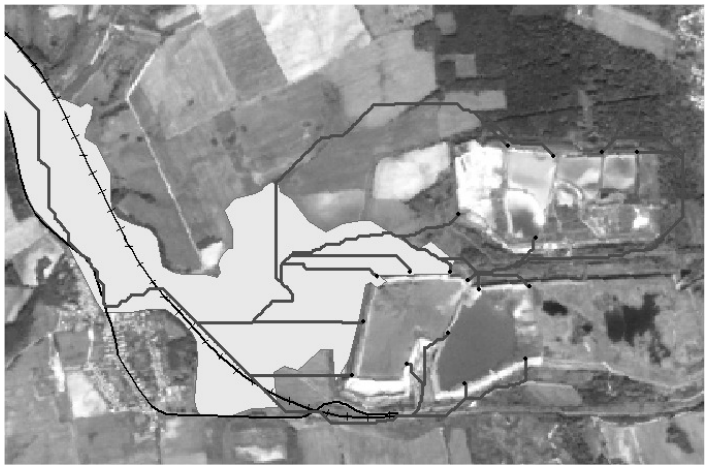

Figure 2. Possible flow path scenarios (indicated by red lines)

Regarding the area of risk in the vicinity of any industrial or agricultural reservoirs, it can be concluded that line objects, i.e. rails and roads have determinative effect not only on flow path, but on the extent of the affected area. In case of our study area, without the governing role of these objects, consequences could have been quite different.
Considering the applications of the flow path models, there can be several outcomes providing valuable information for decision-making, since such flow maps can be combined with any type of GIS database. By combination with a land-use database (e.g. CORINE, in Hungary), or a digital agricultural parcel identification system (e.g. MePAR, in Hungary), land-use units and parcels can be classified according to the risk of flood, while, combining with digital maps of soil properties (e.g. AGROTOPO, in Hungary), buffering capacity and vulnerability of the possibly affected area can be estimated, and applicable clean-up alternatives can be panned well in advance, to be prepared for any case. Furthermore, any change in topography by artificial objects, such as new dams, banks, or roads can also be integrated into the model, and its modifying effect on risk map can be calculated even in the planning period.

Conclusions

Risks on arable lands posed by point sources may be considerable, since there are several agricultural, industrial and mining reservoirs, containing high amount of fluids.

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Though proper risk handling and reduction with adequate controlling and maintenance result in low risk of any damage in such reservoirs, preparedness cannot be understated. And, today, many types of software as well as free databases are available for modelling and prediction, requiring only limited field work for validation. Our case study proved that the predictable flow paths based on a DEM are in high correlation with the expectable ones, and provide a quite reliable tool for risk mapping as well as protection of the agricultural lands.

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ABUSIVE LAND USE AND PROBLEM OF PLANT NUTRITION

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Abstract: The aim of our study is to give a brief overview about the effects of some industrial wastes on the physiological parameters of some crop plants. Sewage sludge, lime sludge and compost were examined and sunflower (*Helianthus annus L. cvs. Arena*) seedlings were used in the experiments. The filtrates of examined materials were added to the nutrient solution. These materials contain plenty of useful elements e.g. calcium (Ca), zinc (Zn), magnesium (Mg), iron (Fe). Moreover these wastes contain also some heavy metals e.g. chrome (Cr), manganese (Mn), lead (Pb). Relative chlorophyll contents and contents of elements were measured. Root – shoot ratio was calculated from dry matter accumulation of roots and shoots. The change of pH of nutrient solution was also followed. The pH of examined materials is alkaline: the pH of compost and sewage sludge are about 8 and the pH of lime sludge is higher – 10-11 pH. The dry matter accumulation increased when compost and sewage sludge were applied and decreased when lime sludge was added to the nutrient solution. The relative chlorophyll contents were about the control at compost and deceased at the sewage sludge and lime sludge treatments.

Keywords: crop nutrition, land use, industrial side - products

Introduction

Low-molecular-weight root exudates may mobilize mineral nutrients directly or indirectly by providing the energy for microbial activity in the rhizosphere. These root-induced modifications are of crucial importance for the mineral nutrition of plants. Although the chemical properties of the bulk soil are very important for root growth and mineral nutrient availability, the conditions play a very decisive role in mineral nutrient uptake in general (Marschner et al., 1986) and in micronutrient uptake in particular (Marschner, 1991a). Conditions in the rhizosphere are also of importance for the adaptation of plants to adverse soil chemical conditions, as occur, for example, in acid mineral soils (Marschner, 1991b). In soil-grown plants the rhizosphere in characterized by gradients which occur both in a radial and longitudinal direction along an individual root. Gradients may exist for mineral nutrients, pH, redox potential and reducing processes, root exudates and microbial activity. These gradients are determined by soil chemical and physical factors, and by plant factors such as species and nutritional status of the plants, and by microbial activity in the rhizosphere. The land application of sewage sludge is getting common in agricultural practice worldwide. It effectively disposes of a waste product while recycling valuable nutrient into the soil - plant system. We have to try to reuse more and more waste and side-products. The sewage sludge and compost are originating from poppy-shell based alkaloida production (ALKALOIDA Co. Chemicals Company). The sewage sludge was mixed to different shavings and used as a cover material of waste rock piles. The black shoot is originating from the chimney of incinerator, while the lime sludge is coming from metallurgy waste transformer plant. This work tries to give details for agricultural use.

Materials and methods

Sunflower *(Helianthus annus L. cvs. Arena)* were used in the experiments. The seeds were sterilized with 18% hydrogen peroxide, and then washed in distilled water. They

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were germinated on moistened filter paper at 25°C. The seedlings were transferred to continuously aerated nutrient solution of the following composition: 2.0 mM $Ca(NO_3)_2$, 0.7 mM K_2SO_4, 0.5 mM $MgSO_4$, 0.1 mM KH_2PO_4, 0.1 mM KCl, 1µM H_3BO_3, 1µM $MnSO_4$, 0.25 µM $CuSO_4$, 0.01 µM $(NH_4)_6Mo_7O_{24}$. Iron was added to the nutrient solution as Fe-EDTA at a concentration of 10^{-4}M. The filtrates of compost, sewage sludge and lime sludge were added to the nutrient solution in different quantities. 92 ml dm^{-3} was given from the compost, 97 ml dm^{-3} from the sewage sludge and 100 ml dm^{-3} from lime sludge to the nutrient solution because of different solution. The seedlings were grown under controlled environmental conditions (light/dark regime 10/14 h at 24/20°C, relative humidity of 65–70% and a photosynthetic photon flux of 300 µmol $m^{-2}s^{-1}$. The element content of filtrate and plants were determined by ICP. The relative chlorophyll contents were measured with SPAD 502 (Minolta). The number of laboratory readings for ICP was the mean of three samples, and SPAD 502 was 60. The samples were dried at 85ºC, the dry matter of shoots and roots were measured.

Results and discussion

The examined side-products were supplied in large quantities by the above-mentioned companies. The contents of some investigated elements are shown in *Table 1.*

Table 1. Contents of examined elements (Al, Ca, Fe, K, P, Zn) in compost, sewage sludge, lime sludge (mg kg^{-1})

Elements	Compost	Sewage sludge	Lime sludge
Al	7,227.00	17,349.00	3,440.00
Ca	223,500.00	123,988.00	278,400.00
Fe	9,883.00	21,098.00	118,500.00
K	1,485.00	2,878.00	1,010.00
P	10,063.00	21,289.00	162.00
Zn	251.00	473.00	106.00

The concentration of Al is approx 5 times higher in the sewage sludge than in the lime sludge and 2.5 times higher than in compost. The large Al content may cause inhibition effects of growth of roots. The toxic actions of Al are primarily root-related (Taylor, 1988).

The contents of calcium and iron are the highest in the lime sludge. It is originated from its emergence because the melted metallurgy is mixed with lime and the main compound of lime is calcium. The sewage sludge contains approx twice fewer Ca than lime sludge. The content of Fe is about 12 times higher in the lime sludge than in compost and approx 5 times higher than in sewage sludge.

The amounts of K, P and Zn are very high in the sewage sludge. These quantities are twice higher in the sewage sludge than in compost.

These elements have advantageous and disadvantageous effects on the growth of plants. The distribution of elements in the shoots and roots of sunflower were also investigated (*Table 2.*)

Table 2. Concentration of examined elements (Al, Ca, Fe, K, P, Zn) in the shoots and roots of sunflower seedlings (mg kg^{-1}) effecting by compost, sewage sludge and lime sludge

Elements	Compost		Sewage sludge		Lime sludge	
	Shoot	Root	Shoot	Root	Shoot	Root
Al	12.74	780.33	7.44	368,33	16.53	437.33
Ca	26,401.00	3,082.00	23,959.67	3,389,33	34,021.67	3,918.33
Fe	129.66	1,147.33	111.00	887.33	164.00	798.33
K	51,177.67	42,299.67	38,632.00	4,3415.00	40,078.67	54,876.67
P	5,152.66	6,104.66	4,202.66	6,324.66	4,945.00	7,625.00
Zn	34.20	55.83	24.66	45.90	23.93	46.96

The pH is one of the most limiting factors of nutrient-uptake. Root induced changes in rhizosphere pH are also related to the nutritional status of plants. The pH of compost is 8.79, the pH of sewage sludge is 8.83 and at the lime sludge this value is 10.77. The lime sludge has a strong alkaline effect. The changes of pH of nutrient solution were measured. The pH of nutrient solution changed effected by examined materials. The pH is decreased at the compost and increased at the sewage sludge but not significantly comparison to the control (results are not shown) and it was decreased at the lime sludge.

Larger concentration aluminium (Al) was measured in the roots than in the shoots. It was approx 22-folds higher at the compost, approx 50 times higher at the sewage sludge and 12 times higher in the roots of sunflower which were treated by lime sludge. The quantity of iron (Fe) is the largest in the roots of sunflower treated by compost. It is twice higher than at the control. The concentration of potassium (K) was higher in the shoots than in roots at the compost treatment. But, at the sewage sludge and lime sludge larger concentration K were measured in the roots than in shoots. Potassium is a cation that appears in the largest quantities in plants. Potassium plays a very important role e.g. in the frost tolerance of plants (Hsiao and Läuchli, 1986). Larger concentration phosphorus (P) was measure in the shoots of sunflower in case of compost and sewage sludge treatments. The P content of roots was higher in case of lime sludge than in the control plants.

Differences were observed also in dry matter accumulation of sunflower seedlings during the experiment (*Table 3.*). The shoot/root ratio was the highest at the compost treatment. This value also increased at the sewage sludge and lime sludge treatment comparison to the control. The dry matter accumulation of shoots and roots increased at the compost and the dry matter accumulation of roots was control value in the case of sewage sludge. The ratio of shoot to root growth varies widely between plant species, during ontogenesis of plants, and it strongly modified by external factors. When parts of the shoots are removed, plants tend to compensate this by lower root growth and returning to a ratio characteristic for the species. However, there is some controversy as

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to whether this reflects functional equilibrium between roots and shoots (Klepper, 1991).

Table 3. Effects of different matters (compost, sewage sludge, lime sludge) on the shoots/ roots ratio of sunflower seedling (g plant^{-1})

Treatments	Shoot		Root		Shoot/root	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
control	0.960	0.169	0.212	0.042	4.571	0.070
compost	1.130	0.160	0.220	0.140	5.136	0.060
sewage sludge	1.030	0.360	0.210	0.120	4.904	0.050
lime sludge	0.880	0.220	0.180	0.010	4.888	0.060

Low chlorophyll contents affect photosynthetic activities. The decreasing dry matter accumulation can be explained by the lower level of the chlorophyll contents.
The relative chlorophyll contents did not change between the 13th and 15th days. The relative chlorophyll content decreased significantly when lime sludge was applied, and on the 13th day when sewage sludge was used (results are not shown).

Conclusions

The investigated materials contain some useful elements for plants. Most of these elements are localized in the roots and not transferred into shoots. The dry matter of shoots increased when compost and sewage sludge were applied. It was significant change when compost was used. The dry matter accumulation of shoots and roots are below the control, when lime sludge was given to the nutrient solution. The dry matter accumulation of roots decreased significantly when plants were treated by lime sludge. After due consideration and more sufficient measurements there is a possibility of widely usage of investigated materials in the plant nutrition.

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LAND USE TRANSFORMATION OF JAKUBIANY WILLAGE (CASE STUDY FROM SLOVAKIA)

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Abstract: The structure of cultural landscape is a result of long-lasting process of coinfluence of human beings and nature in the historical development. In Slovakia the most intensive changes of landscape structure were realized over the 40 - 50 years. A new wave of changes in cultural landscape structure was realized mainly over the last too decades, predominantly in the submountain areas. These changes are considered as positive from the aspect of ecological stability of landscape. The ecological stability has increased in the last decade. Due to the stoppage of excessive use of artificial fertilizers, pesticides, herbicides, heavy equipment. The biodiversity and retentive ability of the landscape have increased and the soil erosion as well as the danger of floods have decreased. The negative consequences are reflected as dilapidation of landscape in visual sense.

Keywords: land use, land cover, land utilization, synergizmus

Introduction

Central-European literature on geography often misuses the term land use and the term land utilization. In English literature the term land responds to the term landscape, i.e. land use does not mean only land utilization, but this is the term of much wider comprehension. It could be expressed by the formula: Land use = land cover + land utilization (Burley, 1961; Feranec and Oťahel', 2001). The primary term land use contains the information concerning not only soil - utilization in the landscape, but also information on characteristics of individual geospheres building the landscape and their mutual relations. It also contains information on past and present management of the society. Land use is a result of synergism not only physical-geographical factors but also economic, institutional and sociological, which depend on the level of the society development.

Materials and methods

Methodology is oriented towards the research of the primary geoecological structure of the cadastral territory (terrain research). Secondary landscape structure was characterized on the base of historical and recent maps and terrain research. It concerns the categories of land use (genetic analysis) and their synergy with the site characteristics. Changes in structure of the land cover show, in the best way, the changes in the land use. Changes of this structure are differentiated in dependence on physical-geographical and human-geographical factors and conditions.

Results and discussion

This study focus on the factors and conditions, which influenced land use in foothill rural, pastoral-agricultural settlement Jakubany and induced irreversible changes.

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Primary land use was in synergy with its natural structure, was adapted to unfavorable natural conditions and inhabitants of the settlement were able to sustain themselves. Regarding substinence, the most important was mountainous area in Levoča hills, with 32% of meadows, 10% of pastures (seasonal pastoralism) and the rest was created by forests (*Table 1.*). More valuable, but a little productive soil in Jakubany furrow presented place for growing the most important food article, potatoes and fodder plants for animals. The upper border for agriculture reached height 1000 m above sea level but this potential was not sufficient for the growing number of population (in 1870 - 1930 2878 inhabitants immigrated to the oversea, sociological factor associated with land use).

The change in harmonic structure of land use - synergy - came in 1953, caused by institutional factors. About 75% of cadastral area was occupied by army district Javorina (*Table 1.*). The aim of the communist state authority was to liquidate the settlement and use it for army purpose exclusively. This intention was not successful. The resistance of inhabitants was, in spite of totalitarian regime, very strong.

Much more later, like in another settlements, there was established incorporated agricultural cooperative in Jakubany (1979). The area of the cooperative streched in cadastral territory (*Table 1.*) reduced of its mountainous part. This institutional change and economic factors and conditions of market economy brought next changes in land structure and its use. The most of arable soil was changed into permanent grass overgrowth mainly after 1989, when agricultural cooperative specialized in dairy farming. Additional function is presented by medicinal plants growing on the arable soil. Grassing of the area moderated soil erosion and stabilized geomorphological processes on the slopes. Regarding land use synergism this specialization is the only one possible and adequate way in relation to all factors and conditions affected in the region (*Figure 1.*). On January 1st 2011 army area Javorina was broken and land use could be broaden in forest management and tourist trade in interesting natural surroundings (genius loci), which was during historical development modified by a man according to his needs.

Review of land use in Jakubany shows, that it depends mostly on the site but also on another factors and conditions, which must be regarded. Agriculture is an artificially created ecosystem, where complicated relations work. Physical-geographical structure of the region, natural landscape potential, represents only one part of the relations in the system used by a man. In accordance with the level of society development the capacity can be increased or spreaded (which is limited, to a certain extent, by effective capacity of natural - spatial potential in a relation to the demands, resulting from social-reproductive processes) by the suitable way of land management, On the other side, unsuitable human intervention to this structure can limit or damage effective capacity of the natural potential. It happens most often when geo-ecological principles in agricultural landscape are not respected. The most important element, from synergism point of view site - land use, in agricultural landscape is soil. It is an offer of one element for land use, but it is connected with all natural content of the landscape which responds to the use in topic site structure interconnected with choric landscape structure.

Table 1. Changes in land use

Land use	1946 ha	1946 %	1953 ha	1953 %	2010 ha	2010 %
Arable land	1301	19,8	1301	80,8	130	8.08
Meadows	1709	26,0	119	7,4	1270	79.0
Pastures	577	8,7	80	5,0		
Forests	2823	43,0	23	1,4	120	7.50
Gardens	2	0,03	2	0,12	5	0.12
Non-produktive area	165	2,5	85	5,3	85	5.30
Sum	6577	100	1610	100	1610	100

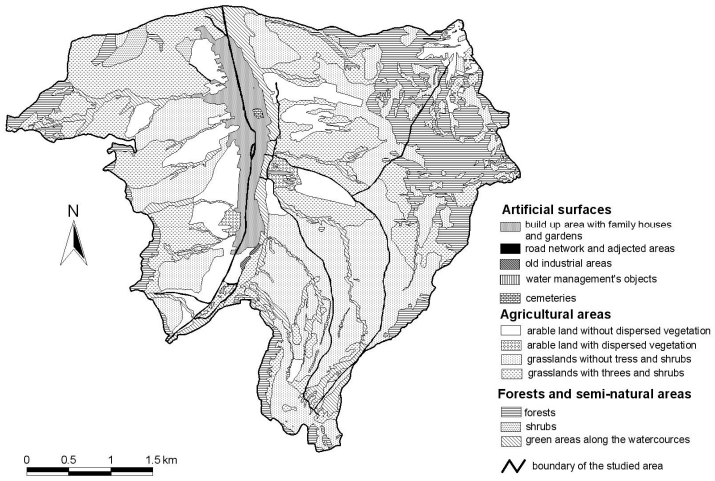

Figure 1. Land use in Jakubany - year 2010

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Conclusions

Cadastral area of Jakubany passed difficult process from land use point of view. Land use structure was changing according to the sociological and institutional factors and conditions. Less favourable natural-physical-geographical conditional and factors were given and inhabitants adjusted to them by sophisticated change in land use, e.g. seasonal point of view, in spite of it, unproportional increase of population caused significant immigration. Inhabitants of Jakubany, as a social group, belonged to conservative communities and kept classic, private farming land management in their area for relatively long time. Farming did not use chemicalisation and heavy mechanism for soil cultivation. Natural potential of the area, with the exception of slight soil erosion, was preserved in relatively better geo-ecological condition than in another regions. This base was a very good precondition for medical plants growing in ecologically clean surroundings and in BIO-quality. In 1998 company Calendula,a.s. was established in Nová Ľubovňa. This company processes cultivated medical plants for extracts, essential oils, nutrition supplements and cosmetic preparations.

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BIODIVERSITY AND ENVIRONMENT QUALITY IN THE CONDITIONS OF ECOLOGICAL FARMING ON SOIL

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Abstract: The research focuses on evaluation of effect of ecological farming system on maintenance and improvement of biodiversity in arable soil and adjacent ecosystems, as well as on preservation of environment quality and not exceeding the limits of pollution. The research was performed in model area in the production conditions of northeast Slovakia during 2008-2010. The evaluated area is situated in cold climatic region (daily temperatures above 10 ºC ranging from 1600-2000, average precipitation 700-1200 mm). Physical (bulk density, porosity), chemical (soil pH, Cox, nitrogen, phosphorus, potassium, magnesium, lead, cadmium, zinc, copper) and biological (soil enzymes activity) soil parameters were monitored and statistically evaluated, as well as the diversity of overgrowth on arable soil and adjacent ecosystems. The results of the research proved synergic effect of ecological farming system on monitored parameters related to the evaluation of soil quality and ecosystems biodiversity.

Keywords: agro-ecosystem, physical properties, chemical properties, biological properties, biodiversity

Introduction

Farming system is the most widespread enviro-technology with its positive and negative consequences. It utilizes basic natural source and at the same time influences its natural environment. Therefore, biologization of the farming system is of highest interest of farmers and environmentalists (Várallyay, 2006; Macák et al., 2009). For evaluation of soil quality, standard characteristics of soil environment – physical, chemical and biological are used. From among the physical ones, they are bulk density, porosity, water retention capacity, soil temperature etc. To chemical characteristics belong total carbon and nitrogen content and available nutrients content. Evaluation of biological parameters focuses on microbial mass and its activity, soil respiration, potentially mineralised nitrogen, soil enzymes activity etc. The enzymatic activity can be used as a microbial indicator of soil quality, because soil enzymes activity is in a close relation to important soil characteristics (Javoreková et al., 2008). To the agricultural area assessment at the present time belongs also determination of state and changes of biodiversity, which increases along with ecosystem and species diversity. The aim of the paper was to evaluate the effect of ecological farming system on maintenance and improvement of biodiversity in arable soil and adjacent ecosystems, as well as on preservation of environment quality and not exceeding the limits of pollution.

Materials and methods

The research project was carried out during the years 2008-2010 in production conditions in the investigated area Liptovská Teplička (48° 57' N; 20° 05' E), situated in marginal region of north-eastern Slovakia. Ecological farming system has been applied here since 1996. The climate is relatively homogeneous. The whole area is situated in the mild zone with sum of average daily temperatures above 10 ºC ranging from 1600 to 2000 and average precipitation of 700-1200 mm. The soil conditions are relatively homogeneous, the largest area being represented by cambisols mostly moderate and

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strongly skeletal, mainly in subsoil. The second most common type of soil is rendzic, moderate, shallow and skeletal. In addition, histosols occur in this territory. From the point of view of relief, the majority of the land is situated on the slopes. In the current crop structure cereal acreage represents 33.3%, potatoes 16 to 18% and fodder crops 49.8%. Arable land is fertilized with manure dosage of about 30 t ha^{-1} once in two years.

The soil samples for physical, chemical and biological soil properties determinations were in springtime in connected coppice, on six permanent research sites, from the depth of 0.05 to 0.15 m. We studied and evaluated the bulk density [t m^{-3}] and porosity [%] in Kopecky physical cylinder with a capacity of 100 cm^3. From among the chemical soil characteristics, we monitored and evaluated soil reaction in 1N solution KCl and $CaCl_2$, inorg. nitrogen, available phosphorus, potassium, and magnesium according Mehlich III., organic carbon according Ťurin (Fiala et al., 1999). Monitored biological soil characteristics were activity of acid and alkalic phosphatase and urease. Activity of phosphatases was assessed according the Chazijev's method modified by Grejtovský (Grejtovský, 1991). For urease activity assessment, method modified by Galstjan in Chazijev (Chazijev, 1976) was used. Content of heavy metals – Cu, Pb, Cd, Zn were determined by atomic absorption spektrometry, after extraction from soil by 1 mol l^{-1} of NH_4NO_3. On the permanent research areas (4 x 4 m), semiquantitative analysis of present taxa was performed. Taxa present were assessed according to Braun-Blanquet's scale. Nomenclature is presented in accordance with Dostál and Červenka (Dostál and Červenka, 1991). Hill's index of diversity (N2) was used for diversity calculation, and the results were evaluated based on the scale according to Jurko (Jurko, 1990).

Obtained data were statistically processed using analysis of variance from StatGraphic package.

Results and discussion

Physical soil properties change not only under the influence of weather conditions, crop year, vegetation pass, but also under the influence of applied management system. Bulk density is most sensitive to changes of environmental conditions, which was proved in the present study. Values of bulk density ranged between 0.87-1.33 t m^{-3} (*Table 1.*), which means better values compared to average values for this soil type, as Líška et al. (2008) states. Porosity corresponded with bulk density, it reached optimal values for plant growth during the research period (49.93-67.04%).

The chemical parameters are considered relatively dynamic (pH, nutrient content), in terms of plant growth and development they are inevitable and their deficiency is reflected on the crop production. At the same time they serve as indicators of additional inputs in form of fertilizers (Kováčik, 2001; Molnárová, 2009). Sustainable farming systems exclude, resp. reduce artificial fertilizers use, therefore, it is necessary to pay attention to dynamics of chemical soil parameters changes in order to prevent one-way draining of nutrients, particularly phosphorus and potassium. This assumption was confirmed by our research, in which the decrease of soil phosphorus was observed.

The amount and quality of enzymes in soils is dependent on their characteristics, number and forms of organic matter and activity of microflora. The values of

phosphatase and urease changed minimally during research period and refer to the values typical for soils with sparse vegetation. The results of measurements of soil activity in years 2008-2010 showed minimal differences, which proved that increasing the amount of organic soil matter promotes the preservation of natural soil enzymes (Burns, 1978).

Important factor of environment quality is non-exceeding the limits of pollution (Šoltysová et al., 2010). The conten of Cu, Pb, Cd and Zn exceeded the limit values pulished in Act No. 220/2004 Coll.

Analyses of variance (*Table 1.*) confirmed the significant effect of tested factors on content of available soil nutrients – phosphorus, potassium and magnesium. On all further tested soil parameters factors had statistically significant effect.

Table 1. Analysis of variance of soil physical, chemical and biological parameters

Parameter	Min.	Max.	Mean	Standard error	P significance
Bulk density [t m^{-3}]	0.87	1.33	1.13	0.0202	++
Porosity [%]	49.93	67.04	57.43	0.7535	++
pH	5.30	7.17	6.44	0.0295	++
C_{ox} [%]	2.30	4.94	3.43	0.0701	++
$N_{inorg.}$ [mg kg^{-1}]	15.57	40.43	26.63	2.1569	++
P [mg kg^{-1}]	9.99	126.01	62.94	4.2119	+
K [mg kg^{-1}]	130.07	441.60	252.61	14.2753	+
Mg [mg kg^{-1}]	236.85	325.82	287.28	5.3938	+
Cu [mg kg^{-1}]	2.116	3.811	3.013	0.1504	++
Pb [mg kg^{-1}]	7.383	15.895	9.535	0.2976	++
Cd [mg kg^{-1}]	0.105	0.369	0.219	0.0164	++
Zn [mg kg^{-1}]	7.959	56.385	27.710	4.2888	++
Urease [mg NH_4^+ - N g^{-1} 24 $hour^{-1}$]	0.366	0.608	0.506	0.0060	++
Acid phosphatase [µg P g^{-1} 3 $hour^{-1}$]	236.123	306.011	279.311	0.9299	++
Alkaline phosphatase [µg P g^{-1} 3 $hour^{-1}$]	239.255	294.745	270.100	1.3229	++
Count	72				

$^{++}P< 0.01$ $^{+}P< 0.05$

The simpliest expression of species richness is the number of species in the record per unit of area. During the research period, 43 plant species beloning in 20 families and 39 genera were found on research localities. The highest species diversity (22 species) was recorded on permanent grasslands. Besides the arable crops, there were 10 to 16 species recorded on the arable soil. The dominant genera were *Alchemilla, Phleum, Trifolium*. Weedy plants coenoses found on arable soil do not pose a threat to arable crops and their outcompetiton from the stand. The coverage of individual weed plants found was under 5% (*Alchemilla* spp., *Taraxacum officinale, Veronica chamaedrys, Galium uliginosum, Ranunculus acris, Myosotis palustris, Euphrasia tatarica*), or negligible (*Plantago major, Capsella bursa pastoris, Achillea millefolium, Viola pratensis, Potentilla anserina, Stellaria media*). Using Hill's diversity index we calculated an average value (6.94), which corresponds with the value for double scythed stands in conventional farming system (Skládanka and Hrabě, 2008).

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Conclusions

In soils with ecological farming systems, in the structures that are dominated by perennial fodder crops, as well as sufficiently high doses of organic fertilizer, positive changes of soil physical properties are observed, soil reaction is maintained, available nutrients content with the exception of phosphorus and retention of humus in soil and non-exceeding the limits of soil pollution. The values of activity of phosphatases and ureases changed minimally during the research period and they refer to the values typical for soils with sparse vegetation. At the same time, it was proven that increasing the content of soil organic matter promotes natural protection of soil enzymes. Analyses of variance confirmed the significant effect of tested factors on content of available soil nutrients – phosphorus, potassium and magnesium. On all further tested soil parameters factors had statistically significant effect. The coenoses of weedy plants as well as individual plant species do not constitute serious threat to the agricultural production. We can consider them to be enrichment of species compositon and enhancing total stability of agroecosystem. The results of the research proved synergic effect of ecological farming system on monitored parameters related to the evaluation of soil quality and ecosystems biodiversity.

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OPTIMALIZATION OF LAND USE IN SILAGE MAIZE PRODUCTION BY MAXIMIZING DIGESTIBLE ORGANIC MATTER YIELD PER UNIT AREA

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Abstract: The natural and economical facilities of Hungary are very favourable for the agriculture, principally crop production. We must save our land resources because the urbanization and the improving infrastructure require more and more territory. It is a big challenge for agriculture to use the decreasing crop area effectively. Within the whole crop area the proportion of cereals and industrial plants are increasing at the expense of fodder crops. The number of livestock – including ruminants – can be increased only if enough forage is available. One thing underlying this is the optimal land use by producing good quality, effectively digestible forages with high energy content. The main objective of silage maize production is to maximize green and dry matter yield per hectare. One way to improve yield is to grow more plants per hectare or improving the canopy of the plant by increasing the number of leaves or the size of the ear. However, plant density and modified morphology do not guarantee the good quality of forage. We must take into consideration the chemical composition and the digestibility of plants as well. In silage maize breeding program in Martonvásár we study not only the morphological and agronomical traits of our hybrids but the chemical quality, digestibility and metabolizable energy content. The results show that among the chemical components the protein content improves and fibre content worsen digestibility. The correlation between lignin content and effective degradability is strong and negative. If we want to produce more digestible organic matter per hectare we must increase protein content and decrease fibre and lignin content.

Keywords: silage maize, yield, digestibility

Introduction

Silage maize is the most important forage of the ruminants. The volatile fatty acids produced during digestion of it are the bases of milk production. One way to improve forage yields per hectare is to apply higher plant densities or to grow taller hybrids with larger ears or more leaves. Modifying the morphology of the plants through changes in the ratio of different plant parts itself does not influence the quality of silage, it is important to improve the chemical composition and digestibility of each part (Verbič et al., 1995). The ear - mainly the kernel - contains the most nutrients, so the main task is to increase the ratio of the ear in the plant dry matter. Among plant parts, this fraction has the best digestibility (Tang et al., 2006; Estrada-Flores et al., 2006). The digestibility of the leaves is also very good (Sun et al., 2009; Tang et al., 2006) and they contain many nutrients, such as protein or minerals (indicated by crude ash content), so increasing the proportion of this fraction is also favourable for good digestibility. Breeding leafy hybrids (Shaver, 1983) can benefit from this. According to literary data, cows feeding on silage made of leafy hybrids produce more milk with better quality compared to those of conventional hybrids (Clark et al., 2002; Thomas et al., 2001). The digestibility of the stem is the worse among plant parts, especially the below-ear fractions, since they contain the most of the lignin (Boon et al., 2008). This can be compensated by rising cutting height, but this is effective only in the case of leafy hybrids, because they still have enough dry matter due to the larger number of leaves compared to normal hybrids (Lewis et al., 2004). The other way of producing more nutrients per unit area is to improve digestibility of the forage. This requires not only

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the improvement of the chemical composition of the whole plant, but the proportion of the different plant parts and their digestibility as well.

Materials and methods

The aim of our work was to study the yield, chemical composition and digestibility of the whole plant and the different plant parts of silage maize hybrids bred in Martonvásár. We tested eight hybrids with different type and different maturity in a randomised complete block design experiment with four replications during 2002-2003-2004, in Martonvásár. The experiment was sown according to 80.000 plants per hectare. The same agrotechnology was applied every year, including irrigation. During the vegetation period we recorded data of the morphological and agronomical traits of the hybrids (not published here). Harvest was performed 40 days after flowering at silage maturity stage, at 35% dry matter content on average. Green and dry mass of the whole plant and the different plant parts were measured. The Weendeii analysis to measure chemical contents of the samples were performed according to the standard MSZ. 6830. Effective and potential degradability was measured *in vivo* by feeding trials on fistulated sheep. Statistical analysis of data was completed by using the software "Agrobase".

Results and discussion

Results show that the proportion of the leaves in the total plant dry matter is greater in the leafy hibrids compared to the others, and the proportion of the stem below the ear is minor due to the lower ear attachment height (*Figure 1.*). The yield of leafy hybrids is not different from the average mean, because these two effects compensate each other. The stem contributes to the dry matter yield in the highest degree (Lewis et al., 2004). The greatest green and dry matter yield was measured for *Mv 2*, and this hybrid had the biggest proportion of the stem. The ratio of the ear fraction was more than 60% for each hybrid, which is a very good result (Józsa, 1981).

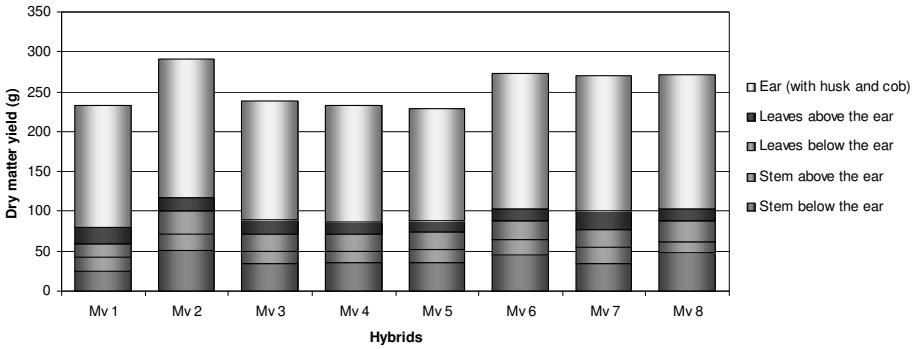

Figure 1. Dry matter yield per plant and the proportion of the different plant parts in the dry matter

The chemical composition of the different plant parts was studied in details for three hybrids. The differences between the hybrids were less than between the plant parts, similarly to other results (Masoero et al., 2006). The lignin content was least for the ear fraction, while the crude protein and crude ash content was the greatest for the leaves (*Table 1.*). This corresponds to earlier literary data (Estrada-Flores et al., 2006; Thomas et al., 2001; Bal and Bal, 2009). The crude fibre content was the greatest for the stem, especially the stem below the ear. Digestibility was mostly affected by the lignin content. A negative correlation (r=-0.35) was found between the two values, similarly to other results (Riboulet et al., 2008). If we define the lignin content as a percentage of the crude fibre content, the correlation gets very strong (r=-0.91). There was also a moderate positive correlation between the crude fibre content and digestibility. There were not statistically significant correlations between the other chemical composition traits and digestibility, but the hybrids with best digestibility had high crude protein content.

Table 1. Chemical composition of the different plant parts (g per 100g dry matter)

	Stem below the ear	Stem above the ear	Leaves below the ear	Leaves above the ear	Ear (husk and cob)
Crude protein	2,79	2,85	8,83	8,03	5,09
Crude ash	5,08	5,10	10,50	10,03	2,03
Crude fat	1,03	1,12	2,96	3,00	3,51
Crude fibre	31,36	29,57	28,80	23,17	7,50
ADF	39,22	36,17	32,43	29,00	8,60
Lignin	5,37	7,90	3,40	3,00	0,97

Mv 4 and *Mv 8* hybrids had the best effective and potential degradability values. The high-yielding hybrid *Mv 2* had the poorest digestibility, resulting in a lower digestible dry matter yield per hectare than *Mv 4*, which hybrid produced lower yields but had better digestibility (*Figure 2.*). The greatest effective digestible dry matter yield per hectare was recorded for *Mv 8*.

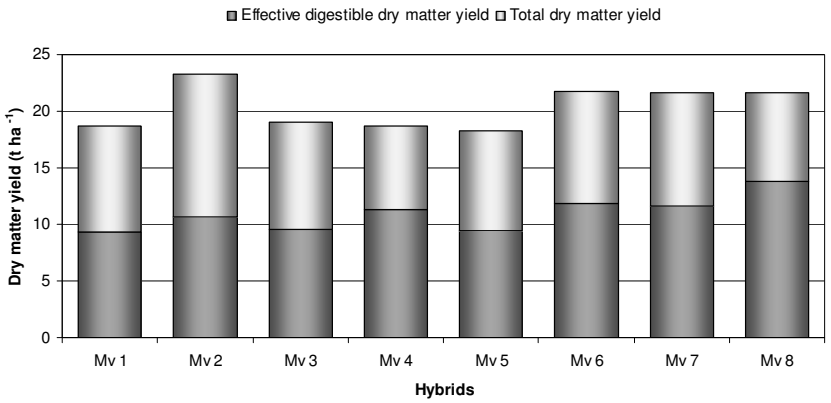

Figure 2. Total and effective digestible dry matter yields of the hybrids per hectare

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Conclusions

Digestibility was affected negatively by lignin content and positively by crude protein content. Leaves had the highest protein content. Lignin content was high in the stem below the ear and low in the ear fraction. This means that decreasing the proportion of the stem below the ear in the total dry matter and increasing the proportion of the ear and the leaves can result in a better digestibility of the forage. The digestible dry matter yield per hectare does not only depend on the dry matter yield but even more on the digestibility of the plant.

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CHANGES OF SOIL SURFACE PROPERTIES IN RYE ISLAND LOCALITIES (SLOVAKIA) DURING YEARS 1999–2009

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Abstract: The upper boundary condition defined by physical and hydrophysical properties of the surface layer of soil is very important in the development of soil water regime and in its evaluation by mathematical models. These characteristics include the volumetric water content of this soil layer. The mass water content *w* of unspecified volume of soil and the soil dry bulk density is usually used in practice to estimate the volumetric water content of soil. There were obtained the courses of dry bulk density in individual soil profile layers 0-5cm and 5-10cm under soil surface in two sites of The Rye Island during years 1999-2009. Both of the sites are with grassy vegetation – Bac and Cilizska Radvan. The values of dry bulk density are very variable during this observation period. Calculation of volume water content of soil using average value of dry bulk density and actual mass soil water is not suitable method.

Keywords: soil, water regime, volumetric water content, mass water content, dry bulk density

Introduction

The upper soil layer or directly the soil surface changes its basic physical and hydrophysical properties also during year. It produces a low conductive soil layer during extreme drought. The layer is not able to transfer major precipitation to lower layers despite the fact that there is a high water potential gradient (Lichner et al., 2008) Minor precipitation soaks very slowly under the soil surface and it is usually very soon evaporated (Gusev and Novak, 2007). The cracks and preferred ways are forming.
Major precipitation produces floods, sometimes only local. The flood water can flow off through preferred ways into deep soil horizons flowing by the horizons that are important for supplying of the plant canopy (Birkás et al., 2009; Koltai et al., 2008). Sometimes the water can flow off along prefered ways down to ground water. If water does not flow off at major floods, a water layer on the soil surface is produced and it prevents the soil from air infiltration and changes the soil surface structure. The dry bulk density and the other physical and hydrophysical characteristics are changed. If the soil is not cultivated the changes are irreversible. If ground water tables do not influence water transfer in soil horizons important for the plant canopy, the plants in lowlands areas are dependent only on the water that inflows to the soil profile through the soil surface. It is important to quantify changes of characteristics of the soil surface layer that changes from being very dry into water saturated and to obtain the volumetric water content of this layer during the whole of year (Sinóros-Szabó et al., 2010)
The mass water content *w* of unspecified volume of soil is usually used in practice to estimate the volumetric water content of soil. The volumetric water content can be calculated using mass water content *w* and dry bulk density ρ_d from relationship (1). ρ_d is usually measured only once or its value is choosen from database.

$$\theta = \rho_d w \quad (1)$$

θ is volumetric water content [$cm^3 cm^{-3}$]; *w* is mass water content [$g\ g^{-1}$] and ρ_d is dry bulk density [$g\ cm^{-3}$].

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The aim of this work is to obtain the time dependences of dry bulk density and volumetric water content in individual soil profile layers 0-5cm and 5-10cm under soil surface in various localities of The Rye Island during years 1999-2009. It will be also assessed the suitability of method based on equation (1) for estimating of volumetric water content of soil layers mentioned above.

Materials and methods

Two sites of Rye Island were selected for the purpose of studying the changes of soil surface properties. There are Bac and Cilizska Radvan. Both sites are used for agricultural and monitoring of soil water regime is made here since 1999. Soil near the surface in Bac is loam, passing into sand-loam and in the depth of about 90 to 100 cm is sand and then gravel. The soil profile is considerably layered The water table often was moving in the gravel and soil water regime was not affected by it. The soil profile in Cilizska Radvan is not so layered. Soil gradually passed from the clay-loam to loam, sandy and about 160 cm of depth in the gravel. During the year the water table is mostly over gravel layer or above the sand, suggesting that soil water regime is influenced by it. Soil samples were collected from the sites which during the years 1999 – 2009 were not cultivated but there were grassy vegetation. The values of dry bulk density were changed only due to natural environmental changes (as the result of weather changes). The volumetric water contents of soil surface layers 0-5 cm and 5-10cm were obtained by gravimetrical method. At the same time were also measured dry bulk density of soil surface layers.

Results and discussion

The values of dry bulk density of soil in both sites during years 1999, 2005, and 2009 are shown in *Figure 1.* Courses of soil dry bulk density during years 2000 – 2004 and 2006-2008 are very similar as in above mentioned years. Linear approximations of these courses are very different as can be seen from coefficients of correlation. In some cases, the tendency of the courses are increasing andalso decreasing. This implies a very low statistical correlation whole set of values measured during the years 1999 -2009 for both layers and sites, *Figure 2.* Volumetric water contents of both soil layers and both sites measured during years 1999-2009 are shown in *Figure 3.*

The volumetric water contents of soil in Bac varied in the intervals (0.0224-0.5522) cm^3 cm^{-3} with average value 0.2139cm^3 cm^{-3} in layer 0-5cm and (0.024-0.5698)cm^3 cm^{-3} with average value 0.2339 cm^3 cm^{-3} in layer 5-10cm, the soil dry bulk densities varied in intervals (0.8911-1.8051)g cm^{-3} with average value 1.3822g cm^{-3} in layer 0-5cm and (0.9315-1.8411) g cm^{-3} with average value 1.4700g cm^{-3} in layer 5-10cm.

The volumetric water contents of soil in Cilizska Radvan varied in the intervals (0.011-0.5226cm^3 cm^{-3} with average value 0.2469cm^3cm^{-3} in layer 0-5cm and (0.031-0.5543) cm^3 cm^{-3} with average value 0.2878 cm^3 cm^{-3} in layer 5-10cm, the soil dry bulk densities varied in intervals (0.7619-1.6519) g cm^{-3} with average value 1.2762g cm^{-3} in layer 0-5cm and (1.0391-1.88) g cm^{-3} with average value 1.4700 g cm^{-3} in layer 5-10cm.

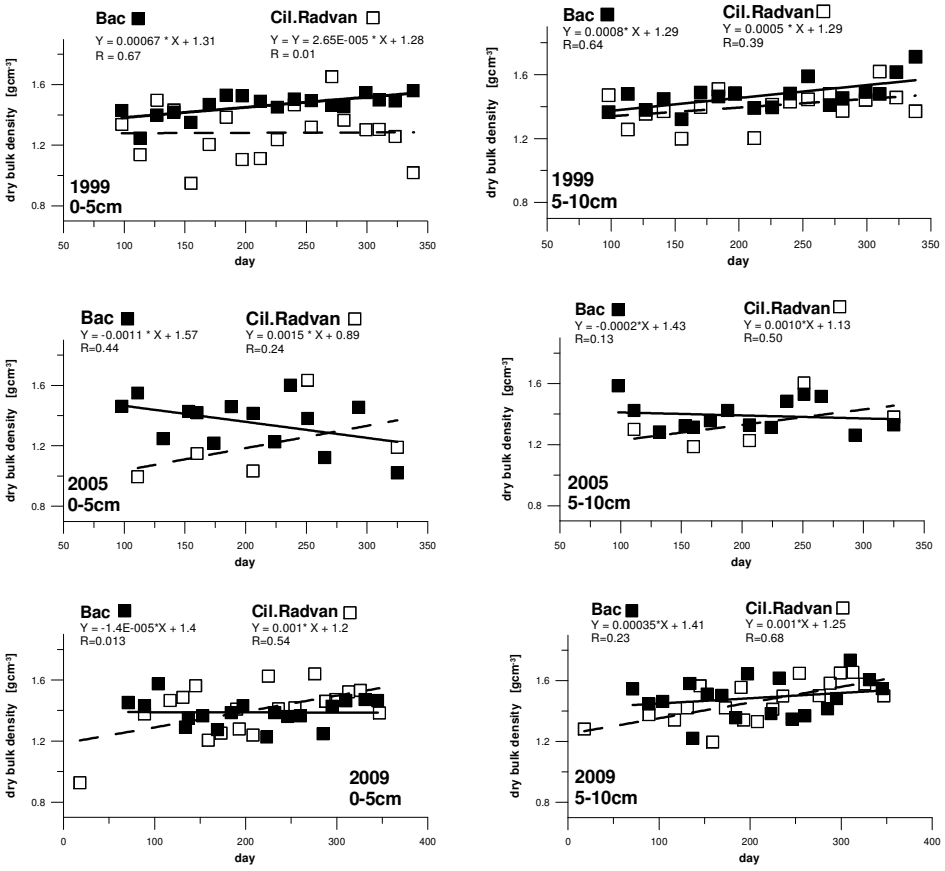

Figure 1. Course of soil dry bulk density in sites Bac and Cilizska Radvan during years 1999, 2005 and 2009.

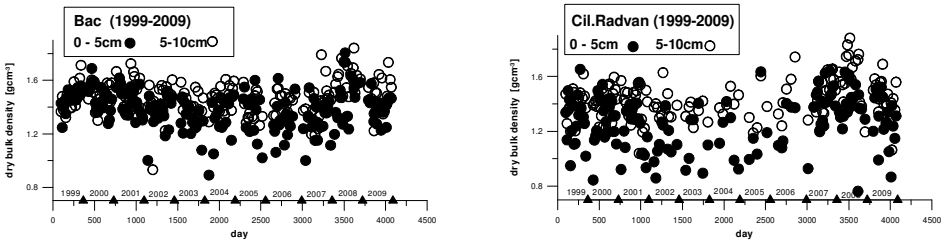

Figure 2. The values of dry bulk density in sites Bac and Cilizska Radvan measured Radvan measured in layers 0-5cm and 5-10cm during years 1999-2009.

If in determining soil volumetric water content in the layer 0-5 cm (it is upper boundary condition for the mathematical modeling of soil water regime) according to Equation (1) will be used mass water content my be 0.3g g^{-1} and the dry bulk density values from interval (0.8911-1.8051)g cm^{-3} (Bac), the values of soil volumetric water content will be from interval (0.2673-0.5415) cm^3 cm^{-3} and for Cilizska Radvan from interval

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(0.011-0.5226) g cm^{-3} will be volumetric water contents from interval (0.2286-0.4956), which are quite large intervals for volumetric water contents.

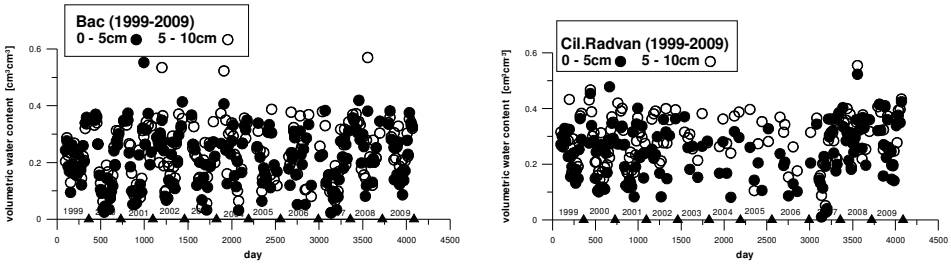

Figure 3. The values of volumetric water content of soil in Bac and Cilizska Radvan measured in layers 0-5cm and 5-10cm during years 1999-2009.

Conclusions

There were obtained the courses of dry bulk density in individual soil profile layers 0-5cm and 5-10cm under soil surface in two sites of The Rye Island during years 1999-2009. Both of the sites are with permanent grassy vegetation. It was found that the values of dry bulk density of both soil layers in both sites show relatively high variability during the observation period, which may be due inhomogeneity of the surface layers. There were also obtained the courses of volumetric water content during the observation period of both layers and in both sites. Intervals at which this values changes are quite large. These values are dependent on rainfall and the spatial variability. Calculation of volume water content of soil using average value of dry bulk density and actual mass soil water content is not suitable method, although quite often practiced. The relatively large errors may arise.

Acknowledgements

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LAND USE IN FORMER MILITARY AREA "MLADA" (CENTRAL BOHEMIA, CZECH REPUBLIC): SUCCESSION OF VEGETATION

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Abstract: The former military area Mlada harbours the remnants of a natural oakwood and semi-cultural xerothermic grasslands. During the vegetation period 2004 - 2010, more than 300 vascular plant taxa were determined there. The authors found some severely endangered and endangered species of the Czech republic´s flora, the former include i.a. *Epipactis muelleri*, *Gentiana cruciata*, *Platanthera bifolia*, *Odontites vernus* subsp. *vernus*, the latter *Prunella grandiflora*, *Dorycnium herbaceum*, P. *laciniata*, *Verbascum phoeniceum*, *Tetragonolobus maritimus* or *Astragalus danicus*. The occurence of very well preserved and biologically valuable herbal community of the union *Bromion erecti* was confirmed there. Rare semicultural xerotherm association alliance of *Bromion erecti* with dominant *Bromus erectus* and *Brachypodium pinnatum* are endangered by accumulation of old grass and expansion of species such as *Calamagrostis epigejos*, *Bromus inermis*, *Elytrigia repens*, *Rubus* sp. Self-seeding of woody species does not endanger these communities acutely. In order to ensure diversity of species, it is necessary to mow once every 2 or 3 years or to ensure that the areas are extensively grazed by livestock (sheep).

Keywords: military area, Bromion erecti, management, endangered species

Introduction

In the Czech Republic, there are currently three former military training areas (Dobrá Voda, Mladá and Ralsko), which were abolished after the departure of the Soviet armies in early 1990s. Until that time, these areas were closed to all natural science research, save for a few exceptions (Kopecký et al., 1987). After access was allowed to these areas, a number of more or less detailed surveys were being carried out there and it was found out that there is a great number of endangered species of plants and animals in these territories strongly affected by anthropogenic activities. These species became extinct in our landscape, which is subjected to intensive agricultural cultivation. The former military area of Milovice-Mladá (BVVP) is situated 50 km northeast of Prague. It is an extensive forest-savannah complex situated between the municipalities of Milovice, Luštěnice and Benátky nad Jizerou, and occupying an area of 58 km^2. At present, it has been proposed to assign the status of a National Natural Monument to this area and it is a territory included in the Natura 2000 system. During the times when it was being used by the army, the surface of the shooting grounds and tank training grounds was being constantly disrupted by the military technology and this, along with regular burning, blocked succession (Lindborg and Eriksson, 2004). As a result of specific management, which was applied in this territory during the existence of the military zone, valuable grass-herbal communities developed here, which can no longer be found in the surrounding landscape used for agricultural purposes (Frackleton and Watkinson, 2002). Exclusion of agriculture, especially exclusion of the use of herbicides and mineral fertilisers, industry and tourism, had a favourable effect on the spontaneous re-naturalisation of the landscape and on the presence of rare and endangered species of plants and animals (Weiner, 1990; Schwinning and Weiner, 1998).

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Main objectives: Overall assessment of the vegetation in several areas of the former military zone of "Mlada". Approximate site characteristics of certain areas using Ellenbergs' indication values by particular species. This includes the relationships concerning light, temperature, continental characteristics, humidity, reactive and soil nitrogen. The presence of protected and endangered species as well as invasive species was also assessed. Finally, the advisable management for the studied areas has been suggested.

Materials and methods

The studied area reaches from N50 17.008 to N50 16.239 and E14 53.057 to E14 53.923. The floristic part was chosen out in the field by inventory methods common in Central-european field botany (the area of Pod Kateřinou, the area of Mýtko and the area of Traviny – Fig. 1). The phytosociological part was worked out with the help of work processes of scientific Zürich-Montpellier School (analysis, synthesis, typization of vegetation) - collecting phytosociological relevés (Rosenthal, 2003). We compare the results concerning the vegetation with the previous surveys.
The topography of the military zone is moderately undulated with the maximum altitude being 246.7 m. The geological bedrock consists of cretaceous rocks, which are all slightly calcareous, partly covered with gravel sand. The average annual temperature is 9.2 °C and there are more than 50 summer days per year here. The average total annual precipitation is 580 mm.

Figure 1. Aerial photo of former military training area “Mladá” – the area of Pod Kateřinou, the area of Mýtko and the area of Traviny.

Results and discussion

In this area more than 300 species were identified mainly in a semicultural xerotherm association of *Bromion erecti*. There were 27 taxa of protected plants of various categories found. The authors have discovered and confirmed the presence of several highly endangered and endangered species of the Czech Republic's flora, the former include i.a. *Gentiana cruciata*, *Platanthera bifolia*, *Epipactis muelleri* and others.
Most often, there are communities of the *Bromion erecti* alliance with predominating associations of *Scabioso ochroleucae-Brachypodietum pinnati* and *Ononido spinosae-Cirsietum acaulis*. There are also communities of the following alliances: *Arrhenatherion elatioris*, *Corynephorion canescentis*, *Hyperico perforati-Scleranthion perennis*, *Trifolion medii*, *Prunion spinosae*. In rare sub-locations with predominant *Calluna vulgaris* and a strong presence of the acidophyte *Jasione montana*, there are communities of the alliance *Euphorbio cyparissiae-Callunion vulgaris* and there are also thinly dispersed communities of the alliance *Plantagini-Festucion ovinae*. Near former military structures and in places exposed to the travel of off-road cars, there are ruderal communities such as *Dauco-Melilotion* and *Chelidonio-Robinion*.

Figure 2. Former military training area "Mladá" – locality "Traviny" with *Bromion erecti* association.

Rare semicultural xerotherm association alliance of *Bromion erecti* with dominant *Bromus erectus* and *Brachypodium pinnatum* are endangered by accumulation of old grass and expansion of species such as *Calamagrostis epigejos*, *Bromus inermis*, *Elytrigia repens*, *Rubus* sp. – Fig. 2. Self-seeding of woody species does not endanger these communities acutely. In order to ensure diversity of species, it is necessary to mow once every 2 or 3 years or to ensure that the areas are extensively grazed by livestock (sheep) (Klimeš, 2005; Williams et al., 2005).
In comparison with the previous surveys (in 1985 and 1991), there are generally widespread species such as *Eryngium campestre*, *Medicago falcata*, *Hypericum perforatum*, *Lotus corniculatus* and others present in the area of interest. As opposed to the previous surveys, particularly ruderal species appeared such as *Arctium tomentosum*,

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Atriplex patula, *Capsella bursa-pastoris*, *Cirsium arvense*, *Descurainia sophia*, *Heracleum sphondylium*, *Sisymbrium officinale* and others. They were present particularly in areas jagged by wild boars and in areas strongly marked by anthropogenic activities (burned by arsonists, surroundings of dilapidated buildings, deposits of debris, etc.).

From among the invasive species, particularly *Lupinus polyphyllus*, *Melilotus albus*, *Melilotus officinale*, *Oenothera biennis*, *Robinia pseudacacia*, *Solidago canadensis*, *Tanacetum vulgare* and *Tripleurospermum inodorum* were present in the territory.

The territory is one of the natural best-preserved territories in the central Bohemian and in the military training area and it is a refuge of many rare and endangered species of animals.

Conclusions

During the vegetation period 2004 - 20010, more than 300 vascular plant taxa were identified there. The authors found some severely endangered and endangered species of the Czech Republic's flora, the former include i.a. *Epipactis muelleri*, *Gentiana cruciata*, *Platanthera bifolia* etc. The occurrence of very well preserved and biologically valuable herbal community of the alliance *Bromion erecti* was confirmed there. The plant communities just mentioned are severely endangered by the expansion of *Calamagrostis epigejos* as well as by the process of being overgrown with *Rubus* sp. and *Bromus inermis*.

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THE IMPACTS OF DIFFERENT HABITATS ON THE DEVELOPMENT OF *TELEKIA SPECIOSA* (SCHREB.) BAUMG.

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Abstract: The *Telekia speciosa* (SCHREB.) BAUMG. is a 100-150 cm high bushy perennial, which has yellow flowers and smells good. According to the descriptions (Farkas, 1999), it can be detected in two smaller areas within Hungary, namely in the Bükk and on the Szatmár-Bereg Plain. By the time of writing this paper, the population around Tiszabecs has already got extinct. Therefore, it is a protected relict species. It is named in honour of Sámuel Teleki, chancellor of Transylvania.
Within the frame of the experiment, the *Telekia speciosa* (SCHREB.) BAUMG. was planted to places differently illuminated (sunny, semi shadow, shade), then the morphological changes brought about the various light conditions were investigated.
The experiment was launched with a stock sown in October 2008. The seedlings were planted to three beds with diverse light conditions. The area of each bed was 1 m^2, and ten seedlings were planted per m^2.
The parameters investigated are as follows: the length of leaf blade, the width of leaf blade, the length of petiole, the number of leaves per plant, and the alterations of leaves.
As a result of our research, we can state that semi shadow is the optimal habitat for the plant. Under such ecological conditions the highest leaf production is observed, the leaves are species specific, healthy and big. The mean number of leaves per plant is 6.6, the mean length of blade is 16.6 cm, the mean width of blade is 13 cm, while the mean length of petiole is 14.2 cm. In the shade the plants grow poorly and the size of leaf is smaller. The mean number of leaves per plant is 4.1, the mean length of blade is 8.6 cm, the mean width of blade is 7.1 cm, and the mean length of petiole is 9.4 cm. In the sunny habitat a similarly high leaf production is observed as in the semi shadow; however, the leaves have brownish spots, they shrivel, feel rough, so they reveal a reduced aesthetical value. The mean number of leaves per plant is 6.6, the mean length of blade is 17.8 cm, the mean width of blade is 11.3 cm, and the mean length of petiole is 13.1 cm.

Keywords: *Telekia speciosa* (SCHREB.) BAUMG, protected plant

Introduction

The *Telekia speciosa* (SCHREB.) BAUMG. is a 100-150 cm high bushy perennial. Clump forming plant with large hairy heart shaped aromatic 30-35 cm long leaves remaniscent of cane sugar. Attracts butterflys and beneficial insects with its bright yellow fuzzy flowers. The diameter of the Flower is 6-8 cm. *Ray florets* are narrow and dark yellow. Flowering period: june – august. The fruit of the plant is *achenium*. An easy care standout that does well in moist areas and shade. According to the descriptions (Farkas, 1999), it can be detected in two smaller areas within Hungary, namely in the Bükk and on the Szatmár-Bereg Plain. By the time of writing this paper, the population around Tiszabecs has already got extinct. Therefore, it is a protected relict species. It is named in honour of Sámuel Teleki, chancellor of Transylvania.
According to the results of the investigations of Dobolyi the most frequent occurrence of Telekia speciosa is in mountainous regions, in beeches, in alder woodlands, in suffruticose associations of creeksides, and on roadsides. Ecological requirements of Telekia speciosa: slightly acidic, neutral of slightly basic, humid soil with good nutriment and water supply; cool, steady climate (Dobolyi, 1983).

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The *Telekia speciosa* (Schreb.) Baumg. is a relatively recent synanthropic neophyte in Central Europe originating from a Southeast European-Caucasian natural distribution area, introduced to Germany in the course of the establishment of landscape gardens in the second half of the 19th century To date, it has not been known to host powdery mildew in Germany (Boyle et al., 2007). Nowdays this plant has two typical causative agents, the *Golovinomyces cichoracearum* (DC.) V. P. and the *Coleosporium telekiae* Thüm. (Kabaktepe et al., 2005).
Bernáth investigated thye plant of Solanum dulcamare, planted differently illuminated habitat. The plant had a strong reaction on the several light conditions. With the growth of the light condicion decreased the high of the climber, the LAI, and the length of the internodes (Verbal informations of Bernáth, 2009)

Materials and methods

After the research of Bernáth, we planted the *Telekia speciosa* (SCHREB.) BAUMG. to places differently illuminated (sunny, semi shadow, shade), then the morphological changes brought about the various light conditions were investigated. The tree living area was appointed in the Botanical Garden of Nyíregyháza. The area of each bed was 1 m^2, and ten seedlings were planted per m^2. The experiment was launched with a stock sown in October 2008. We planted the seedlings in 30. april 2009 to several beds with diverse light conditions.
The statistical analysis involved analysis of variance followed by Tukey's test, using the SPSS 7.5 for Window program.



Figure 1/a. Telekia speciosa (Schreb.) Baumg. at semi shadow habitat
Figure 1/b. Telekia speciosa (Schreb.) Baumg. at shadow habitat
Figure 1/c. Telekia speciosa (Schreb.) Baumg. at sunny habitat

Results and discussion

We did the measuring on 10. 08. 2009. The parameters investigated are as follows:

1. the length of leaf blade
2. the length of petiole
3. the width of leaf blade
4. the number of leaves per plant
5. and the alterations of leaves

The *Table 2.* contain the results.

Table 2. The variation of the length of blade of the *Telekia speciosa* (Schreb.) Baumg. at different habitat

The parameters/ Type of the habitat	The mean number of leaves per plant	The mean length of blade (cm)	The mean width of blade	The mean length of petiole
shadow	4, 1-a	8, 6-a	7, 2-a	9, 4-a
semi shadow	6, 6-b	17-b	13, 1-c	14, 2-b
sunny	6, 6-b	17, 8-b	11, 3-b	13, 1-b

Different small letters in each row indicate significant differences (P<0.05)between at the different habitat

We can notice, that significant discrepancy was in the investigated parameters at different habitat.
In the case of the length of blade, the shadow living area give an separate subset, the data of semi shadow and sunny habitat don't show significant difference. In the case of the width of blade every area show significant variance. In the case of the length of petiole, only the data of shadow areas divide significantly from the other two habitat.

Conclusions

As a result of our research, we can state that semi shadow is the optimal habitat for the plant. Under such ecological conditions the highest leaf production is observed, the leaves are species specific, healthy and big. In the shade the plants grow poorly and the size of leaf is smaller. The mean number of leaves per plant is low. In the sunny habitat a similarly high leaf production is observed as in the semi shadow; however, the leaves have brownish spots, they shrivel, feel rough, so they reveal a reduced aesthetical value.

Figure 3/a. The leaf of the *Telekia speciosa* (Schreb.) Baumg. at semi shadow habitat
Figure 3/b. The leaf of the *Telekia speciosa* (Schreb.) Baumg. at shadow habitat
Figure 3/c. The leaf of the *Telekia speciosa* (Schreb.) Baumg. at sunny habitat

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EFFECT OF ENVIRONMENTAL FACTORS ON TOBACCO LEAVES COMPOSITION

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Abstract: The objective of the present study was to provide information on the heavy metal content of flue-cured tobaccos produced in different growing regions of Hungary, and to examine relationships between certain environmental factors and the metal content in the leaves. A two years investigation was conducted including 192 farms randomly selected in the main seven growing regions across the country.
Soil acidity appeared to be the most important factor to influence the concentration of Cd, Ni, Sr, Co, Zn and Mn in the leaves, with highly significant negative correlation between the pH value in soil and leaf metal content. Higher levels of available metals in the soil did not result in increased metal concentration in the leaf. Leaf Pb and Cr were positively correlated with rainfall.
Leaf concentrations of Cd, Ni, Co and Zn differed significantly among the growing regions, according to differences in soil pH. The lowest values (as mg/kg) for the regional means of leaf Cd (0.50), Ni (0.33), Pb (0.38), Co (0.02), Zn (19,7) and Mn (82) were obtained in the central part of Hungary, where the reaction of tobacco soils is neutral or slightly alkaline. Extreme high leaf metal concentrations were found in the North-East (Cd 1.89, Ni 5.40, Pb 1.17, Co 0.52, Zn 57.6, Mn 471) where the mean soil pH value is 4.50.

Keywords: Tobacco, heavy metals, soil pH, soil analysis, plant analysis

Introduction

Although heavy metals have long been recognized as toxic elements for humans, it is only recently that their occurrence in the environment has been intensively studied (Jurkovic et al., 2008; Kovacevic et al., 2006). Tobacco smoking has been established as one of the origins of heavy metal load for man. A number of investigations have been carried out on the natural occurrence of heavy metals in tobacco leaf (Kádár, 2006; Tursic et al., 2008).
Generally speaking cadmium is of particular concern, as tobacco (N. tabacum) is known to easily accumulate this element in the leaves. Part of the heavy metals in the tobacco leaf is transferred to the smoke. The level of metals taken up by the plants is the function of a number of factors, including soil properties and genotype (Adamu et al., 1989). No comprehensive information is available on the heavy metal content of flue-cured tobaccos produced in Hungary yet. The objective of the present study was to survey the metal content of the tobacco leaf produced in different growing regions, and to determine the most important environmental factors influencing the metal concentration in the leaves.

Materials and methods

A two years investigation was conducted during 1990 and 1991 including 192 farms, each of them planted to one of the nine flue-cured cultivars available for commercial production is that period. The farms were randomly selected with a distribution pattern proportional to the hectarage of flue-cured tobacco in each particular region. The soils typically exhibit coarse texture, with a clay content of less than 10%.

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Cured leaf composite samples of the 2nd ('light B') grade were taken from the mid-stalk position by farms. Determination of Cd, Ni, Pb, Cr, Sr, Co, Zn, Mn and Fe was made by ICP technics using cc. HNO_3 and cc. H_2O_2 for wet ashing. Total nitrogen, total alkaloids and reducing sugars were determined by Kjeldahl, UV spectrophotometric and colorimetric methods, respectively. Soil composite samples consisting of 8-10 subsamples were taken from the upper 20 cm layer of each field in spring, prior to transplanting and fertilizer application. The available heavy metal content of the soil was determined by ammonium-acetate + EDTA method (Lakanen and Erviö, 1971) using ICP technics.
Rainfall data recorded by the National Meteorological Service were used in this study, including 34 of the reporting meteorological stations. Only rainfall totals for June and July were taken into account.

Results and discussion

Data presented in *Table 1.* indicate that the variability of heavy metals in the cured leaf, expressed by the CV %, is higher than that of total alkaloids, total N and reducing sugars, over the seven growing regions and the two years. Among the heavy metals studied, Cr has the highest and Cd has the slightest variation. The levels of Cd, Ni, Pb and Cr (the most commonly studied toxic metals in tobacco) are lower than data published from other studies (Adamu et al., 1989). The level of the essential elements Mn, Zn, Fe is consistent with other published data on flue-cured tobacco (Tso, 1990).

Table 1. Means and variations of tobacco leaf components, soil pH and total rainfall over the growing regions and years. (Tobacco growing regions of Hungary, 1990-1991, N=192)

Variables	Unit	Mean	Minimum	Maximum	CV%
Total alkaloids	%	1.91	0.40	6.65	58
Total N	%	2.36	1.34	3.74	22
Reducing sugars	%	13.8	1.51	30.4	48
Cobalt	mg/kg	0.24	0.01	5.95	208
Lead	mg/kg	0.66	0.01	9.02	176
Chromium	mg/kg	0.77	0.01	21.00	222
Cadmium	mg/kg	1.15	0.22	4.53	63
Nickel	mg/kg	2.40	0.01	15.90	109
Zinc	mg/kg	35	8	209	74
Iron	mg/kg	224	60	1704	75
Manganese	mg/kg	248	30	3072	136
Strontium	mg/kg	285	27	1373	89
Humus	%	1.24	0.28	6.12	62
Soil pH(KCl)		5.69	3.52	8.10	26
June + July total rainfall	mm	129	55	226	36

Leaf Cd, Ni, Sr, Co, Zn and Mn content related negatively to soil pH. This finding is in general agreement with results reported by other investigators (Adamu et al., 1989). There was no significant correlation between the pH value of the soil and leaf Pb and Cr content. These two elements were, however, positively associated with rainfall. Of the metals studied, only Cd gave significant positive correlation with the clay content of

soils. None of the metals were influenced by the organic matter levels in soil. Leaf Fe content showed no significant correlation with any of the environmental parameter studied. Highly significant, positive correlations were found between and among leaf Cd, Ni, Sr, Co, Zn and Mo levels. Cr vs. other metals were not correlated, except for the relationship between Cr and Ni. Highly significant positive correlations were observed, however, for rainfall vs. reducing sugars and negative correlations for rainfall vs. total alkaloids and total N.

Table 2. Means for soil pH, rainfall and for some selected chemical components (Tobacco growing regions of Hungary, 1990 and 1991. n=192)*

The seven growing regions	Soil pH	Rainfall	Total alk.	Red. sugars	Total N
Vásárosnamény	4.50	161	1.60	18.0	2.42
Nyírbátor	4.55	131	1.85	14.8	2.47
Nagykálló	4.73	122	1.28	17.3	2.18
Nagyatád	4.98	153	2.22	11.3	2.58
Nyíregyháza	5.51	118	1.66	11.9	2.33
Mean	*4.85*	*137*	*1.72*	*14.7*	*2.40*
Kiskunhalas	7.55	129	1.41	14.8	2.00
Kiskunfélegyháza	7.78	116	2.13	13.7	1.94
Mean	*7.66*	*122*	*1.77*	*14.2*	*1.97*
$LSD_{5\%}$	*0.59*	*NS*	*NS*	*NS*	*NS*

* Rainfall = June + July total in mm; Total alkaloids, nitrogen and reducing sugars in %

Table 3. Means for tobacco leaf metal content, mg/kg d.m. (Tobacco growing regions of Hungary, 1990 and 1991. n=192)

The seven growing regions	Co	Cr	Cd	Pb	Ni	Zn	Fe	Sr	Mn
Vásárosnamény	0.52	1.65	1.89	1.17	5.40	58	244	395	471
Nyírbátor	0.22	0.38	1.25	0.49	2.83	48	178	174	264
Nagykálló	0.39	0.99	1.24	0.98	3.70	29	246	182	291
Nagyatád	0.10	0.66	1.25	0.43	1.35	31	208	319	228
Nyíregyháza	0.42	0.83	1.11	1.08	2.77	36	229	457	277
Mean	*0.33*	*0.90*	*1.35*	*0.83*	*3.21*	*40*	*221*	*305*	*306*
Kiskunhalas	0.02	0.64	0.50	0.39	0.50	27	183	203	89
Kiskunfélegyháza	0.02	0.45	0.54	0.38	0.33	20	312	181	82
Mean	*0.02*	*0.54*	*0.52*	*0.38*	*0.42*	*24*	*248*	*192*	*86*
$LSD_{5\%}$	*0.43*	*NS*	*0.50*	*NS*	*3.16*	*32*	*NS*	*NS*	*NS*

The differences in leaf metal content among the growing regions are presented in *Table 2.* and *3*. LSD values were computed for the means of the seven regions using years as replications. Significant differences existed among the regions for Cd, Ni, Co and Zn, as well as for soil pH. Lower leaf metal concentrations were obtained in regions where soil pH values were higher. A 3.8-fold range was found for mean concentrations of Cd among the regions. The same values for the ranges of Ni and Co amounted 16.4 and 32.3, resp.

Although the variations for Pb, Cr and Mn were not significant, their concentrations in the leaf also tended to be higher in regions with lower pH value. These findings are in accordance with the general knowledge on the influence of soil acidity on the plant available level of most microelements. Tobacco soils are highly acidic in North-Eastern Hungary that is why tobaccos produced in these regions accumulate higher amounts of

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heavy metals than do tobacco plants in the central part of the country, where soils are neutral or slightly alkaline.
Decreasing soil acidity by liming has been reported to lower the plant uptake of Cd and of some other heavy metals. Lime application is therefore highly recommended to most of the tobacco soils in the North-East of the country. Heavy metal content of tobacco leaf from the South-West region (Nagyatád) is in general, in-between that of the North-East and of the central regions, according to differences in soil pH.

Conclusions

Soil pH appeared to be the most important factor to influence the concentration of Cd, Ni, Sr, Co, Zn and Mn in the leaves of flue-cured tobacco. Higher levels of soil available metals did not result in increased metal concentrations in the leaf. Mean leaf content of Cd, Ni, Co and Zn differed significantly among the seven growing regions studied, according to differences in soil pH. Higher values of leaf metal concentrations were obtained in the North-Eastern regions, where soils are highly acidic. Liming of acid soils in North-East Hungary is recommended to lower the leaf heavy metal uptake.
Because of the general discrepancy between soil available heavy metal content and leaf concentrations (plant uptake), the heavy metal limit values for soil testing and related recommendation work shall be established taking into consideration other soil properties like pH, clay and humus content etc. The mean level of the essential elements Mn, Zn, Fe was consistent with other foreign published data on flue-cured tobacco, while the most commonly studied toxic metals of Cd, Ni, Pb and Cr were found lower than other international studies showed. As it might be expected, significant positive correlations were observed between total rainfall and reducing sugar content and negative correlations for rainfall vs. total alkaloids and total N.

Acknowledgements

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AGROCHEMICAL POLLUTION OF HABITAT. ECOTOXICOLOGICAL INVESTIGATIONS OF HARMFUL EFFECTS ON A LIVING SYSTEM MODEL

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Abstract: Insecticides used in crop production are toxic chemicals, they may have harmful effects on non-target organisms. Ecotoxicological investigations are required to estimate the risk. Living organisms can easily be exposed to insecticide intoxications via pollution of their habitat. Agrochemical intoxications in fish-ponds may influence the growth and life conditions of fish that may have serious economical loss and food-quality consequences. An *ex vivo* maintained carp brain area was used to detect harmful changes caused by bensultap and fipronil, and to model the effects of these agrochemicals. The results were compared to data obtained in an *in vitro* rat brain slice model, after exposition to the same agrochemicals. In the *in vitro* rat brain slices, fipronil increased basic excitability and the extent of long-term plasticity (LTP) as well. The treatment of the *ex vivo* carp brain area with fipronil resulted in a slight decrease in excitability and a significant inhibition of LTP, similarly to the effect of bensultap. These effects did not depend on the applied dose. Two more chemicals were applied to reveal the mechanisms of action.

Keywords: insecticides, agrochemical pollution, risk assessment, ecotoxicological biotesting, model systems

Introduction

The incorporation of agrochemicals into soil and water may cause habitat modification. Insecticides used in agriculture are toxic chemicals, they may have harmful effects on non-target organisms. Pesticide poisoning of humans and non-target species may create a health risk. Aquatic animals like fish can easily be exposed via pollution of their habitat, so ecotoxicological investigations are required to estimate the risks. Insecticide-intoxications in fish-ponds may influence the growth and life quality of fish, this may have serious economical consequences. On the other hand, *ex vivo* living tissue model systems have great potential as biotesters of the overall sub-lethal toxic effects of exposure to agrochemical pollutants of habitat. The teleost optic tectum is an integrative brain area which can be isolated and maintained *ex vivo* with intact laminar organization. It is suitable for examining changes in excitability and synaptic plasticity (Teyler et al., 1981; Lewis and Teyler, 1986) caused by agrochemical pollutants. Several widely used insecticides are designed to act on synaptic receptors. Bensultap is a neonicotinoid type insecticide, it acts as an agonist or antagonist on nicotinic acethylcholine receptors (nAChRs), depending on the concentration. Fipronil belongs to the phenylpyrazole group, it is an antagonist of ionotropic GABA receptors. Fipronil is highly toxic to fish and aquatic invertebrates, while bensultap shows a lower toxicity to non-target animals. In the present experiments, the direct effects of these insecticides were tested on isolated carp optic tecta. Basic excitability, short- and long-term plasticity were examined. Results were compared to data obtained from rat somatosensory cortex slices exposed to the same agrochemicals.

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Materials and methods

Optic tectum hemispheres with the optic nerve stump were isolated from one-summer-old carps (*Cyprinus carpio*). 400 µm thick coronal slices from the somatosensory cortex of young adult Wistar rats (100-250 g) were cut. Tecta or slices were placed into an interface-type recording chamber, continually perfused with oxygenated Ringer-solution. Recordings of extracellular field potentials with glass microelectrodes were carried out. After determination of stimulation threshold (T), evoked response-stimulus intensity curves were recorded. Short-term plasticity was examined with paired-pulse stimulation tests; long-term plasticity (LTP) was studied with high-frequency stimulation: 20 s, 5 Hz for carp tecta, 4x5 s, 100 Hz for rat neocortex slices. Insecticides and antagonists were dissolved in the perfusion solution. Applied concentrations: bensultap 60 µM, mecamylamine 10 µM, fipronil 10 µM and 20 µM, bicuculline 10 µM. Exposition time: 30 min. The peak-to-peak amplitude of the evoked potentials was evaluated. As statistical analysis, Student t-test ($p<0.05$) was applied, data were plotted as means ± SEM.

Results and discussion

Evoked response-stimulus intensity curves

By gradually increasing the stimulation intensity, beginning with the stimulation threshold T, amplitude-stimulus intensity curves were obtained. In case of the carp tecta, the amplitudes of control responses were greater than in rat brain slices, but after 30 min exposition both insecticides decreased the amplitude. In contrast, in the rat somatosensory cortex, both insecticides increased the amplitude of evoked potentials, fipronil in a more significant degree than bensultap (*Figure 1*.).

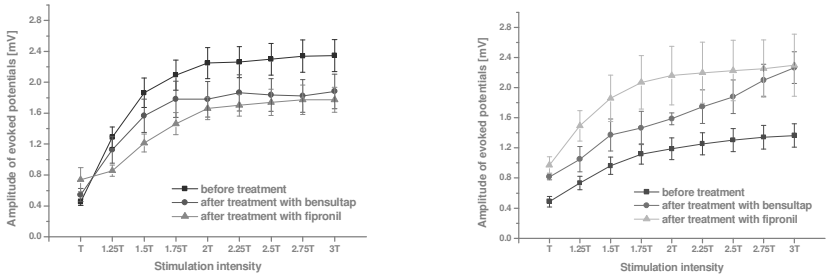

Figure 1. Evoked response-stimulus intensity curves from carp and rat *ex vivo* brain model systems

Effects on excitability and long-term plasticity (LTP)

All insecticides slightly decreased the amplitude of the evoked potentials, while mecamylamine and bicuculline increased it. Neither of the substances caused a significant change in the basal excitability of the tecta at 2 T stimulation intensity after 30 min perfusion. In case of the rat brain slices, bensultap increased slightly the amplitude of the evoked potentials, while after fipronil exposition, a significant enhancement could be observed.

LTP-induction in the carp optic tectum implied only a small (5-10%) increase in amplitude of the evoked response. In contrast, rat brain slices displayed a greater enhancement (55-60%). In carp tecta, exposition to bensultap or fipronil significantly inhibited this increase, long-term depression could be observed instead of LTP. Treatment with mecamylamine lead to an increase similar to the control, while bicuculline produced a higher increase. As for the rat brain slices, bensultap decreased, while the higher dose of fipronil increased the degree of LTP (*Figure 2*.).

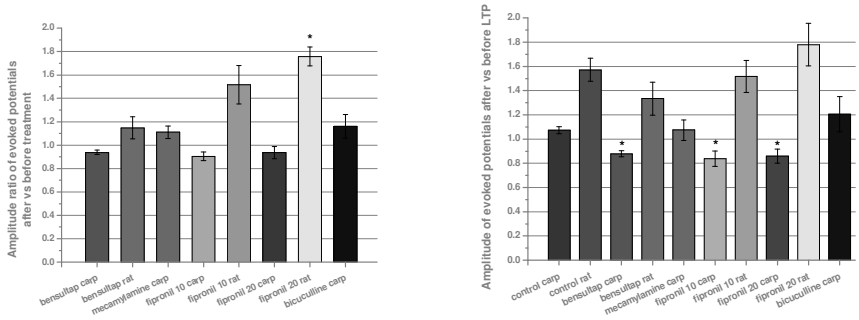

Figure 2. Effects on excitability and on long-term plasticity (LTP)

Effects of paired-pulse stimulation

During paired-pulse stimulation at an interstimulus interval of 50 ms, in carp tecta a marked inhibition of the second evoked potential (paired-pulse depression) was observed. Every treatment slightly inhibited this depression, bensultap caused the greatest effect. None of these changes was significant. In case of the rat brain slices, the amplitude of the second evoked response was nearly equal to the first at this interstimulus interval, and the treatments did not modify this (*Figure 3*.).

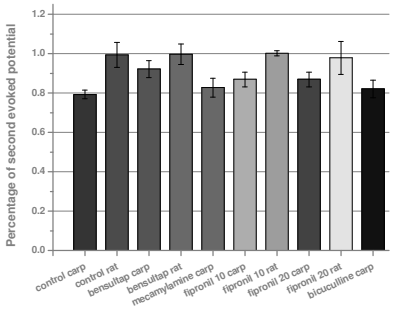

Figure 3. Effects of paired-pulse stimulation

Isolated optic tectum of the carp was used to model the effects of two insecticides on the excitability and plasticity phenomena of the fish brain. The results were compared to data obtained in an other *in vitro* biotesting system, in rat somatosensory cortex slices, after exposition to the same chemicals. Physiological characteristics were changed after exposition to agrochemicals. After treatment with bensultap, in carp tecta, a decrease in excitability and a significant inhibition of the development of LTP were observed. In contrast, bensultap increased the amplitude of evoked potentials in rat brain slices, but it

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decreased the degree of LTP. Treatment of the tecta with fipronil resulted in a slight decrease in excitability and a significant inhibition of LTP, similarly to the effect of bensultap. These effects did not depend on the applied dose. In the rat brain slices, fipronil increased basic excitability and the extent of LTP as well. The latter effects are consistent with expectations, as far as fipronil is a $GABA_AR$-antagonist. The results obtained with fipronil-treatment in the carp tecta were rather unexpected, so additional measures were performed, using two routinely used chemicals which antagonize the same receptors as the insecticides: mecamylamine (nAChR-antagonist) and bicuculline ($GABA_AR$-antagonist). Mecamylamine exerted an inverse effect compared to bensultap, it produced an increase in excitability. On LTP-induction and paired-pulse depression it did not have any effects. Bicuculline increased both the excitability of the tecta and the development of LTP. It increased the paired-pulse ratio at 500 ms interstimulus interval. These results can be explained by disinhibition.

The most important result is that both applied insecticides significantly inhibited the development of LTP in the carp tecta. This may be due to aspecific effects, as mecamylamine has no effect on this phenomenon, while bicuculline exerts an inverse effect compared to fipronil. Further research is needed to elucidate the mechanism of action of these insecticides on the carp brain.

Conclusions

Agroecosystems produce a variety of ecosystem services, among others such as regulation of soil and water quality. Depending on management practices, agriculture can also be the source of disservices, including pollution of habitat, pesticide poisoning of humans and non-target species. Disservices should be also evaluated. Appropriate agricultural management practices are critical to realizing the benefits of ecosystem services and reducing disservices from agricultural activities (Power, 2010; Moss, 2008). Control of habitat pollution and monitoring of harmful ecotoxicological effects may help to predict health risks, and to modify the crop production process, using less harmful agrochemicals. The proposed *in vitro* biotesting models may provide a useful method for risk assessment that enable to reveal the exact mechanisms of harmful changes and to select less toxic agrochemicals.

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CO-EVOLUTIONARY ASPECTS OF SOIL-BORN ENTOMO-PATHOGENIC NEMATODE – BACTERIUM SYMBIOSES

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Abstract: The control of soil pollution is an essential element of sustainable agriculture. The use of entomopathogenic nematode / bacterium (EPN/EPB) biocontrol symbiotic association is an effective way of reducing soil pollution of insecticide nature. The EPN/EPB symbiotic complexes have aroused interest in co-evolutionary relationships of the symbiotic partners. The species recognized in genus *Photorhabdus* are: *P. asymbiotica, P. temperata*; *P. luminescens*. Each includes subspecies, which, apart from *P. asymbiotica ssp. asymbiotica* and *P. asymbiotica ssp. austral is*, are obligate endosymbionts of heterorhabditid nematodes. The symbiotic host range of the obligate *Heterorhabditis / Photorhabdus* symbioses were studied on a new agar media (ENGM). Gnotobiological analysis delineated partner specificity of different *Photorhabdus* and *Heterorhabditis* subtaxa. We suggest the term "Symbion" for those associations, within which the symbiotic partners could reciprocally been exchanged. The natural symbiotic partner of each known strain of *P. temperata ssp. trachensis*, *P. luminescens* ssp. *laumondii* and *P. luminescens* ssp. *luminescens* is a *H. bacteriophora* (Symbion I). *P. temperata ssp. kleinii* are symbionts of *H. marelatus* and *H. megidis* (USA) (Symbion II). *P. temperata ssp. temperata* are symbionts of *H. megidis* (NWE) (Symbion III). *P. luminescens* ssp. *akhurstii* are symbionts of *H. indica* but the symbionts of *H. indica* strains cannot be exchanged. Two strains (HIT, JUN) of *P. asymbiotica ssp. stackebrandtii* are symbionts of *H. downesii* (HIT) and *H. megidis* (JUN). *H. downesii* HIT and K122 symbiotic complexes do not form Symbion. The rare overlaps between symbions provide an option reveal the history of the existing symbiotic relations. These data provide an option of introducing new EPN/EPB complexes for replacing chemical insecticides with bio-insecticides for to controlling soil pollution processes.

Keywords: Control of soil pollution processes**,** *Photorhabdus*, *Heterorhabditis*, Symbiosis, Gnotobiological analysis

Introduction

The control of soil pollution is an essential element of sustainable agriculture. The use of entomopathogenic nematode / bacterium (EPN/EPB) biocontrol symbiotic association is an effective way of reducing soil pollution of insecticide nature. The EPN/EPB symbiotic complexes have aroused interest in co-evolutionary relationships of the symbiotic partners. The *Heterorhabditis* / *Photorhabdus* symbiosis is a model for the analysis of pathogenicity and mutualism (Forst and Nealson, 1996). First the 16S rRNA gene has been the marker of choice when classifying/naming *Photorhabdus* species and subspecies (Rainey et al., 1995; Szállás et al., 1997). The non-symbiotic strains of *P. luminescens* form a homologous subcluster by themselves. The comparative sequence analysis was later expanded to other *Photorhabdus* strains. These studies also included PhastSystem PAGE RFLP and automated RiboPrint phenotypes of *Photorhabdus strains* (Szállás et al., 2001). Through a polyphasic approach utilizing 16S rRNA gene phylogenetic inference, phenotypic characterization, and DNA–DNA hybridization data, Fischer-Le Saux et al., (1998) proposed the existence of three separate species of *Photorhabdus: P. luminescens, P. temperata*, and *P. asymbiotica*. Furthermore, the study went on to propose the existence of three subspecies within *P.*

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luminescens. A second polyphasic approach (Akhurst et al., 2004), and a multilocus sequence typing analysis (Tailliez et al., 2009) proposed the separation of *P. asymbiotica* into two subspecies. We are interested in reconstructing the evolutionary history of the *Photorhabdus – Heterorhabditis* symbiotic associations. Our gnotobiological approach has been based on culturing different strains of *Heterorhabditis* sp. on each other's *Photorhabdus* symbionts. In order to evaluate the hypothesis of co-speciation between *Photorhabdus* and *Heterorhabditis*, we used a recently published (Peat et al., 2010) robust phylogenetic hypothesis.

Materials and methods

Fifty-one *Photorhabdus* (Boemare et al., 2002) strains were analyzed for their symbiotic partner specificity. Many of them are kept deposited in the Georgikon EPN/EPB Stock Center in Keszthely, Hungary. Four of the studied strains (ATTC strains of *P. asymbiotica ssp. asymbiotica*) do not have any known natural nematode symbiont. The nematode symbionts of ten strains (DSM 3368^T, Meg 1 and Meg 2 from E. Stackebrandt); Hm1, WX6, WX8, WX9 Hyper, WX11, WX 12 and WX 13 from K. H. Nealson) had been lost before they arrived to our laboratory. We isolated 15 strains (HP88, ACOWS, Arap Vin 15H, AZ29, AZ35, AZ36, AZ37, AZ39, BRECON, TT01) from *H. bacteriophora*; 2 strains (Hepialius, OR-10) from *H. marelata*; 5 strains (OHI, H4, HL81, HE87.3, JUN) from *H. megidis*; two strains from *H. downesii* (HIT); 4 strains (IS5, EG2, IND, Hawaiiensis,) from *H. indica*; and one strain (NZH3) of *H. zealandica* in our laboratory used by Szállás et al., (1997). From the 51 *Photorhabdus* strains36 were also used by Peat et al., (2010). 15 strains (DSM3368, Acows, Arap Vin 15H, AZ35, AZ37, AZ 39, V6-1, Q614, A1, OR-1, Meg2, HE87.3, CJG and NZH3 were first analyzed her for their symbiotic relations. The gnotobiological studies were carried out in entomopathogenic nematode growth media plate, called ENGM (Fodor et al., 2010). The re-isolated bacteria were identified (Lucskai, 2000) by using colony morphology and /or *Alu*I restriction pattern of the IGS of the 16S – 23S rRNA operon (Szállás et al., 2001; Pamjav, 2000).

Results and discussion

Comparing our data to those of Peat et al., (2010) we found that Subcluster I (Szállás et al., 1997; 2001) is equivalent to *P. l.* ssp. *luminescens*. Subcluster II is equivalent with *P. t. temperata*. Subcluster III is equivalent with ssp. *P. temperata*, what we suggest here to rename as *P. temperata* ssp. *kleinii.* Subcluster IV is equivalent with *P. l. laumondii*. Subcluster V is equivalent with *P. trachensis.* Subcluster VI is equivalent with *P. a. asymbiotica*. Subcluster VII contains only one strain, WX13, the taxonomic position of which is still unknown. Subcluster VIII includes NZH3, the taxonomic position of which is still unknown. Subcluster X is equivalent with *P. luminescens* ssp. *akhurstii*. With the only exception of IS5, what we scored for another (XII) Subcluster. Subcluster XI is equivalent with the bacterium strains of the monophyletic of *P. temperata* group including Heliothidis + NC19 + Wx12 + Wx11 + Wx10 + MEG1 + OH1 +Wx9; the monophyly is supported by the „branch values" of the Partitioned

Bremer support (Peat et al., 2010). We introduced the term "Symbion" for those associations, within which the symbiotic partners could reciprocally been exchanged.

Symbion I: Each studied *H. bacteriophora* strains could be grown and propagate on each other' symbionts independently of the taxonomic position of *Photorhabdus* strain involved. We concluded that *H. bacteriophora* comprise a symbiotic unit (Symbion I) with *P. l. laumondii*, and „the group that contains the strains KOH, AZ29, and MOL. All of which formed a monophyletic group with *P. t. trachensis* in the 49 taxon analysis (Peat et al., 2010), within which the symbiotic partners could unrestrictedly and mutually be exchanged.

Symbion II: The symbionts could mutually be exchanged between American *H. megidis* (OH1, Heliothidis, NC19, Arap VIN 15H, H4) and *H. marelata* (Hepialius, OR-10); nematode species. Majority accepted the WX4, WX6, WX8, WX10, WX11, and WX12) as a new symbiont. *H. marelatus* and American *H. megidis* nematode species and *P. t. kleinii* comprise another Symbion (Symbion II, see *Figure 1*).

Symbion III: The symbiotic partners between *H. megidis* NWE nematode strains (HL 81, HE87.3, HSH1, HSH2, HSH3, H4, and H-JUN) could unrestrictedly and mutually be exchanged. They are *P. t. temperata*, similarly to CJG and HUK211 bacteria, which could also be taken up by each *H. megidis* NWE nematode strains. The natural symbiont *H. megidis* JUN nematode is a bacterium belongs to a branch supported uncharacterized monophyletic group (subspecies) of *P. asymbiotica* (Peat et al., 2010). The *Heterorhabditis* strains belonging to *H. megidis* NWE group form a Symbion 3 with *P. t. temperata* and the JUN strain of *P. asymbiotica* ssp. *cinerea.*

Non-exchangeable symbiotic associations between *H. indica* and *P. l. akhurstii* strains: It was not possible to grow *H. indica* LN2, IS5, EG2, Indica and Hawaiiensis strains on each other' symbionts, although each of them belong to *P. l. akhurstii*.

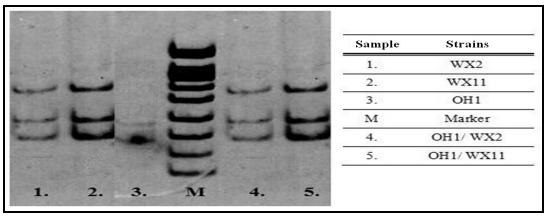

Figure 1. Symbion II: Molecular proof of retaining WX2 and WX11 *Photorhabdus* strains by *H. megidis* OH1nematode

Conclusions

To replace harmful chemical insecticides with environmentally friendly bio-insecticides is an urging challenge people working on controlling soil pollution processes. Entomopathogenic nematode / bacterium (EPN/EPB) biocontrol symbioses are good candidate bio-insecticides. The efficacy might be improved by introducing new symbiotic complexes. To determination of symbionts provide an option to create and adopt new nematode bacterium complexes suitable for this purpose. *H. bacteriophora* strains use *P. l. laumondii*, *P. t. trachensis* as natural symbiont. *P. temperata* is monophyletic. **Symbion II and III:** The *H. megidis* and *H. marelata* share *P. temperata*

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khanii as symbionts. All *H. megidis* belong to the same species but the American and European strains cannot use each other's symbionts.

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EVALUATION OF LAND USE, BASED ON RECYCLING OF LIQUID BIOGAS BY-PRODUCT

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Abstract: In 2008 Hungarian government approved the Renewable Energy Strategy which targets the increase of biogas production to 6,1 % by 2020. Biogas production rate was only 0,8 % in 2006. Hungarian agricultural biogas is based mainly on agricultural waste, by-products and residues. The recovery of digested biogas endproduct for agriculture conserves and recycles nutrients and may reduce waste disposal and the use of chemical fertilisers. In point of view of soil protection is also very important to change inefficient nutrient supplement to an environment friendly one that suits climate and soil conditions.
The Biogas Plant of Nyírbátor is built and operated by the Bátortrade Ltd. in 2003, a partner of a company group, which main profile is complex agricultural production and processing. The digested by-product of biogas production is used directly for irrigation with nutrient supply, or restored in transit-tanks. University of Debrecen, Institute of Water and Environmental Management and Bátortrade Ltd. have a long-term close correlation by research and development.
The objective of this study was to determine optimal nutrient quantities by planting area conditions. A field experiment was set up three years ago. Wheat yield was compared in sand and sandy loam soils. In several treatments the effect of liquid digested biogas by-product, compost and fertilizer on wheat yield was analysed by precision conditions.

Keywords: fertilization, fermented by-product**,** precision agriculture

Introduction

Modern crop production has to meet the issues of new police agenda, which means sustainability, environmental protection, agronomic and economic efficiency and high quality standards.
The definition of sustainability of agriculture and the environment, according to Pearce and Atkinson (1995), is that natural resources and man-made capital are complementary to each other in the production process, so that natural resources create the limiting factors to the increase of production, and they should be used rationally. By the turn of the millennium, sustainability has got a broader interpretation. The new paradigm of agricultural research and development was considered as an interaction on three factors: ecological sustainability, economic efficiency combined with equal opportunities, as well as mutual help from government and non-governmental sectors to improve the enterprise system's performance and profitability. This has become the basic paradigm of the 1990s and of the following decades in sustainable agro-economics (Láng, 2003; Csete and Láng, 2005; Várallyay, 2007).
Before every agricultural cultivation intervention knowledge of cultivated area is very important because global problems are solved by understanding local ones (Tamás, 2001). Precision farming, precision agriculture (PA) or site-specific management (SSM) is a management system where crop production practices and inputs such as seed, fertilizers and pesticides are variably applied within a field. Moreover PA is conceptualized by a system approach to re-organize the total system of agriculture towards a low-input, high-efficiency, sustainable agriculture. Almost all precision agriculture activities now use Global Positioning System (GPS) receivers to provide the

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spatial coordinates required to generate mapped information. A detailed description of the application of GPS to precision farming can be found in Tyler et al. (1997). Managing the variability can be achieved by two approaches: the map-based approach and the sensor-based approach (Naiqian et al., 2002). The GIS created by computing background makes possible to generate complex view about our fields and to make valid agrotechnological decisions (Pecze, 2001). Using this technology, it is possible to provide the optimal or near-optimal nutrient and chemical (Mesterházi et al., 2001) amount and proper cultivation for each part of the field (Jóri and Erbach, 1998). With the availability of topographic data for fields implemented with PA technologies, the interaction between tillage and soil/water erosion can be examined and, thus, reduction in erosion can be achieved (Schumacher et al., 2000).

Materials and method

Nyírbátor is in Szabolcs-Szatmár-Bereg County. The Regional Biogas Plant of Nyírbátor was built by the Bátortrade Ltd. In the Regional Biogas Plant of Nyírbátor the biomass is 29% livestock manure, 13% is produced vegetal main product, 19% is vegetal byproduct and waste, and 39% is animal waste. Crop resources are produced on 3.000 ha own land, and 5.000 ha contracted with cooperation.

Climate and soil conditions are the followings:
Sunshine hours are between 1850 and 1900. The annual average cloud cover varies from 58% to 62%, and the prevailing wind direction is generally north. Annual average temperature is around 10°C. (Gál, 2005) The annual average maximum temperature is 35 °C., and the minimum is -18 °C. Characteristic physical soil types of Nyírség mezo-region are sandy and sandy loam. In field experiment in situ measurements were carried out to measure the effect of different treatments (*Table 1.*) on winter wheat yield by planting area conditions. We got the highest yields in the case of Fermented liquid biogas by-product + Fertilizer in every year on sandy loam soil.

Table 1. Nutrient treatments and average yield data (t*ha^{-1})

Soil type	Fermented liquid biogas by-product	Fermented liquid biogas by-product and Fertilizer	Compost	Fertilizer
Sandy	4. 1-4. 3	4. 6-5. 0	4. 2-4. 5	4. 4-4. 8
Sandy loam	4. 4-4. 7	5. 1-5. 5	4. 3-4. 6	5. 0-5. 3

One key tool of precision farming is the utilization of GIS. Archiving of GPS and the real time coordinates guarantees the correspondence to the hard agro-environmental rules. Through GIS it is possible to map the yield and the content of nutrients in plant and in soil. Digital map data by Trimble AgGPS FM 550 job computer were tested. The computer is controlling the autopilot system continuously on the bases of applied digital maps. It controls the irrigation of the liquid phase on the defined routes and enables to place out the nitrogen of max. 170 kg/ha considering the EU Nitrate Directive. During

the planning, several data had to be digitalized (for example: relief, surface waters, ground waters, settlements, roads etc.) to determine the unsuitable areas and safety buffer zones. The useful quantity of the liquid phase of fermented material has been defined after the examinations of the soil parameters, agro-chemical characteristics, cropping and water management. With loading the results into the job computer of the discharging vehicle, movement of the vehicle itself can also be planned and monitored during the discharge.

Results and discussion

The soils nutrient supplement reaction was measured in the above mentioned treatments, based on different physical soil types on winter wheat by independent T test. Results are shown in *Table 2.*

Table 2. Independent T test values

Treatments	Nitrogen nutrient (kg t^{-1})	Phosphorus nutrient (kg t^{-1})	Potassium nutrient (kg t^{-1})
Fermented biogas by-product and Fermented biogas by-product + fertilizer	1.63	0.906	7.635*
Fermented biogas by-product and Compost	0.050	4.371*	9.888*
Fermented biogas by-product and Fertilizer	0.429	1.727	0.945
Fermented biogas by-product + fertilizer and Compost	1.427	4.395*	11.240*
Fermented biogas by-product + fertilizer and Fertilizer	1.131	1.791	1.426
Compost and Fertilizer	0.449	3.465*	2.684*

*below SD 5%

The t-test assesses whether the means of two groups are statistically different from each other. These t values are marked. Nitrogen nutrient maximum quantities were 170 kg ha^{-1} considering the EU Nitrate Directive. The Potassium and Phosphorus supplying capacity of soils is low or middle. So we got statistical differences only in the case of Phosphorus and Potassium.

In addition we measured the effect of treatments on winter wheat yield too by independent t test (*Table 3.*). Results of SPSS programme analyses show that the effects of all treatments are statistically different on winter wheat yield.

In the case of compost treatments were the lowest yield values on sandy and sandy loam soils too.

Most efficient treatment is Fermented biogas by-product and Fermented biogas by-product + fertilizer. Biogas fermented liquid by-product has high water content and low dry matter content which contains a lot of organic matters. From this point of view fermented liquid biogas by-product is an environmental friendly solution. Furthermore this biogas by-product could be used as an irrigation method too.

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Table 3. Independent T test values of wheat yield

Treatment	Wheat yield (t ha^{-1})
Fermented biogas by-product and Fermented biogas by-product + fertilizer	3.692*
Fermented biogas by-product and Compost	2.746*
Fermented biogas by-product and Fertilizer	2.468*
Fermented biogas by-product + fertilizer and Compost	18.800*
Fermented biogas by-product + fertilizer and Fertilizer	3.632*
Compost and Fertilizer	13.220*

*below SD 5%

In 2010, the wheat fields, which were treated by fermented by-product, avoid the fusarium infection too.

Conclusions

Studying the effect of different soil nutrient capacity in precision conditions is actually. Most environment friendly and most efficient treatment was the Fermented biogas by-product and Fermented biogas by-product + fertilizer on both physical soil types.

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RAGWEED (*AMBROSIA ARTEMISIFOLIA*) – THE GREATEST WEED PROBLEM IN EUROPE

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Abstract: The paper is providing a brief overview on the spread, detection and protection against the common ragweed *Ambrosia artemisiifolia* L.

Keywords: Common ragweed, *Ambrosia artemisiifolia* L.

Review

Common ragweed, *Ambrosia artemisiifolia* L is an invasive plant species, which causes significant damages of human health and agriculture in Hungary.
It has been known in Hungary from 1920's (Kazinczi and Béres, 2008). . In the beginning of the 1990's, there have been changes int he structure of land ownership as well as land use patterns in Hungary as well as many other countries in Europe. This time many fields were abandoned because of the improper soil cultivation. So ragweed became the most frequent weed species in Hungary. In 1988 it was found in the weed survey, including to twelve weed species and all fields of Hungarian agricultural units, that ragweed become the predominant weed species (Gólya et al., 2008). The results of the last survey on this species in 2005 showed some regions of Northeast Hungary (Borsod-Abauj-Zemplen and Heves counties) with restricted spread of ragweed, but the Southern part of these counties were heavily infested. Nowadays the agricultural areas are greatly infested in Hungary. Therefore besides the prevention, control of this weed is essential after its establishment (Kőmíves et al., 2006).
Official control is organized at government level in Hungary and is obligatory for each landowner before the flowering period. In Hungary the obligatory control of *Ambrosia* is regulated by Act 2000/35 on plant protection and the following rules:
– Decree 5/2001 (16 January) of Ministry of Agriculture and Rural Development (MARD) on plant protection activity;
– Government Decree 160/2005 (16 August) on detailed rules on determination of fees of control of public interests;
– Government Decree 335/2006 (23 December) on administrative organization of plant protection;
– Act 140/2004 Act on general rules of the official administration procedure and service;
– Government Decree 187/2006 (5 September) amended by 214/2007 (7 July) on detailed plant protection fine; 30 June is the deadline of the obligatory control of ragweed, as specified in the legislation. This is an average period of the appearance of ragweed buds. After this deadline the authorities order control of public interest. The local checks are carried out by employees of the Land Offices. Control of public interests is ordered by notary inside the settlements, and by county agricultural offices, plant protection and soil conservation directorates outside the settlements The Land Offices submit their data on *Ambrosia* infestation by server, which is operated by the

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Institute of Geodesy, Cartography and Remote Sensing to the authorities Csornai et al 2008). This server contains also data (documents etc.) of plant protection authority. In the case of default of obligatory control, fine is ordered. The fines are between 20.000 to 5 million HUF depend from the size of are, the level of infection, departure of settlements.

The national control of *Ambrosia* is organised by "Interministerial Commission For The Ragweedfree Hungary "of six Hungarian ministries (MARD, Ministry for Human Health, Ministry for Local Government and Regional Development, Ministry for Economy and Transport, Financial Ministry, Ministry of Environment and Water, Ministry of Education and Culture) with the participation of non-governmental organizations.

Realizing the high importance of the ragweed problem Hungary has hosted the "First International Ragweed Conference" between 10-13 September 2008, in Budapest. The international scientific community launched discussions over research results and practical land use measures as well as plant protection techniques related to this invasive weed species.

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