Abstract book

| of the 19th Alps-Adria Scientific Workshop
26th April - 1st May 2020, Wisła, Poland

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19th Alps-Adria Scientific Workshop
26th April - 1st May 2020, Wisła, Poland

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Zoltán KENDE

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Abstracts of oral presentations

Agriculture, climate change and biodiversity – in a vicious circle

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Keywords: large-scale farming, animal husbandry industry, climate change, biodiversity

A healthy diet is a key element for our health and well-being. These needs are being met by an increasingly complex and increasingly globalized food production and supply system. In the twentieth century, food production became a large industry, whose main goal was profit. Keywords in food production are mechanization, chemization and intensification. Agriculture covers 37% of the ice-free land, which means that it has a huge impact on the world we live in, the landscape, soil, water resources and biodiversity (Agriculture Overview).

In 2016, in an article in *Nature*, the results of research by scientists from the University of Queensland in Australia and the International Union for Nature Conservation were presented, in which the authors looked for the main causes of species extinction (Maxwell et al. 2016). One of such key factors (in the second position), the so-called *big killer*, there was agriculture. Agriculture, which today has the form of large-scale farms and animal husbandry, which we define as industrial, contributes to global warming. Current food system accounts for between 25 and 30% of greenhouse gases (The EAT-Lancet Commission). Agriculture is a source of significant emissions of methane (CH₄) and nitrous oxide (N₂O) - two strong greenhouse gases. CH₄ emissions are mainly the result of the digestive processes of ruminant animals (primarily cows and sheep). In turn, N₂O is emitted to the atmosphere from agricultural land, mainly as a result of microbiological processing of nitrogen fertilizers in soil. N₂O emissions represent half of all agricultural emissions. Both gases are also released during the storage and distribution of animal manure. Food production also means the need for its storage, processing, packaging, transport, preparation and sale. Large quantities of greenhouse gases are released at all these stages.

On the other hand, climate change is affecting agriculture, which is of growing concern to us. Crops require adequate soil, water, sunlight and heat to grow. Higher and higher temperatures affect the length of the growing season. Flowering and harvesting season for cereals are shifted. In a given region, the cultivation of specific plant species becomes unprofitable and impossible over time. In the case of Europe, in the northern part of Europe, agricultural productivity may increase due to the longer growing season and the extension of the frost-free period. Higher temperatures and a longer growing season may also enable new plants to be grown. However, a decrease in crop yields can be expected in southern Europe. A particularly serious situation due to extreme heat may affect the Mediterranean area. Heat waves and heat stress caused by prolonged exposure to high temperatures will negatively affect farm animals, the efficiency of this sector of the economy.

Making agriculture sustainable is a global challenge. If we want to stop climate change, we must radically change the food production system, including the cessation of industrial animal husbandry and industrial fisheries. The world must turn towards health plant-based diets to stop climate change (Ripple et al. 2017). Agriculture must become a system that respects the planet's natural limitations and uses its regenerative capacity. Unfortunately, despite the growing number of reports demonstrating the key importance of small farming, traditional ecological methods and the democratization of the food system to combat climate change and feeding the growing population, there is no political will to question the prevailing industrial model. Without a doubt, if we want to survive and not finish as a species with the shortest evolutionary history (*Homo sapiens* exists only 200,000 years), we must create a "new" world in which agriculture will cease to be a threat to life on Earth.

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Does biomass collected from coal mine spoil heaps can be the effective energy source?

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Keywords: biodiversity, biomass, renewable energy, brownfields, wild plants

Introduction

The modern world needs to produce more energy for humans and their daily needs in a manner friendly to the environment (Papoutsidakis et al. 2018). One of solution is to use renewable energy sources, in particular biomass. The results of the analysis of the energy properties of wood small-reed biomass (*Calamagrostis epigejos* L.) a grass species that spontaneously colonize wastelands or brownfields, were presented. The harvesting biomass for energy purposes, wastelands such as coal mine spoil heaps can gain new economic possibilities (Nabais et al. 2017). Therefore the aim of this work is to determine the energy potential of biomass of species that spontaneously colonize of coal mine spoil heaps.

Materials and methods

The study was carried out on coal mine spoil heaps. The research was conducted on 135 study plots (0.5m x 0.5m). In the first stage of studies plant species that was the most common on study object was selected. In the second stage of research the relationship between the biomass of species present on the plots and values of the diversity indices: *Simpson's* (D), *Evenness* (E), *Shannon-Wiener* (H') was verified by Spearman rank correlation test. The next stage of research included a collection of the species biomass. The species that was the most common and produced the largest amount of biomass was selected for further research. Such energy properties of chosen species were determined as: the calorific value, heat of combustion, humidity as well as the content of C, S, Cl, N, H and volatile parts of biomass. The area that species occupies on the investigated heap, was identified using the WorldView-2 multispectral time series classification method. The biomass of chosen species was collected according to PN-EN ISO 18135:2017-06 standard from the coal mine spoil heap Sośnica in Zabrze (Upper Silesia, Poland) in September 2019. Biomass of *Calamagrostis epigejos* was estimated as average biomass of the 26 research plots >1000m². In the last stage, the quantity, properties and availability of biomass were estimated in terms of its use in power energetics.

Results and discussion

Calamagrostis epigejos (wood small-reed) with the highest frequency was recorded on the heaps. 25% of the research plots were dominant by *C. epigejos*. with percentage coverage from 2 to 80% and biomass from 8.3 to 175.8 g·m⁻², average 65.2 g·m⁻² (±42.2). The dry biomass of the dominant species was negatively correlated with the values of the tested diversity indices: D, E, H (rs=-0.43, -0.53, -0.32, p<0.0001). The calorific value of the biomass of wood small-reed was 17.54 MJ·kg⁻¹ heat of combustion 16.62 MJ·kg⁻¹. Humidity 4.8% and content of C 45.2%, S 0.14%, Cl 0.26%, N 0.82%, H 4.94%. Volatile parts of wood small-reed biomass is 70.34%.

The biomass properties of *C.epigejos* are similar to the biomass properties of native grass species used as an energy source, e.g. *Phalaris arundinacea* (Aryszak, 2015). Total biomass of *C. epigejos* on the coal mine spoil heap Sośnica in Zabrze was about 525 kg·year⁻¹.

Conclusions

1. The biomass of species plants species occurring in brownfield areas is similar in quantity and properties to this produced by plants for energy. 2. Biomass is the highest when one species dominates. 3. Taking into account the properties of analyzed biomass, biomass can be used in small-sized distributed combustion and gasification systems.

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Phytoremediation of Potential Toxic Elements by Tree Species in Abandoned Mining Sites

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Keywords: phytoextraction, dendroremediation, bioconcentration factor (BF), heavy metals

Abstract

Toxic elements such as heavy metals are left behind after the completion of mining operation and being non biodegradable, these contaminate the soil and water ecosystem for generations. This research work evaluated the phyto extracting ability for potential toxic elements by eleven (11) tree species that are predominantly growing in an abandoned mining spoil sites in Mogpog, Marinduque, Philippines. Plant and soil samples were collected in the field and analyzed using ICP-OES. The soil was highly contaminated with heavy metals, largely copper (Cu) and manganese Mn which is fifty and twenty times more than the typical non-contaminated Philippine soil. Among the trees evaluate, *Antidesma ghaesembilla* showed the highest potential for Cu and Mn denromediation, having a bioconcentration factor (BF) of 1.51 and 29.2, respectively. This tree species had 466.98 mg kg⁻¹ dry wt. of Cu and 496.78 mg kg⁻¹ dry wt. of Mn. Another tree species that showed promising potential as phytoremediators for Cu and Mn contaminated soils was *Eucalyptus camaldulensis* with 1.17 and 22.5 BF, respectively. This tree species had 360 mg kg⁻¹ dry wt. of Cu and 382.13 mg kg⁻¹ dry wt. of Mn, *Pterocarpus indicus* had 270.75 mg kg⁻¹ dry wt. of Cu and 287.30 mg kg⁻¹ dry wt. of Mn and *Trema orientalis* had 219.56 mg kg⁻¹ dry wt. of Cu and 215.21 mg kg⁻¹ dry wt. of Mn. *Alstonia scholaris* gave the highest potential for Ni and Fe toxic soils with a value of 242.53 mg kg⁻¹ dry wt. of Ni and 43,004.93 mg kg⁻¹ dry wt. of Fe. None of the tree species was found to be hyperaccumulator for Cu, Ni, Cr, Mn and Zn.

Environmental changes in Kecskemét between 2008-2018

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Keywords: air quality, environmental conditions, transportation, urban heat island, water management

Results

Kecskemét, as the most environmentally exposed city on the Danube-Tisza Interfluve, faces numerous challenges. The most important are the deterioration of air quality, the urban heat island effect, and the issues of sustainable green areas and water management.

According to the data, between 2011 and 2017, 150 measurement points show approximately 4% annual increase in road traffic (Magyar Közút). Parallel to this, parking difficulties have increased. The process creates a growing conflict between transport and the need to expand green areas.

Stopping the unfavorable processes is vital for Kecskemét. Emission of pollutants from road traffic and non-environmentally friendly heating of households have become more frequent (www.levegominoseg.hu). Expected, that various air pollutants (eg. PM₁₀; PM_{2,5}; NO₂; NO_x; SO₂; O₃) more often exceed limit values in the near future.

There are significant differences between various coverings and built-up areas of the city, especially in daytime surface temperatures (Hook – Hulley, 2019; Running et al., 2011). The southern industrial area, as well as the giant paved surfaces of the airport, are the warmest parts of the city. The downtown and densely built-up housing estates are among the warmest areas also. The temperature-reducing role of green surfaces can be detected in larger contiguous areas, such as the Zoltán Benkó Leisure Center (so called city's „green wedge”) or cemeteries.

The extent of all municipally owned green areas decreased by more than 30% between 2009 and 2017. The decline primarily affects the southern industrial area, where Mercedes-Benz and its suppliers' production facilities are located.

As the green areas decrease, the amount of airborne dust increases. At the same time, green areas play a key role not only in reducing airborne dust, but also in absorbing CO₂ and other pollutants, venting the city, increasing evaporation and producing oxygen.

In addition to the issue of green areas, water management has also great importance. Due to the intensification of weather extremes, the increase in rainfall-free periods and heat wave days, irrigation is essential for maintaining green infrastructure, which makes the development of the Urban Rainwater Management System indispensable.

Acknowledgement

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Interaction of tillage, fertilizer and winter wheat forecrop on yield of maize hybrids

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Key words: tillage, fertilizer, crop rotation, maize

Introduction

Maize is a major grain crop in Hungary with significant fluctuation in yield, ranging from 3.7-8.5 tons ha⁻¹ in the last decade (KSH, 2018). Tillage, forecrop and fertilization are integral farm production practices which have significant impact on yield, as well as the environment (Al-Kaisi et al., 2015; Wang et al., 2015) and therefore the aim of this research is to determine the ideal combination of treatments which can optimize and sustain the yield of maize.

Material and methods

This research is part of an ongoing longterm experiment conducted at the Látókép Research Station in 2017-2018. The experimental design was a split-plot with three main plots representing three tillage treatments: mouldboard tillage (MT), strip tillage (ST) and rip tillage (RT). The plots were subdivided to accommodate three levels of fertilizer treatments; N0 (control); N80 & N160 kg ha⁻¹ which were replicated four times. Winter wheat was sown on 20% (0.2 ha) of each of the main plots and rotated with maize hybrids, FAO 380 and FAO 490, which were sown at 80,000 seeds ha⁻¹ at a row spacing of 76 cm. Soil moisture and infiltration rate in each tillage treatment was measured with capacitance moisture probe and infiltrometer respectively.

Results and discussion

Soil moisture content varied significantly with tillage practices (ST>RT>MT). Fertilization had the largest effect on yield, followed by forecrop and tillage. Interaction between tillage and fertilization was not significant ($P=0.293$); however interaction of forecrop, fertilization and tillage was significant ($P<0.05$). Yield of maize in RT plots was 8% higher in monoculture (RT>MT>ST), while MT was 4% higher than RT in biculture plots (MT>RT>ST). Yield gain from rotation with winter wheat was highest in the control plots (4.39 tons ha⁻¹) with FAO 490 yield being 10% higher than FAO380.

Conclusions

FAO 490 cultivated under rip tillage (RT), with 80 kg N ha⁻¹ and in rotation with winter wheat forecrop was the ideal combination of treatments for optimum yield (13.06 tons ha⁻¹).

Acknowledgement

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Compared analysis by HPLC and TAC for woodland grape (*Vitis sylvestris* C.C. GMEL.) genotypes and European grapevine (*Vitis vinifera* L.) cultivars

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Keywords: HPLC, TAC, woodland grape

Abstract

The evolution of cultivated plants played important role in the ascent of humanity. Based on theoretical and practical researches, it is supposed, that this species itself, or crossing with other species could be the progenitor of the European grapevine (*Vitis vinifera* L.) (De Candolle, 1894, Kozma, 1991 and Terpo, 1986).

Vitis sylvestris C.C. GMEL. occurs in flood basins, with tendrils clinging vines and split forehand leaves. It has a blue berry fruit, usually 2-seeded, but it has 1-5 seeds, which are brownish, short-billed. The exocarpium is naturally thin, gelled meat, some of it must be obtained. The colour is provided only by material that contains anthocyanins monoglycosides (Bartha and Kevey, 2010).

In this study, a total of 6 *Vitis sylvestris* C.C. GMEL genotypes compared to cultivated grapes of *Vitis vinifera* L. were studied by HPLC (High Performance Liquid Chromatography) in three different years (2014, 2015, 2018). In 2015 and 2018 TAC (Total Antioxidant Capacity) was measured for *Vitis sylvestris* C.C. GMEL wine. The predominant sugars in *Vitis sylvestris* C.C. GMEL and *Vitis vinifera* L. (Italian Riesling and Pinot noir) berries were glucose and fructose. In total acid, the percentage of tartaric acid content in woodland grape berries was lower than that of the malic acid, in all three years.

The preliminary results of this study pointed out interesting differences in the constitution of organic acids, sugars, elements of woodland grape genotypes and European grapevine cultivars. The TAC value of *Vitis sylvestris* C.C. GMEL. wine was 3 times higher compared to Cabernet sauvignon wine.

Because of the high content of compounds of positive physiology effect, so woodland grapes, it can be used in our future breeding program as the donor of this feature.

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Effect of irrigation on the development and yield of maize hybrids

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Keywords: Maize, Leaf area index, SPAD value, yield, irrigation

In our experiment we examined the effect of water supply on the leaf area index, relative chlorophyll content and yield of different maize genotypes on chernozem soil. The maize production is influenced by many agro-technical factors such as water supply, environmental factors, nutrient supply and temperature (Salifu – Dóka, 2019; Jakab et al, 2005). Pepó and Csajbók (2014) results showed that the impact of each agro-technical element on maize yield is greatly affected by crop year and crop rotation. Ruzsányi and Csajbók (2001) found that a good-quality soil and adequate technology significantly reduces the effect of the crop year. Széles (2008) analysed the SPAD values of maize at average nutrient supply and found correlation between the yield and quality parameters. Széles et al. (2011) added that significantly higher chlorophyll content was measured in droughty conditions. In the year 2019, we examined four maize hybrids from the same maturity group: Kamaria (FAO 370), P 9903 (FAO 390), DKC 4351 (FAO 370) and Kamparis (FAO-350-400). Half of the parcels were irrigated two times (1st July and 15th July) with 25 mm irrigation water. In the vegetation period we measured in five different times (29th May, 14th June, 1st July, 15th July, 5th August, 28th August) the chlorophyll content of leaves with SPAD 502 equipment, which is suitable for measuring the chlorophyll content of plant leaves without damaging the plant (Tóth et al, 2014). In non-irrigated conditions, we found differences between the hybrids SPAD values in the fourth and fifth measurements (15th July, 5th August). The Kamparis achieved higher SPAD values than the other genotypes. The maximum SPAD values (60.62-63.68) were found in 5th August. To the end of August the relative chlorophyll content of the leaves decreased. At good water supply the differences between the hybrids were smaller (62.05-63.62). The SPAD value of Kamaria increased in irrigated parcels. We cannot find correlation between the yield and the SPAD values measured in the vegetation period. To examine the leaf area of the maize genotypes we used the SunScan type SS1 plant canopy analyser, which is suitable for field measurements in agricultural crops to provide valuable information about Leaf Area Index (LAI). According to the values of leaf area (14th June, 1st July, 15th July, 5th August, 28th August), some of the hybrids developed greater biomass in the early period in the irrigated parcels. In non-irrigated conditions the hybrids achieved their maximum leaf area (4.18-4.46 m²m⁻²) to the middle of July. In case of good water supply in 15th July we measured higher values (4.35-5.26 m²m⁻²) and the leaf area increased until the beginning of August in case of Kamaria and P9903 hybrids (5.08-5.67 m²m⁻²). We found positive correlation between the yield and the LAI values from the second to the fourth measurement (1st July, 15th July, 6th August) in the irrigated and non-irrigated conditions. The LAI values detected at the beginning of the development and at the last measurement were not in correlation with the yield production.

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Effects of combined application of solid pyrolysis products and digestate on selected soil and plant properties in laboratory experiment

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Keywords: wood chips char; animal bone char; digestate; plant nutrient uptake; phytotoxicity test; soil properties

Abstract

The application of biochar as a soil amendment is a promising practice in agriculture and can have an important role in mitigating the effects of climate change. Many studies were conducted to examine the effects of biochars on soil properties but most of the related research has been taken place in tropical environments and the results were widely depended on the applied pyrolysis technology and raw materials eventuated various products with diverse properties.

The use of digestates as a cost effective and renewable source of plant nutrients can be also a good complementary solution to decrease the amount of synthetic fertilizers applied in agriculture. The fertilization effect of digestate may be a good supplementation to biochar application as well, but no data is available on this topic yet.

Thus the aim of our study was to investigate the effect of two types of biochar and combined application of biochar and digestate respectively on selected soil physical and chemical properties and on ryegrass (*Lolium perenne*) growth, yield and selected element content in a laboratory experiment.

Our results show that the easily soluble phosphorous content of soil increased in the animal bonechar (ABC) and combined animal bone char-digestate treatments (ABCAD), but the plants could not take up this high amount of phosphorous in our study. The pH and water soluble salt content of the tread soil was increased significantly in the ABC treatments, while in case of BC treatments the increase of pH was observed just at higher application rates, and no effect on water soluble salt content was detected. Wood chips char (BC) increased the water holding capacity and the carbon content of the treated soil, while no effect of ABC on these soil properties was observed. Pyrolysis products did not cause phytotoxic effects on test plants but higher doses resulted in slower germination. Combined biochar-digestate applications effected higher yield compared to the soil biochar treatments.

Effect of algae containing biostimulant foliar fertilization on the physiological parameters, yield quality and quantity of maize.

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Keywords: algae, foliar fertilization, maize, proline, relative water content

Biostimulants are tools for compensating the effects of climatic extremes, soil acidification or the increase in salinity due to inadequate agro-technology. Due to the acidification of the soils their salinity increases, therefore the uptake of numerous micro, meso and macro elements through the roots is inhibited. Algae cells sprayed on the surface of the plant can enter the leaves via the stomata and the hydathodes and they are able to transfer nutrients and plant hormones to plant cells through cytoplasmic fibres via indirect diffusion (MOLNÁR - ÖRDÖG, 2005).

Our examinations were carried out in the demonstration garden at the Böszörményi str. campus of the University of Debrecen. Our test plant was maize (*Zea mays* L.). The experimental plots were treated with an aqueous suspension of the cyanobacterial strain MACC-612 at 8-leaf stage of development at the 2nd value of the Hanway scale (HANWAY 1966). The substance was mixed with water, placed into an ultrasonic device for three minutes, and stored refrigerated until application. Two concentrations were used (0.3 g/l and 1 g/l) for our tests, which were applied with 400 l/ha water. Proline content, relative chlorophyll content, and relative water content were examined 7 times during the growing season, using the CABRERA - BOSQUET (2009) method for measuring relative water content and the TEKLIĆ et al., (2010) method for proline.

Under osmotic or dehydrated stress conditions, the integrity of cell membranes must be maintained to avoid protein precipitation and denaturation. Proline may interact with several enzyme systems to preserve the structure and functions of proteins. (CHADALAVADA et al., 1994). The presence of high concentrations of proline provides better protection against biologically unfavourable environmental factors and thermodynamic disturbances caused by water shortage in plants (HAMILTON - HECKATHORN, 2001).

As a result of the treatment, the yield increased with 1236 kg*ha⁻¹, which resulted in an increase of 11.5% for the higher 1 g/l dose. Based on the values measured on the second and third leaves from the top and the one opposite to the maize ear, relative water content decreased as a result of the treatment, but the SPAD values increased significantly. The amount of proline increased with the treatment, the biggest difference was recorded on the second leaf from the top. Proline content in the leaves continuously decreased during the growing season, but the high 1 g/l algae treatment increased the proline content throughout the growing season.

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Nitrogen fertilization level: an important factor of plant's nutrient distribution in long-term field experiment

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Keywords: long-term experiment, maize, nitrogen level, nutrient distribution

Introduction

Efficient use of N fertilizers is a great challenge in precision crop production due to environmental and economic reasons. Accurate N fertilizer rates with higher N use efficiency (NUE) are important factors for maximizing the yield and its quality, while protecting the environment (Dhital and Raun, 2016). Maize is the crop with highest production area among all crops and is amongst those with the highest demands for N fertilizer (Sivasankar et al., 2012). Application of new hybrids and integrated soil-crop management resulted in gradual increase in maize yields, so any advances made in N fertilizer use will lead to significant financial and environmental benefits (Chen et al., 2016). Although the nutrient focus in high-yield maize production is generally on N, equally important are the acquisition, timing and quantities of all macronutrients (Ciampitti et al., 2013).

Materials and methods

In our study 3 different maize hybrid genotypes (*Zea mays* L. H1: FAO 360, H2: FAO 420, H3: 490) were used to analyse the differences in the plant's nutrient distribution caused by the different nitrogen fertilization levels. To evaluate this effect a long-term small-plot field experiment was used at the Látókép Experimental Station of the University of Debrecen, with 5 different nitrogen levels (60, 120, 180, 240 and 300 kg*ha⁻¹ +PK) and with non-fertilized control plots (Nagy 2019). The macro- and mesonutrient (N, P, K, Ca, Mg and S) and Zn content of the stem and the leaves were measured 3 times at the initial development stage, in the first 4 weeks after plant emergence at Hanway Stage 0.5, 1 and 2 (Hanway 1966). The determination of the nutrient content was carried out at the premises of WESSLING Hungary Ltd, Budapest, Hungary, using Dumas-method for total nitrogen, ICP-OES and ICP-MS for metal analysis. R Studio and MS Excel 2019 were used for the statistical analysis.

Results and discussion

Significant differences were measured among the different hybrids, N levels and sampling times. The obtained data indicates that the different N levels can modify the distribution of each macro- and mesonutrients. Concerning the N treatment levels, the effects were significant among the control plots, the 60, 120 and 180 kg*ha⁻¹ levels. It can be concluded that the dynamics of nutrient acquisition is a hybrid-specific factor, which has to be well considered when choosing the suitable hybrid for the different crop management strategies.

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Examination of the nutrient content of various genotype maize hybrids at different N supply levels

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Keywords: maize, nitrogen, protein, starch,

Introduction

Maize can be utilized as feed, energy source and industrial raw material (Nagy, 2007). For achieving outstanding yield results and quality the selection of hybrids that are adapted to the conditions of the production site and the cultivation objectives is of key importance (Pepó, 2017). Protein content of the maize grain can be significantly increased through N-fertilization (Győri, 2002; Széles et al., 2018), however it reduces its starch content (Miao et al., 2006).

Materials and methods

Our experiments were carried out at the Látókép Experimental Station of the University of Debrecen. We analysed the effect of different N doses on the nutritional values of maize hybrids of different genotypes in two years (2018, 2019). In the scope of the experiment, in addition to the non-fertilized (control) treatment 60 (A_{60}) and 120 kg N ha^{-1} (A_{120}) doses as base fertilization in spring was followed by an additional +30 and +30 kg N ha^{-1} (V_{60} ; V_{120}) in the V6 and V12 phenophases. The nutritional values were determined by means of the Foss-InfratecTM 1241 Grain Analyzer.

Results and discussion

The protein content of maize was between 7.03-10.10 g (100g dm^{-1}) dry matter during the experimental years. For both hybrids, it was found that the control treatment had the lowest protein content, which was increased proportionally with the increase of fertilizer doses. In the case of the Renfor hybrid, protein content was not significant beyond the $V_{6_{150}}$ (8.93 g (100 g dm^{-1}); $P < 0.05$) treatment in 2018, and the A_{60} (9.30 g (100 g dm^{-1}); $P < 0.05$) treatment in 2019. In the case of the Fornad hybrid, the statistically confirmed highest protein content also changed in every year, which was achievable with the lower $V_{6_{90}}$ (9.17 g (100 g dm^{-1}); $P < 0.05$) treatment in 2018 and with the higher $V_{6_{150}}$ (9.93 g (100 g dm^{-1}); $P < 0.05$) treatment in 2019. The starch content ranged from 73.89 to 74.15 g (100 g dm^{-1}) dry matter during the examined years. The highest starch content in both years and for both hybrids was recorded in the case of the control treatment. In 2018, the Duncan test formed a homogeneous group for both hybrids, with no significant differences in the starch content of grains as a result of the treatments. In 2019, the starch content of the Renfor and Fornad hybrids developed similarly to that of the non-fertilized treatments as a result of the A_{60} treatment, but the additional fertilizer caused a significant reduction. There was a negative correlation between starch and protein content, which was different in the case of each hybrid.

Conclusions

It can be stated that the hybrids reacted with different nutritional values to the different N doses. Increasing the fertilizer dose resulted in a linear increase in protein content. The fertilizer dose had a statistically significant ($P < 0.05$) influence on the protein content of maize. It can be stated that the effect of increasing fertilizer doses on the decrease of starch content was significant ($P < 0.05$).

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Interaction between genotype in traits on FAO 340 hybrids based on GGE bi plot analysis

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Keyword: GGE bi plot analysis, Stability, Maize

Introduction

Chemical fertilizer changes significantly the relations between kernels and other part of the plant (Nagy, 2006). In the GGE bi plot graphical method, unlike other conventional methods, selections are made based on graphical analysis of data and data. This method has many capabilities and simplicity in interpreting outputs. (Mousavi *et al.*, 2019). Other researchers report stated that weight of cob, number of seeds in column and stem diameter have best yield in FAO 340 and FAO 380 and FAO 410 too (Mousavi *et al.*, 2019). Objective of this study was evaluation interaction between genotype in traits in six fertilizer treatment on FOA340 in Hungary.

Method and materials

In this experiment applied six treatment of fertilizer (T0 (N:0, P2O5:0, K2O:0), T1(N:30, P2O5:23, K2O:27), T2(N:60, P2O5:46, K2O:54), T3(N:90, P2O5:69, K2O:81), T4 (N:120, P2O5:92, K2O:108), T5(N:150, P2O5:115, K2O:135) on FAO340 hybrid. experiment carried out in center for agricultural science, institute of crop science Látókép in two years, that the GGE bi plot analysis done by Gen Stat software.

Results & Conclusions

The result showed that one thousand seeds, number of seeds in column, weight of fresh plant and stem diameter have desirable stability of the FAO 340 Hybrids in two years, also fourth treatment was best yield or best stability of the fertilizer treatment, after that fifth treatment, third treatment, second treatment, first treatment and control treatment were desirable stability of this study. GGE bi plot analysis cover 88.19% of all data in this study. Length of ear and number of seeds in row have desirable stability on all treatment of this study. Stability yield of FAO340 hybrids depend to fertilizer treatment and effect of fertilizer to each parameter of plant and find relation between sink to source in plant too.

Figure: Ranking of fertilizer treatment with traits in FAO340 hybrid (green secer (GR), Chlorophyll Meter (SP), stem diameter (SD), outer ear diameter (OD), number of nodes (NN), weight of ear (WE), weight of cob (WC), number seeds in each row (NSR), number seeds in each column (NSE), length of ear (LE), weight all seed in each ear (WSE), Number of seed in each ear (NSE), weight of fresh plant in hectare (WFP) one thousand seeds (IS), grain yield (GR). 0-5 level of the NPK).

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Granulated biofuel ash as source of plant nutrients

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Keywords: ash, fertilizer, nutrients, heavy metals

Influence of granulated ash in spring barley and soil

Recovery of nutrients from biomass combustion ash is of great importance for sustainable bioenergy waste use (Frans Lamers, 2018). Constantly expanding the biofuel boiler network there are large amounts of ash from this fuel that are not rationally used and accumulate as waste. Every year a large amount of biomass combustion ash is generated (Denmark 31 kton, Austria 133 kton, The Netherlands 234 kton, Italy 250 kton, Sweden 528 kton, Canada >1,000 kton). Biofuel ash is alkaline waste (pH ~ 13). It is therefore very useful to use it where there are acidic soils (pH <5.5). Ash contains a lot of nutrients (K, P, Ca, Mg), which are necessary for plants and soil. The environment benefits when less waste ends up in landfill sites and nutrients are returned to the environment from which they came. In this work, granulated fertilizer materials were engineered from biofuel ash, lime kiln dust and water, analyzed for their chemical complexity and tested in pot experiments (2017 -2018) for their propensity to release nutrients. For the experiment, we used three different ash variants of granulated biofuel, where the ash content in the granule was 30%, 50% and 70%. The XRD patterns attributed to calcium hydroxide, calcium carbonate and quartz were identified in all granulated biofuel ash samples. The main difference between the samples was the intensity of the calcium carbonate peaks, which decreased with increasing granule size. The results obtained in this work showed that spring barley yield improvement was observed to be the highest for granulated biomass ash with 70% of ash in the granule. The yield increased by 70.0% in 2017 and by 53.9% in 2018. The biofuel ash statistically significantly increased spring barley straw yield by 50.6 % in 2017 and 40.9% in 2018. When using granulated ash, an increase in total potassium in spring barley straw (21.5 – 28.0 g kg⁻¹) was observed in 2018 while in 2017 potassium did not change significantly. Calcium concentration significantly increased in soil, grain and straw. No significant changes in soil mobile phosphorus were obtained as well as for the heavy metal concentrations in soil. Cadmium (0.003 – 0.026 mg kg⁻¹) and zinc (4.58 – 22.2 mg kg⁻¹) were detected in spring barley grains and zinc, copper and chromium in straw. This suggests that biofuel ash can be a significant source of certain major nutrients for crops that can also beneficially affect soil pH. The results of this work can provide policymakers with the information needed to diversify existing and enable new biomass bottom ash utilization routes which currently vary significantly between the countries (Freire, 2015).

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Relationships between Cd and Zn content and photosynthetic apparatus efficiency in selected *Arabidopsis arenosa* populations from various sites in Central Europe

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Keywords: hypertolerance, cadmium, zinc, photosynthesis

Arabidopsis arenosa is a plant species, which frequently grows together with *Arabidopsis halleri* on metalliferous sites. This indicates that metalcolous populations of *A. arenosa* are well adapted to soils contaminated with heavy metals (HMs) such as Cd and Zn. However, in contrast to *A. halleri* that is a well known hyperaccumulator of Cd and Zn, there is a dearth of data on physiological responses of *A. arenosa* to treatments with Cd or Zn. *A. arenosa* occurs naturally both in diploid ($2n=16$) and tetraploid ($2n=32$) form, in contrast to *A. halleri* in which only diploid forms ($2n=16$) were found (Peer et al., 2006; Hollister 2015; Kolář et al., 2016). Populations of *A. arenosa* are observed in many places in Europe, but diploid populations were found mainly in south-eastern Europe on the Balkan Peninsula and in northern Hungary. *A. arenosa*, similarly as *A. halleri*, are known as pseudo-metallophytes, which are used to study adaptations to the environment highly contaminated with heavy metals (Sitko et al., 2017; Szopiński et al., 2019; Preite et al., 2019). Both species can be commonly found on metalliferous and nonmetalliferous sites (Fiałkiewicz and Rostański, 2006) however, it is suggested that in *A. arenosa* different mechanisms are involved in tolerance to metal toxicity compared to *A. halleri* (Preite et al., 2019; Szopiński et al., 2019). In contrast to *A. halleri*, *A. arenosa* is described as an excluder, a plant species that maintains physiological Zn and low Cd concentrations in its aboveground biomass in natural populations (Peer et al., 2006). 14 investigated sites with metalcolous (M) and non-metalcolous (NM) populations of *A. arenosa* were selected in Poland, Slovakia and Hungary. Populations in Slovakia and Hungary were selected on the basis of literature. Polish populations were selected on the basis of a preliminary research. From each site 10 individual plants with soil samples were collected. Before plant collection chlorophyll *a* fluorescence measurements were done for the same plants using the Plant Efficiency Analyzer (PocketPEA fluorimeter; Hansatech Instruments Ltd., England). Then in the laboratory collected plant and soil samples were acid digested in a microwave-assisted wet digestion system ETHOS1 (Milestone, Italy) and metal concentration was measured using flame atomic absorption spectrophotometer iCE 3500 FAAS (Thermo Fisher Scientific Inc., USA). The highest Cd, Pb and Zn content in shoots of *Arabidopsis arenosa* was measured for two populations from extremely contaminated sites. Piekary Śląskie and Miasteczko Śląskie in Poland. It was associated with the largest total concentration of these HM in the soil from the sites. Moreover, all 10 analyzed plants from these two sites showed traits of Cd and Zn hyperaccumulation in accordance with the definition proposed by Van der Ent et al. (2013). In *Arabidopsis arenosa* uptake and accumulation of Zn is much more efficient compared to Cd, because Zn hyperaccumulators have been shown for 5 out of 6 metalliferous sites, whereas hyperaccumulation of Cd was observed in plants derived only from 3 metalliferous sites. The highest efficiency of the photosynthetic apparatus characterized by the percentage of active reaction centers (RC) was observed for the non-metalcolous population, while the smallest percentage of active RC was recorded for the non-metalcolous from Hungary and metalcolous population from Poland.

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Effects of wetland rehabilitation with water buffalos to the water quality in lake Nagyszéksós (Mórahalom, Hungary)

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Keywords: saline lake, water buffalo, water chemistry, organic matter, habitat recultivation

Introduction

Sustainability project was implemented in 2012 by Kiskunság National Park and the local government of Mórahalom in the area of Lake Nagyszéksós aiming the rehabilitation of the protected sodic wetland. The former white saline lake started to dry in the 80's and by 1992 almost there was no open water surface left. The sodic character and the biodiversity significantly reduced and the former endemic flora and fauna mostly disappeared. Invasive plants species started to replace the local vegetation and continuous reed and bulrush covered the lake in 2000. These plants are the main sources of food for the water buffalo (*Bubalus bubalus*) therefore it was assumed that these animals are capable of maintaining the natural state excellently. A buffalo colony was settled to the area and by 2012 it was obvious that effective rehabilitation could have been began by the reed grazing. The reed withdrew from the southern buffalo-occupied area and former plant and animal species started to reappear. Nowadays buffalos are spread in the whole area of the lake and reed can be found only in some mosaic locations. The aim of our project was the assessment of the changes caused by the buffalo reservation and the following of lake's condition by monitoring the water chemistry.

Results and Conclusions

Water samples were taken and analysed from Lake Nagyszéksós in 2012 and 2019. Each water chemistry parameter was summarized in a distribution map. In 2012, results at the location of the buffalo herd were significantly different from the other parts of the lake and the water chemistry measures in this south-eastern area showed typical sodic lake characteristic (e. g. conductivity, sodium, carbonate). By 2019 the area of the buffalos was extended to the entire lake and accordingly every results corresponded to saline values.

In the course of the project we developed a new method for analysing the organic matter (fulvic and humic acid) suspended in the water with UV-Vis spectrometry. Absorbance values were measured from the samples in 320-800 nm wavelength range and the spectrum data were plotted on exponential curve: $y = A * e^{-k*(x-x_0)} + B$, where A is the maximum point, k is the slope of the curve, x₀ is the starting wavelength, and B is the intercept of Y axis. We found positive linear connection between A values and chemical oxygen demand concentrations of the samples. With this method the organic matter of waters can be real-time monitored.

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Influence of two pioneer tree species on the enzymatic activity and the microbial communities structure of soils contaminated with heavy metals

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Keywords: soil enzymes, PLFA, *Betula pendula*, *Pinus sylvestris*, heavy metals

Introduction

The dominance of different tree species, as well as long-term exposure to heavy metals, changes the functional structure of soil microbial communities, which is reflected in the activity of soil enzymes (Waldrop et al., 2000; Lasat, 2002). Plants interact directly and indirectly with soil microorganisms (Niklińska and Stefanowicz, 2015), e.g. in the root zone, the soil pH, and thus the bioavailability of metals, may be affected by the release of hydrogen or hydroxide ions by the roots (Hinsinger et al., 2006). The aim of this study was to determine the effect of pioneer tree species: silver birch and Scots pine on the activity of selected soil enzymes and the structure of soil microorganism communities under conditions of chronic heavy metal contamination.

Materials and methods

The study was carried out in three polluted sites located in the close vicinity of large non-ferrous metal smelters in southern Poland: Szopienice, Miasteczko Śląskie, and Bukowno. The control sites were located in Kórnik, central Poland, and in Złoty Potok, southern Poland. The pollution level was characterized using the toxicity indices for both total (TI_{Total}) and bioavailable (TI_{Bio}) concentrations of heavy metals. Other physico-chemical parameters were determined using standard methods. Activity of selected soil enzymes was determined according to Schinner et al (1996). The analysis of phospholipid fatty acid profiles (PLFA) was carried out in order to determine the structure of soil microorganism communities according to the methodology described by Pennanen et al. (1996).

Results and discussion

The activity of dehydrogenase, acid phosphatase, arylsulfatase and urease was negatively correlated with the heavy metal toxicity index TI_{Bio} . On control sites, the silver birch creates better conditions for soil microorganisms, probably due to the better litter quality, which was manifested by the higher enzymatic activity of the soils than in the pine plots. On the other hand, in industrialized areas, the activity of soil enzymes was more affected by physico-chemical properties than the tree species. The analysis of the contribution of particular groups of microorganisms showed that fungi on pine plots around the smelters have a higher contribution in the biomass of microorganisms than on contaminated birch plots. One of the reasons for the high proportion of fungal PLFA in soils on pine plots may be that fungi are more effective than bacteria in pine litter degradation.

Conclusions

On contaminated plots, the tree species influences the activity of soil enzymes and the structure of microorganisms, but this influence is regulated by the physico-chemical properties of soils.

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The relationship between the accumulation of cadmium and the level of root colonization by arbuscular mycorrhizal fungi in root hairs mutants of barley

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Keywords: barley, cadmium, photosynthesis, arbuscular mycorrhiza fungi

The aim of this study was to investigate the relationships between the development of root hair, root colonization by arbuscular mycorrhiza fungi (AMF) and accumulation of cadmium in barley (*Horedum vulgare*). The effect of Cd on photosynthesis was also measured.

Experiments were carried out with two barley genotypes: wild type 'Karat' and its hairless mutant *rhl1*. During experiment plants were cultivated in pots on arable field soil, which were sterilized. Additionally half of the sterilized soil was supplemented with commercial AMF inoculum. Soil in pots was spiked with Cd at different concentrations: 0 mg, 2.5 mg, 25 mg, 50 mg and 100 mg Cd per kg of soil. After 5 weeks of plant cultivation photosynthesis activity was measured on each first fully developed leaf. Relative anthocyanins content was measured using a plant pigment meter (DUALEX SCIENTIFIC⁺™, Force-A, France). Additionally, the Dualex device provided a Nitrogen Balance Index (NBI). Part of the roots were processed according to Philips & Hayman method and estimation of root mycorrhizal colonization according to Trouvelot et al. method was performed. Plant samples were oven dried and then digested using microwave digester system.

Shoot biomass was higher for Karat compared to its root hairless mutant independently on Cd and inoculum treatment. Also for treatments with low Cd concentration (< 25 mg Cd/kg) higher shoot weight was found in sterilized soil without inoculum. The effect of inoculation was the most pronounced in the highest Cd treatment (100 mg kg⁻¹ Cd). The same tendency was noted for the abundance of arbuscules in the roots. High anthocyanin content was observed at high Cd treatment, especially in the treatment without inoculation. The Nitrogen Balance Index was twice higher in Karat than in *rhl*. In addition, only for Karat NBI increased with increasing of Cd concentration in soil. Photosynthetic rate decreases with increasing concentration of Cd in soil, except for the highest concentration, what might be associated with the highest mycorrhiza abundance.

In conclusion, the higher abundance of AMF in roots reduce the negative effects of high cadmium concentration in the soil, especially in the case of the root hairless barley mutant.

Effect of the crop year's weather on the quality and quantity of winter wheat (*Triticum aestivum* L.)

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Keywords: winter wheat, gluten, weather effect, nitrogen, quality

Abstract

Improvements in technology, agronomy and cultivars have effectively increased the rainfall use efficiency of wheat at a greater rate than rainfall has declined (Sudmeyer et. al. 2016). Zampieri et. al. (2017) found that linear correlation between total global wheat production and globally averaged CSI explained 42% of the total variability in wheat production. Furthermore, the authors found that the effects of heat are comparable or even larger than the effects of water stress for most countries. protein based water footprint assessment seem to be more applicable in crop species evaluations than that of yield based methodologies. Since protein formation in all live systems represent a more advanced level in physiological processes (Eser et. al. 2019). Impact of the weather of the crop year on the quality and quantity of winter wheat varieties had been studied at the experiment field of the Crop Production Institute of the Szent Istvan University, Gödöllő/Hungary. All of the five winter wheat cultivars (Mv Karéj, Mv Nádor, Mv Toldi, Mv Toborzo and Alföld (*Triticum aestivum* L.) studied under identical agronomic applications. Tested winter wheat cultivars threated by six different N fertilizer in split and undivided way of application with 0, 80, 120, 160, 80+40 and 120+40. Undivided dosses applied on stage of tillering and in case of split dose application tillering and stage of heading was the application time on the 10 m² split-plot trials with nine replications. During the 2017-2018 season the weather was 28.57 % warmer in average than 2016-2017 season, however in 2016 total rainfall was 297.22mm that 2.2 mm slightly higher than 2017 where 295.02 mm rain was fallen to the experimental field/Gödöllő. As well as on the 2016-2017 season had 2259.5 hrs and 2017-2018 season 1994 hrs sunny hours were recorded. The warm and frost free winter period may have influenced the vernalisation processes of the crop (Jolankai et. al. 2018). The 2016–2017 crop year provided the wheat crop with more favorable results with better 6.51% gluten, 7.75 % protein and 8% on thousand kernel weight. Amongst the 5 tested cultivars Alföld manifested the greatest result in average 16% in protain and 36.8% gluten content both recorded on 2016-2017 season. Karej was the greatest one on thousand kernel weight with 48.47%.

Acknowledgement

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An investigation on replacement alternatives of the nutrient requirements of microalgae with agricultural byproducts

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Keywords: plant nutrition, microalgae, waste management, carbon dioxide mitigation, environmental biotechnology

Introduction

Due to the diverse utilization possibilities of the produced biomass, the biotechnology of microalgae is a rapidly increasing industrial sector. Uses include the production of healthy food, animal feed and valuable substance extraction in fine chemical industry. Microalgae can reach high growth rates and are capable of all year round production, which makes it a promising base material for bioplastic production. The ratio of lipids in microalgae can reach 20–50 % of dry weight of biomass, its production requires less water than terrestrial crops, and the cultivation in closed reactors does not require the application of herbicides and pesticides. These traits make microalgae a potential base of future biofuels, like biodiesel, biomethane or biohydrogen, (Dragone 2010) furthermore it is able to capture carbon dioxide (CO₂) from flue gases. However, the production of microalgae biomass in commercial scale is not yet available due to the costly dewatering techniques and the nutrient supply (Uduman 2010). The target of our research is to develop methods for the reduction of nutrition costs.

Materials and methods

The algae species used in this experiment was *Chlorella vulgaris* cultured according to the modified OECD (2006) algae test method. All treatments were run in quadruplicates where pH, electrical conductivity (EC) and optical density were measured on the days 0., 1st, 2nd, 4th. and 7th., while the N, P, K and Pb content of the media was measured in the initial and the final state. Control samples were grown on specific culture medium, while the treatments were grown in the aquatic extraction of nine different wastes and byproducts of agriculture, such as universal plant fertilizer, poultry, cattle, horse and swine manure, compost tea, mash, molasses and straw extract. All samples were set to EC 1000 µS/cm in the initial phase and were provided sufficient aeration and light density with a 12 hours per day illumination period for one week.

Results, conclusions

Our investigation indicated that algal growth was maintained in the exponential phase in all cultures during the one-week experiment, although there were large differences in the slope of the curves. The steepest growth curve was produced by the universal plant fertilizer, followed by poultry manure, compost tea and sewage sludge extraction. Changes in EC did not proportionally relate to changes in the biomass. The initial pH only affected the growth during the lag phase due to the continuous aeration which resulted in the free dissolution of CO₂. By the 7th day significant nutrient removal was detected in all samples.

Based on the results, we can declare that complicated algae culture media made in laboratories can be replaced by cheaper fertilizers. Moreover, specific agricultural byproducts or waste materials can also be a good alternative for culturing media. In order to balance the nutrient content of byproducts, mixtures of their different ratios should also be investigated.

Acknowledgement

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Analysing salty chernozem soil by soil scanning in consecutive years

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Keywords: electric conductivity, soil mapping, precision farming

Introduction

Nowadays precision farming has an increasing importance, and the data about the in-field difference is getting more valuable. These data sources for precision agriculture are satellite images, drone images, NIR images, yield mapping, soil lab data, and soil mapping. Electric conductivity (EC) is one of the values can be measured by soil mapping, and its value is determined by several factors including soil humidity, salt concentration, cation exchange capacity, physical soil quality (Brickleyer-Brown, 2009; Ragan et al, 2019).

Materials and methods

The examined field is 27.5 ha in area, the soil type is chernozem, located on the west side of Hajdúsági loess plateau, its physical characteristics is loam, with 3 major salt spots with high sodium content. The soil scanning was carried out in by VERIS U3 deceive with EC sensor in April 2018 and September 2019. Prior to soil scanning the last tillage was done by field cultivator both times. The swath distance for scanning was 10 metres, and it was conducted in one direction, diagonally to the cultivation; the field boundaries were scanned in 2 parallel lines 5 and 15 metres from the edges. In 2019 digital elevation data were acquired with 2 cm accuracy. The soil scanning data was converted to 10 x 10 m squares for comparison. The spatial data analysis, map generating was done with the help of Surfer, QGIS and statistical analysis was run in RStudio software.

Results and discussion

The two soil EC scanning was compared to each other and to elevation according to the 10x10 grid, which resulted over 2500 values. The high EC values (*Figure1*) showed similar distribution to the elevation and values. The results of the EC 2018 and 2019 measurement had a very strong correlation ($R^2 = 0,54$) to each other. Comparing EC 2018 and elevation resulted ($R^2 = 0,29$) a strong correlation but EC 2019 and elevation resulted weak correlation ($R^2 = 0,10$) probably due to drier soil conditions in September 2019.

Figure1: The distribution map of EC values

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Induced climate impacts on mycotoxins contamination in maize

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Keywords: maize, mycotoxins, storage, climate chamber

Introduction

Maize is an important commercial crop in Hungary. The biggest problem for food and feed safety is caused by the *Fusarium* species. The main problem is caused by mycotoxins, which get into the food chain they can be a serious threat to public health. Furthermore, we have to pay attention to the problem of the effects of global warming that influence the growth of microbial infections in different ways (http1). In the results of Veres et al (2002) *Fusarium* infection and toxin contamination were mainly due to vintage, temperature and precipitation effect. Major *Fusarium* mycotoxins that can occur in maize and maize-based products are deoxynivalenol (DON), zearalenon (ZEA) and fumonisin (FUM). This is why we considered it important to investigate the occurrence of these toxins, including quantitative changes during storage of the crops under artificial conditions.

Materials and methods

For the experiment, we selected 2018 maize samples that were infected with *Fusarium* but did not contain mycotoxin. These samples were stored at various laboratory settings to simulate unprecedented storage conditions. The samples (25 g) received different amounts of water, 0, 10, 20, 30 and 40 ml and it was placed in a climate chamber at 30 °C for 0.5, 1, 3 and 7 days, all in triplicate. The three mycotoxin contents we tested were determined by the Rosa FAST5 DON / ZEA / FUM quantitative test.

Results and discussions

The DON and ZEA toxins were not found in the tested maize. Vesonder et al. (1982) observed that deoxynivalenol strains of *F. graminearum* and *F. culmorum* the optimum temperature for the production of DON was 29-30°C and 25-26°C on wet (30%) maize. Fumonisin was detected in more samples. Half a day at 0 ml with minimal growth. After one day storage, 30 ml had the highest value, averaging 850 ppb. After 3 days, 10 ml reaches 1850 ppb, the highest of all values. After 7 days, 20, 30, 40 ml values are around 1000 ppb.

Conclusions

The stress effects caused by storage triggered and increased the production of fumonisin mycotoxin from *Fusarium* species. As the duration of the faulty storage and the amount of water increased, we could see that the amount of FUM has also increased, separately in proportion to the two independent factors, or in synergy when combined. I would like to continue my research on several temperature parameters and share it on Alps-Adria Scientific Workshop.

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Addressing climate change adaptation governance in mountain regions

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Keywords: Adaptation; climate change; mountain regions; procedure

Setting up a procedure for sub-regional adaptation measures in the Alps as an application of the Budoia Charter for local adaptation

Governance of climate change adaptation received a growing attention in recent times. Much focus is often placed on the level at which adaptation takes place, depending on the affected administrative units, governance structures (e.g. countries, regions, municipalities) and planning/programming instruments (Bonzanigo et al., 2016). However territorial and geographical differences can be dramatic even between similar administrative units, depending on characteristics that shape territorial units not corresponding to institutional and administrative borders as set by the law (Hanssen et al., 2013; Hamilton & Lubell, 2018). Mountains are a case with non-conventional territorial units that tend to show recurring features of particular relevance for climate change policy. Notwithstanding their distinctive characteristics – object of long lasting research – they are usually subject to the same set of spatial planning instruments that apply to any other part of the territory in a country. In this paper we present the prevailing governance structure of climate change in mountain territories, by focusing on the case of Italy where national to regional instruments address mountain zones in the country. We also provide an overview of governance approaches in other countries of the Alpine region (e.g. Austria, Germany, Slovenia, Switzerland). We focus on the application of the “Budoia Charter” in some sub-regional sites across the Italian Alps. The Charter is a voluntary tool for adopting and implementing sub-regional adaptation measures launched jointly by Italy and the Network of Municipalities “Alpine Alliance” in 2017, following the Guidelines on local adaptation to climate change in the Alps developed under the Italian Presidency of the Alpine Convention (2014). We aim to set up a standard procedure for identifying suitable adaptation actions for sub-regional territorial units (municipalities and their groupings, according to territorial or administrative criteria) and some proposal for adjusting regional to local planning tools in a mountain environment, assuming current institutional governance structures as stable in the short run. We use existing figures and information, and regional/local stakeholders' assessment aiming at identifying suitable adaptation measures for mountain areas in general and for the sites under inquiry. Selected measures are assessed for their alignment to overarching and/or legally binding plans (PNACC, 2017) in order to identify mountain and site-specific adaptation measures coherent with binding plans. As a result, we expect to identify a modular approach based on quantitative and qualitative indicators aimed to frame a Decision Support System for sub-regional application of adaptation measures. Research aims at designing a structured procedure for assessing distinctive characteristics of areas where adaptation measures are to be implemented and for selecting appropriate measures. The procedure will be tested in five pilot-areas at the sub-regional level from Western to Eastern Italian Alps, and is planned to be further extended to other mountain regions in Italy and worldwide.

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Soil nitrogen and organic carbon in different uses in Terric Histosol

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Keywords: terric histosol, carbon, nitrogen, C:N

Introduction

Changes in organic matter and other chemical composition in histosol are much more intensive and faster than in mineral soils (Šlepetienė et. al., 2013). Extremely fast organic matter mineralization of histosol occurs in cultivated peatlands (Norberg et. al., 2016), which not only decreases organic matter concentrations but releases significant amounts of CO₂ into the air and releases nitrate nitrogen in deeper histosol layers to the groundwater. (Čermák et al., 2009). To reduce organic matter degradation and nitrogen pollution, grassland vegetation is grown in terric histosol (Volungevičius et. al., 2015).

Materials and methods

In 2016-2019 in Eastern Lithuania in Naujienos terric histosol (*HSS-d*) natural meadows, cultural meadows and annually cultivated areas of cereal crops there were monitoring sites installed. Where at different times of the year at different histosol depth - 0-30, 30-60 and 60-90 cm layers, organic carbon (C_{org}), total nitrogen (N_{sum}), mineral nitrogen (N_{min}) concentration and their relationship were investigated.

Results and discussion

Studies have shown that the highest N_{min} concentration was found in natural meadows, followed by cultural meadows and finally cereal crops in terric histosol at the 0-30 cm depth – mean concentrations were obtained, respectively 100.7, 88.3 and 79.0 mg kg⁻¹. The highest N_{min} concentration was observed in the first days of July. It was 137.6 and 105.4 mg kg⁻¹ in natural and cultural meadows respectively. In the deeper terric histosol layers, the N_{min} concentration in cereal crops was slightly different. At the 30-60 cm depth, it ranged from 45.6 to 102.2 mg kg⁻¹ over the years, and at the 60-90 cm depth from 55.1 to 87.2 mg kg⁻¹. C_{org} concentration at the 0-30 cm depth in natural meadow was 41.2 %, in cultural meadow – 35.6 % and in cereal crops – 19.4%. The same sequence of N_{sum} concentration was found – 3.04, 2.18 and 1.97 % and C:N ratio – 13.6, 16.3 and 9.8 %. The calculated correlation between the investigated agrochemical indices in the 0-30, 30-60 and 60-90 cm lowland layers showed that mineral nitrogen correlated best with C:N ratio, total nitrogen concentration and to a lesser extent with organic carbon concentration (Table 1).

Table 1: Correlation between N_{min} (y) content and agrochemical indices (x) in 0-30, 30-60 and 60-90 cm depth. (n=18)

Terric Histosol depth	C _{org} %	N _{sum} %	C:N
0-30 cm	0.341	0.618*	0.872**
30-60 cm	0.564*	0.568*	0.562*
60-90 cm	0.362	0.358	0.286

* - significant at the 0.05 level, ** - significant at the 0.01 level

At the deeper terric histosol layers the values of these indicators differed slightly between the crops. N_{min} concentration at 0-30 and 30-60 cm depth correlated best with C:N ratio ($r_{0-30\text{ cm}}=0.872^{**}$, $r_{30-60\text{ cm}}=0.562^{*}$), N_{sum} concentration ($r_{0-30\text{ cm}}=0.618^{*}$, $r_{30-60\text{ cm}}=0.568^{*}$) and to a lesser extent with C_{org} concentration ($r_{0-30\text{ cm}}=0.341$, $r_{30-60\text{ cm}}=0.564^{*}$).

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The interaction between the yield and the relative chlorophyll content of the maize leaves in a long term field experiment.

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Keywords: maize, chlorophyll, SPAD

Correlation of measured SPAD values and yield

The purpose of this study is the analysis of relationship between the measured SPAD-values of the maize leaves and the yield in a long term field experiment. The examinations were carried out in 2019 at the Látókép Experimental Site of the University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management (47° 33'N, 21° 26'S, 111 m).

The Minolta SPAD-502 chlorophyll meter was found to be a reliable, quick, fast and non-destructive tool for a directly measuring leaf relative chlorophyll content. (Costa, 2006) The tool calculates chlorophyll content, namely SPAD, ranging from 1 to 100 (Minolta Camera Co. Ltd., 1990). Chlorophyll content of the plant is in close correlation with the amount of yield (Ványiné, 2012; Montemurro, 2006).

Multiple authors have found positive correlation between the measured SPAD values and the amount of yield (Markwell, 1995; Reyes, 2017) The tests were carried out at 5 measuring times, 4-leaf 6-leaf, 10-leaf stage, silking and the in the stage of grain filling of maize in 10 repetitions.

The statistical analysis was performed in R statistical environment (R Core Team, 2018), by means of RStudio (RStudio Team, 2016) graphical interface using the “agricolae” (de Mendiburu, 2016) software package. In the study, the treatments of 80,000 plants/ha and 60,000 plants/ha was selected from the experimental data. Linear regression analysis was performed to analyse the correlation between SPAD and yield. The example code for this analysis in the R statistical environment is the following:

```
model <- with(database, lm(measured_variable1 ~ measured_variable1))
summary(model)
anova(model)
```

Based on the regression analysis it can be concluded that the plant density has an effect on the relative chlorophyll content of maize leaf. The analysis of the amount of yield and the SPAD values obtained in the 60,000/ha plant density indicates that there is a low ($r = 0.31$) significant ($p < 0.05$) correlation between the obtained values. The similar tendency was found with the 80,000/ha plant density. we found lower ($r = 0.29$) significant ($p < 0.05$) correlation between the yield and the measured SPAD values. Yield was influenced by the measured SPAD values at 9,4% at the plant density of 60,000/ha and 8,4% with the plant density of 80,000/ha.

Table 1: Correlation of SPAD and yield in different planting

SPAD-yield	r ²	r ² %	r	significance
60000 plants/ ha	0,09431	9,431	0,3071	0,000172***
80000 plants/ ha	0,08474	8,474	0.2911	0,000361***

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Past and Future Carbon Dioxide Emissions in Hungary

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Keywords: Agricultural sector, Energy sector, CO₂, ARIMA, Hungary.

Introduction

The European Union was applied many strategies for minimizing greenhouses gases emission (GHGs). Interestingly, a negative trend in the GHG emissions in most of the EU was detected (Mohammed et al., 2019a; Mohammed et al., 2019b) The main aim of this research was to analyse CO₂ emissions from all sectors in Hungary between 1985 and 2016 then to predicted future CO₂ emissions based on recorded data.

Methods

To achieve the study goals, CO₂ emissions data were collected from the Hungarian Central Statistical Office (Ksh). After that, the Mann-Kendall trend test (M-K) was applied for detecting trend in the time series. In the last step, the ARIMA model was applied for predicting future emission changes.

Results

A significant reduction of carbon CO₂ emissions ($p < 0.001$) from different sectors (i.e. energy, industry and households) were detected. In contrast, a positive significant trend was noticed for biomass (agriculture) and transportation sectors. Results also reveal those upcoming years till 2040 will witnessed a remarkable decrease in CO₂ emissions from different sectors except agricultural and transportation sectors, as can be seen in Fig.1 (white blue and dark blue).

Figure.1 Predicted CO₂ emission from different sectors in Hungary till 2040

Conclusion

All in all, the total emission of CO₂ in Hungary was reduced significantly from different sectors. While a serious concern should be taken into consideration regarding emissions from agricultural and transportation sectors

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The impact of liming with pelletized lime kiln dust on the yield and soil chemical parameters

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Keywords: liming material, soil pH, liming, soil parameters

Introduction

Soil acidification is an ongoing natural process in nature but it can be caused by acid rain, leaching of nutrients, using physiologically acid fertilizers and other (Haynes and Naidu, 1998). Liming is the most economical method of ameliorating soil acidity. Applying various types of liming materials can neutralize hydrogen ions in soil solution, reduce the availability of elements that are less soluble at higher pH values and increase the availability of nutrients that are more soluble at higher pH values (Bolan et al., 2003). Lime kiln dust (LKD) is a fine particulate material produced during the lime burning processes. Due to the presence of Ca, Mg and other microelements which can serve as micronutrients to the plants, LKD has the potential to be used as a replacement for conventional liming materials for both soil pH increase and plant supplement with secondary major and micronutrients.

Materials and methods

The pot experiment was conducted in 2016 at the LAMMC Agrochemical Research Laboratory testing site. The liming rates 1, 2 and 4 t/ha was calculated by the amount of active substance. Spring barley *Ema DS* was grown in vegetation pots. For the experiment were used 7 different liming materials: ground chalk, crushed dolomite, crushed limestone, pelletized LKD and pelletized LKD with humic acid. A chemical analysis of liming materials was carried out with ICP-OES spectrometer and Atomic Absorption spectrometer. The determination of soil pH was made in 1:5 (v/v) soil suspension in the 1 M KCl solution.

Results and discussion

In this work, we explored a range of liming conditions (1, 2 and 4 t/ha of liming material). Quite unexpectedly, the data showed that different liming materials did not have the same effect while neutralizing soil pH. The quickest and the highest increase in soil pH was with applied GC. PLKD with a fine fraction reached similar pH values after 48 weeks of 4 t/ha application as those for CD and CL. The application of PLKD with coarse particles did not significantly increase Ca content in the soil even after the highest application rate. The finest fractions of pelleted liming materials significantly ($P \leq 0.01$) increased exchangeable Ca content in soil when compared to control at all application rates. This increase may be possible due to the $\text{Ca}(\text{OH})_2$ content in pelleted liming materials. The highest rate of liming materials increased spring barley grain yield but not statistically significant. The highest yield improvement was obtained when liming with GC. PLKD 0.1-2 and PLKD HUM 0.1-2 increased grain yield compared to control by 5.54 % and 7 %, respectively, but not statistically significantly.

Conclusion

LKD can be pelletized alone or with additives and the addition of humic acid additive increased pellet strength. Pot experiment results showed that all application rates of the finest size of PLKD statistically significant increased exchangeable Ca concentration in soil. Also PLKD 0.1-2 and PLKD HUM 0.1-2 increased soil pH to the desired optimal range after 24 weeks of liming at all application rates. The PLKD with coarse particles did not significantly increase exchangeable Ca and Mg content in soil and did not reach optimum pH range after 48 weeks.

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A set of molecular genetic analyses in the case of apricot (*Prunus armeniaca* L.) clones

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Keywords: microsatellites, retrotransposons, iPBS, MSAP, SSR

Introduction

In plant breeding application of molecular markers have been found as an efficient method for genetic analysis, early selection, and fingerprinting. In our institute microsatellites are well utilized analytical tool for *Prunus* genus. SSRs (Simple Sequence Repeats) are highly polymorphic and their transferability within wide cross-species are useful for examine intra- and inter-families to develop comparative maps (Cipriani et al., 1999; Dirlwanger et al., 2002; Blaker et al., 2013). However, in the case of clones new approaches need to be introduced. Our aim was to bring in new practices to determine differences between apricot (*Prunus armeniaca* L.) clones using several molecular methods (SSR, iPBS, MSAP) (Kalendar et al, 2010; Baránek et al., 2012; Avramidou et al., 2015).

Material and Methods

We have analyzed apricot clones which were provided by the National Food Chain Safety Office. Microsatellite examinations were carried out using 15 *Prunus* specific SSR primer pairs. Moreover, iPBS (inter-Primer Binding Site) markers were introduced and MSAP (Methylation Sensitive Amplification Polymorphism) were analyzed.

Discussion and Conclusion

Apricot clones were checked using SSR markers, only clear, reproducible and well-separated bands were selected for scoring. From the given samples one of them proved to be different even in the case of SSRs. We have further investigated the plant materials using iPBS retrotransposon-based markers and MSAP. We have discovered different bands with these tools, which were isolated from the gels. We would like to further analyze them by sequencing and by using bioinformatic methods in order to develop markers which could routinely be used for genotyping.

Further samples and primers are to be used in order to get more precise results in the case of clone analysis. Since stock nurseries are not allowed to develop fruits, thus it is complicated and challenging to distinguish genotypes based on fruit morphology. Therefore molecular genetic analyses –like ours - would support breeders to identify genotypes more efficiently.

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Correlation between the patterns of anthocyanin, total polyphenol content and antioxidant capacity of *Capsicum annuum* L. in different phenophases

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Keywords: anthocyanin, *Capsicum*, biosynthesis, antioxidant

Introduction

Pepper (*Capsicum annuum* L.) is an important vegetable crop not only in Hungary but worldwide as well. Not only the chemical composition of the berries is important but their colour is also of high significance. As in the case of several other *Solanaceous* crops, the anthocyanin biosynthesis of peppers has been well described. However, there are some contradictions regarding the regulation of the pathway which would be crucial to understand because of nutraceutical properties of the anthocyanins (Winkel-Shirley, 2002, Deepa et al, 2008).

Their occurrence is scarce in case of *Capsicum* species although there are some exceptions; there are different varieties which are bred for ornamental purposes due to their elevated level of accumulated anthocyanin (Lightbourn et al., 2008). Anthocyanin biosynthesis starts from phenyl-alanine (phenylpropanoid pathway) and can be divided into two main phases, namely the early and the late biosynthetic pathway. The genes of the late biosynthetic pathway are governed by the so-called MBW complex, consisting of R2R3-MYB, WD40 and bHLH transcription factors. Our aim is to study the anthocyanin accumulation with regard to the changes of the nutraceutical composition of the berries.

Materials and Methods

A white berried Soroksári type pepper was used as a negative and an extreme lilac *C. chinense* pepper was applied as a positive control, respectively. Berries were sampled in 4 different phenophases (early green stage, late green stage, turning, biologically ripe) over the course of 2 years. For the gene expression studies RNA was isolated, reverse transcribed and the qPCRs were carried out. For the analytical studies the samples were extracted with formic acid-methanol solution and the total monomer anthocyanin (TMA), total polyphenol content (TPC) as well as the antioxidant capacity (FRAP) of the berries were measured with spectroscopic methods in the 4 phenophases.

Discussion and Conclusion

Tendencies were observed between the TPC and FRAP, these values showed positive correlations throughout the ripening of the berries. As for the gene expression, our results indicate that the R2R3-MYB transcription factors promote the expression of the late biosynthetic genes only. The expression pattern of one of the studied putative R2R3-MYB transcription factor displayed a positive correlation with the anthocyanidin synthase gene. In the two green stages where the expression of anthocyanidin synthase had elevated values, both the TPC and FRAP values were higher as well. Therefore we suppose that the effects of anthocyanins to the overall antioxidant capacity of the berries are additive.

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The effect of grain chemical composition of cereals on the *Fusarium* infection and mycotoxin contamination

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Keywords: *Fusarium*, cereal, mycotoxin

Cereals are crop plants that have always been in the first place in field crop production for a long time. In Hungary the maize and the wheat are the most important crop plants from the point of view of area harvested. Both of these cereals can be infected by different fungal diseases during the production period. Some of the fungal problems occur in different phenophases like the *Fusarium* infection. In case of the late *Fusarium* infection, the head blight, the damage caused is twofold, in addition to the quantitative losses in yield, there could occur some accumulation of different chemical compounds (Kató 2019). In the second part of the 20th century it was found that some of that chemical products can be harmful for mammals, for the human as well (Rotter 1996). We call them mycotoxins. First the T2 was described and abortion in pig reproduction was found. As it has high importance, we know more and more about the *Fusarium* infection (Tarnawa 2018), but the environmental conditions for the mycotoxin production are still unclarified.

The experiment was carried out in the experimental field belonging to the Szent István University. It is situated in Gödöllő, in the centre of Hungary with typical climate for the whole region. As different combinations of agrotechnical elements were used in the same experiment, samples of grain could be gained with different chemical composition from the same cropyear (Jolánkai 2019). The yield quality was measured in the laboratory of the Crop Production Institute by the use of INSTALAB 600 NIR analyser. The fungal infection was measured by the use of *Fusarium* specific media in petri dishes. The mycotoxin contamination was measured by ROSA analyser. The evaluation was made by the use of MS Excel software package with the correlation and regression analysis. Tendencies were found between the chemical composition and *Fusarium* infection; just as the mycotoxin contamination.

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Effect of EDTA on soil element content

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Keywords: soil heavy metals mobilisation, EDTA

EDTA (Ethylenediaminetetraacetic acid) is a powerful complexing agent of metals and a highly stable molecule, offering a considerable versatility in industrial and household uses. Its presence in soils may be due to agrochemical application or to the disposal of products containing EDTA in land and soil reservoirs. EDTA has received considerable attention in agronomy: (i) Estimating the potential metal mobile pool and the metal bioavailability. (ii) Soil remediation process. (iii) Trace metal fractionation studies. (iv) The supply of micronutrient cations for plants (Manouchehri and Bermond. 2009)

However, the availability and mobility of heavy metals in soils were low and difficult to absorb by plants, so it limits the extraction efficiency of plants (Neugschwandtner et al. 2012). Therefore, a series of artificial and natural chelating agents have been developed to increase soil heavy metal activity. About 80% of the total soil metal is solubilized and becomes available for phytoextraction when EDTA is applied (Haag-Kerwer et al., 1999).

The mobilisation effect of the EDTA on various potential toxic elements could be measured simply if well-known artificially soiled soils were treated with different EDTA concentrations solution. For that 500g 3 different type of soils (Nyérség soil - acidic sandy soil, Józsefmajor – chernozem soil, Szárirópuszta – brown forest soil) were prepared to the 100% of the field water. The concentration of the soils was 100 mg.kg⁻¹ of potential toxic elements (Ni, Pb). The homogeneously mixed samples aged at incubation temperature and humidity for 3 weeks. The amount of extractant (EDTA) was set at 8 levels, with the following concentrations: 0; 1; 5; 10; 50; 100; 500; 1000 mg.l⁻¹. These concentrations are 1:10 (10 ml of appropriate extractor for 1g of soil) 0; 10; 50; 100; 500; 1000; 5000; Concentrations of 10,000 mg.kg⁻¹ were reported on soil. In addition, the presence of lime and EDTA may be a problem in determining the amount of potentially toxic elements in soils with high lime content. In this case, potentially toxic elements are not solubilized by the action of a certain

In general, the model result showed, that the concentration of the ions in the solution increased in decreasing pH values and increasing EDTA concentrations. The rate of increase of the different ions varied, however, it can be estimated with good approximation by the help of the modelled values. The solved and desorbed ion concentration was increased by increasing EDTA concentrations. The mass balance and from this, the liquid/solid partition coefficient were calculated from the measured ion concentrations and the added amount metal ions. The partition coefficient values generally increased by the increase of EDTA concentrations according to the solution concentrations.

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PHARMATÉKA PREVENTIVE KFT. <http://www.pharmateka.hu/>

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Does plants really enhance soil enzymatic activity in the surface layer of spoil heaps after hard coal mining: monocots versus dicots

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Keywords: soil enzymes, monocots, dicots, soil functional diversity, species diversity, biomass

Introduction

Till now many studies have been conducted on the activity of soil enzymes in the agricultural areas or forest ecosystems, as well as some anthropogenic sites (areas contaminated with heavy metals, open cast lignite mining, spoil heaps after brown coal mining) (Zak et al., 2003). Only a few studies on the activity of soil enzymes, soil diversity and aboveground vegetation were carried out in the spoil heaps after hard coal mining (Li et al., 2015). We examined vegetation patches dominated by commonly occurring herbaceous species on soil heaps (*Poa compressa*, *Calamagrostis epigejos*, *Daucus carota* and *Tussilago farfara*). The aim of the study was to determine which physico-chemical substrate parameters and/or biotic factors (functional groups of species: graminoids other forbs, biomass of a dominant species, species diversity) decide on enzymatic activity of post-industrial substrate, (ii) to study the relationship between vegetation diversity and soil functional diversity.

Materials and methods

The study was carried out on coal mine spoil heaps located in the Silesian Uplands (Southern Poland). 60 sample plots were established to examine relation between vegetation dominated by *Calamagrostis epigejos*, *Poa compressa*, *Daucus carota*, *Tussilago farfara*, species commonly occurring on the spoil heap and enzymatic activity of substrate (15 plots for each dominant). In each plot floristic composition and abundance of species in percentage was estimated. The aboveground part of the plant biomass has been collected from the 0.25 m² quadrats. The weight of fresh biomass was determined in the field, next samples were dried at 105°C for 48 hours in an incubator and weighted to determined dry biomass. Moreover 15 control plots without vegetation were founded. In each sample plot the rhizosphere soil was taken from a depth of 10 cm to determine physicochemical soil parameters and activity of soil enzymes (Schinner et al., 1996).

Results and discussion

The activity of dehydrogenase and alkaline phosphatase was highest in plots dominated by grasses (*Calamagrostis epigejos*, *Poa compressa*) in comparison to other herbs (*Daucus carota*, *Tussilago farfara*). Significant positive correlations were found between pH, P₂O₅, soil moisture and dehydrogenase and alkaline phosphatase. Dehydrogenase activity was also positively correlated with MgO. Strong positive correlations were found between dehydrogenase, alkaline and acid phosphatase and water holding capacity. Negative correlations were found between activity of urease and acid phosphatase and soil organic carbon. Strong correlations were found between grasses, Shannon-Wiener diversity indices (H'), Evenness, species richness and soil functional diversity for plots dominated by grass species (*Calamagrostis epigejos* and *Poa compressa*) and plots dominated by herbaceous species (*Daucus carota*, *Tussilago farfara*) (with the exception of Evenness)

Conclusions

Understanding the way how the co-development of spontaneous vegetation and the soil biota communities goes on will provide a powerful tool to enhance the restoration processes based on natural mechanisms as well to improve the overall biodiversity of the site and its surroundings.

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The influence of long-term anthropopressure on species and functional diversity of vegetation of large urban river valleys

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Keywords: physicochemical soil parameters, vegetation, species and functional diversity, urban river, functional traits

Introduction

Vegetation can be treated as a sensitive indicator of anthropogenic changes in both biotic and abiotic conditions of the riverine ecosystems. Changes can be detected in species and functional diversity, serious transformation or even disappearance of the original species combinations or creation of some novel combinations of species, frequently dominated by some expansive or invasive species that are better adapt to habitat conditons. The aims of the study were: (i) to recognize the species and functional diversity of the vegetation of the Kłodnica valley being under different impact of anthropogenic transformations, (ii) to determine relationship between soil parameters and diversity of vegetation.

Materials and methods

In order to show the influence of anthropopressure on the vegetation of Kłodnica valley, some seminatural and anthropogenic sections were selected. In semi-natural sections (e.g. Katowice), Kłodnica flows in unregulated or slightly regulated riverbed. This area is less populated (242 inhabitants/km²), forest and agricultural land use and a large dispersion of single-family buildings dominate (Otwarty Regionalny System ... 2016). The anthropogenic section (Gliwice) is characterised by densely populated (2081 inhabitants/km²), regulated riverbed, lack of natural thickets and riparian forests, dominance of compact urban and industrial buildings and sport-recreational infrastructure (Hanczaruk and Kompała-Bąba, 2019). Sample plots were founded in patches of vegetation. Mixed soil samples were collected in order to determine physico-chemical soil parameters (Bednarek et al., 2004). Relationships between soil parameters and chosen functional traits of species were determined by performing Principal Component Analysis (PCA).

Results and discussion

The actual vegetation of the Kłodnica valley is represented by 18 phytocoenoses along the semi-natural section and 13 plant communities along anthropogenic section. Statistically significant influence of anthropopressure on the species richness ($Z = 3.09$; $p = 0.002$) and species diversity ($Z = 2.76$; $p = 0.005$) of vegetation and values of hemeroby ($Z = -1.97$; $p = 0.049$) and urbanization ($Z = -2.66$; $p = 0.008$) indices were detected. Average values of hemeroby indicators (semi-natural section = 3.45; anthropogenic = 3.76) and urbanization (semi-natural section = 2.42; anthropogenic = 2.87) indicate moderate influence of human pressure on the vegetation of the semi-natural section of Kłodnica valley and synanthropization of plant communities of the anthropogenic section. Analysis of chosen functional traits of species along gradient of anthropopressure allowed 5 functional groups of species to distinguished. They reflect life strategies of native and alien species that enable them to adapt to habitat conditions.

Conclusions

The anthropopressure has influence on both and abiotic (physicochemical soil parameters) and biotic parameters (species and functional diversity) of vegetation dominated by expansive native or invasive alien species.

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The effect of agronomic practices on yield and malting quality of barley in dry conditions

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Keywords: malting barley, soil tillage, previous crop, protein content in grain, seed grading

Spring malting barley (*Hordeum vulgare* L.) is a traditional crop in the Czech Republic. Present climate variability and changes in the frequency of extreme events are essential for yield level and malting quality of barley. In our study we analysed the effect of three pre-crops (grain maize, sugar beet and spring barley) and two soil tillage systems – conventional with inverting soil by ploughing to the depth of 0.24 m (CT) and shallow loosening by chisel cultivator to the depth of 0.15 m (ST). Three-year data set (2017-2019) consisting of yield, proteins content in grain and seed grading (proportion of grains above 2.5 mm sieve) from the Field experimental station in Žabčice (South Moravia, 49°01'20"N, 16°37'55"E) were evaluated by analysis of variance (Statistica 12, StatSoft, Inc.). The site belongs to the hottest and driest areas in the Czech Republic, with more frequent droughts occurring in recent years. The nitrogen fertiliser was applied at the rate of 60 kg/ha before sowing. Spring malting barley of cultivar Bojos was sown with the sowing rate of 400 seeds per square meter. Post-emergent herbicide was applied and the canopy was treated with fungicide against leaf diseases at the stage of stem elongation.

Analysis of variance revealed significant effects of year and pre-crop on grain yield. The lowest yield was in 2018 (4.39 t/ha) compared to 2019 (6.74 t/ha) and 2017 (6.62 t/ha). The lowest grain yield was after grain maize (5.40 t/ha), while higher yield was after sugar beet and spring barley (6.07 and 6.28 t/ha, respectively). Protein content (PC) in the grain was influenced by year, pre-crop and soil tillage. The lowest content of PC was in 2019 (11.5%), higher in 2017 (12.4%) and the highest in 2018 (13.5%). After spring barley, the PC content was the lowest (12.0%) compared to the pre-crop maize (12.5%) and after sugar beet (12.9%). After ploughing, the PC content was higher than after loosening (12.9 vs. 12.5%). The highest seed grading (SG) was in 2017 (81%), lower in 2018 (79%) and the lowest in 2019 (only 60%).

The results illustrate reduction of grain yield and decrease in quality parameters in malting barley due to year, especially when higher (extreme) temperatures were combined with lower total precipitation during vegetation. High content of PC (above the limit acceptable for malting industry) was found after sugar beet and grain maize. In both cases crop residues (beet leaves and maize straw) may be the reason, because they are decomposed more slowly in drier conditions and released nitrogen is thus available even at the time of ripening. Bundy et al. (1993) and Agehara and Warncke (2005) state that nitrogen release from organic N source is difficult to predict as N mineralization is influenced by soil moisture and temperature and varies based on location and year. The higher PC content after ploughing can be in relation to the higher porosity and aeration of the soil in this intensive tillage, which promotes mineralization and release of nitrogen into the soil. Similarly, Carr et al. (2014) resulted that tillage has been found to influence malting barley grain quality, especially barley grain protein concentration, averaging 13.1 % in a conventional, 12.1 % a reduced (single tillage to 0.20 m depth), and 11.3 % in a no-tillage system.

The above mentioned results show that spring barley production for malting use is risky in drier conditions. Consequently, the areas of spring barley are commonly replaced by winter barley or other crops with higher profitability.

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Evaluation of wheat varieties in terms of grain and protein production under contrasting environmental conditions

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Keywords: wheat, grain and protein yield, contrasting environments

A set of 30 winter wheat (*Triticum aestivum* L.) varieties was evaluated for three seasons (2015 – 2017) in sandy and clay-loam fields of the Mendel University in Brno, Czech Republic. Objectives were to identify genotypes which combine high grain yield and cover the protein content standards. Every season two replicated plot experiments were performed; first on drought prone sandy soil and the second on clay-loam soil with good water retention and high yield potential. Grain yield was adjusted to 14% of moisture content and expressed in tons per hectare. The protein content in grain samples was determined using NIR technology (Granolyser, Pfeuffer GmbH, Germany). The protein yield was calculated in tons per hectare (Table 1).

Table 1: Mean, minimum and maximum values of grain yield, protein concentration and yield in sandy and loamy field experiments in 2015 – 2017 season

Field	Year	Grain yield (t/ha)			Protein concentration (%)			Protein yield (t/ha)		
		mean	minimum	maximum	mean	minimum	maximum	mean	minimum	maximum
sandy	2015	6.32	4.99	7.67	13.88	12.73	16.40	0.75	0.61	0.84
clay-loam	2015	12.25	10.71	13.55	13.54	11.97	15.90	1.42	1.30	1.53
sandy	2016	5.11	4.49	5.72	16.81	15.20	18.73	0.74	0.67	0.81
clay-loam	2016	10.42	7.59	11.56	12.90	11.73	15.37	1.15	1.00	1.32
sandy	2017	6.46	5.15	8.18	15.05	12.80	17.43	0.83	0.67	1.01
clay-loam	2017	10.46	9.03	11.54	13.31	12.00	14.67	1.20	1.07	1.30

The sandy and clay-loam fields averaged. Respectively, 5.96 and 11.04 t/ha grain yield, and 0.77 and 1.26 t/ha protein yield. The protein content of wheat usually ranges between 10 and 15% (Shewry et al. 2001). All varieties in the clay-loam field met the standard of protein which is set at the level of 11.5% and most of them reached the level of 13%. The variety protein contents were much higher in the sandy field (12.7 – 18.7%). The increase of protein concentration is commonly associated with stressful conditions during the grain-filling stage, particularly drought and heat stress (Balla et al., 2011). A negative correlation of grain yield with protein content was strong for sandy field and very weak for clay-loam field ($r = -0.76$, $P < 0.001$; $r = -0.23$, $P < 0.025$) which is in agreement with Mesfin et al. (2000) and Tokatlidis et al. (2004). The correlation turned to be positive when protein yield was considered in sandy field ($r=0.74$, $P < 0.001$) as well as in clay-loam field ($r=0.85$, $P < 0.001$). Several varieties combining high grain yield and over average protein content were identified, 'Balitus', 'Gordian' and 'Julie' in sandy field and 'Bernstein', 'Rebell' and 'RGT Reform' in clay-loam field. It indicates the necessity of recommendation of specific varieties for different environmental conditions.

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Assessing soil fertility challenges and accessibility to inorganic fertilizer and manure resources by smallholder farmers in the Central Highlands of Kenya

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Keywords: soil fertility, fertilizer, manure, fertilizer subsidy, agricultural extension.

Farming systems in sub-Saharan Africa are characterized by low use of fertilizer. The region has the lowest fertilizer use globally (Chianu, Chianu, & Mairura, 2012), with an average application rate estimated at 12 kg per hectare per year (CABI, 2017). Low use of fertilizer among smallholder farmers in Africa has been attributed to weak policy and institutional support, lack of access to credit facilities, weak fertilizer market, poor infrastructure, long distance to the nearest fertilizer seller or distribution centre, poor fertilizer quality, declining soil science and extension capacity, farmers' lack of technical skills in applying the inputs, and inappropriate fertilizer packaging sizes (Ariga & Jayne, 2011). Cases of negative nutrient imbalance are also reportedly common in regions with improved application rates due to poor combination of mineral fertilizers largely attributed to lack of soil fertility skills among farmers (Makokha, Kimani, Mwangi, Verkuijl, & Musembi, 2001). This study evaluates the use of mineral fertilizer and manure among smallholder farmers in Meru and Tharaka Nithi Counties. The factors conditioning the uptake of these soil fertility practices are examined. Data for this study was obtained through a survey conducted between January-March 2019 with 106 farmers. Descriptive statistics were used to generate frequencies on the use of fertilizer and manure. Results show that the proportion of farmers who used manure and inorganic fertilizer was 93.4% in each case. The commonly used fertilizers were Calcium-ammonium nitrate, CAN (32.1%) and Di-ammonium phosphate, DAP (31.2%). Most of the farmers (40%) used cattle manure. Farmers accessed fertilizers mostly through direct purchase from the local market (73.9%). Most of the manure is obtained from on-farm (84.8%). More than half of the farmers (66.7%) used fertilizer both for planting and top dressing. However, only 20% of the farmers used fertilizer every other season. Fisher's exact test and Welch's t-test were used to examine variables associated with the use of fertilizer and manure. Result show a significant association between a number of variables and the decision to use inorganic fertilizers and organic resources. Poverty (low income), low literacy levels, lack of soil fertility management skills, poor quality fertilizers, shrinking sizes of household farms, low livestock units, limited and declining capacity of agricultural extension explain the low investment in soil fertility management. To reduce the gap between the actual and potential yields will require increased opportunities for smallholder farmers to access fertilizer and organic manure. Such actions have led to positive results including increased food surpluses as demonstrated by the case with smallholder farmers in Malawi (Blackie & Mann, 2005; Denning et al., 2009). Timely delivery of low-cost, high quality fertilizer is of paramount concern. Glaring loopholes that have undermined the efficiency of the government subsidy program have to be addressed. Policy and institutional support are necessary to reverse the declining capacity of soil science research and agricultural extension. Increased access to agricultural credit by smallholders, farmer training, improvement of infrastructure will create an enabling environment and motivate farmers to invest in soil fertility.

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Novel ecosystems an important element in climate change mitigation on example of habitats of urban industrial Silesian region

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Keywords: novel ecosystems, biodiversity loss, CO₂ sequestration, functional diversity, species diversity, biomass

Introduction

Novel ecosystems are defined as human-built or modified habitats (niches) of the Anthropocene Epoch. The novel ecosystems exist in places that have been created or irreversibly altered. The structure and function of novel ecosystems need human agency to emerge (Hobbs et al. 2013, Ellis 2015). It is stated that novel ecosystems lack natural analogues, among others vascular plant species composition. Novel ecosystems are not known in any natural and semi-natural habitats (ecosystems), (Betts et al. 2014). New habitats (ecosystems) have extended, or being influenced and/or converted on more than three-quarters of Earth. The understanding of novel ecosystems flora composition and function is necessary to work out mechanisms supporting the global change mitigation and environmental activities (Ellis 2013, Kattan et al. 2016). The aim of this study is to present how the current results obtained for the biological properties of the novel ecosystems (coal mine heaps, coal mine sedimentation pools, railway tracks) can be supportive in the global change mitigation through biodiversity enhancement, water and CO₂ catchments.

Materials and methods

The records on the species composition as well as indexes for functional and taxonomical diversity of the vegetation patches mosaic (alfa and beta diversity) have been obtained during the field study on human made habitats (novel ecosystems) such as coal mine heaps and sedimentation pools. Changes in biotic and abiotic soil substratum parameters have been assessed in the collected samples. Soil physico-chemical parameters as well as soil enzymatic activity were measured using standard procedures. Functional diversity of soil microbial communities was estimated using BIOLOG[®] method.

Results and discussion

More than 2 500 vegetation patches and their habitats (niches) have been tested. As result more than 100 different vegetation types and 600 vascular plant species have been stated on coal mine heaps. The performed analysis has revealed that vegetation types on post-industrial sites are distinguished on the basis of the dominant plant cover. The previously unknown species composition (including protected and rare vascular plants) of the vegetation patches has been revealed. The functional diversity of bacteria has been depended on the vegetation type. The same has been stated for the soil substratum enzymatic activity. Many species typical for water, wetland and peatland habitats have been recorded.

Conclusions

The presence of novel ecosystems (coal mine heaps, coal mine sedimentation pools or railway tracks) in the urban landscape can contribute to global change mitigation through enhancement of biodiversity as well as CO₂ storage.

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Environmental threats occurring in anthropogenic recreational facilities versus standards of their identification and methods of prevention.

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Keywords: recreational tanks, human hazards, environmental monitoring

Introduction

The number of people increases every year, in 2018 it was 20 million (GUS, 2019), who were participating in tourist trips, including spending their free time in the areas of lakes and water reservoirs, including anthropogenic ones. The development of recreation is accompanied by the development of complementary infrastructure, such as beaches, water equipment rentals, accommodation, camping sites, catering points, etc. Their functioning and the intensity of the number of users leads to the emergence of threats to the functioning of aquatic ecosystems (UPW, 2017) as well as individuals using these places (RMZ, 2019; Ferrari et al., 2019). The purpose of the presented research is: to determine the types of environmental hazards, including human factor, originating from the multifunctionality of anthropogenic reservoirs;

Materials and methods

Hazard groups were identified based on knowledge of the functioning of the model object. The Sosina Reservoir was selected for this purpose, one of 9 water reservoirs located in the city of Jaworzno, in southern Poland. The Sosina Reservoir is a flooded excavation of filling sand with an area of 47 ha, which has a recreational, nature and retention function. Based on the applicable legal regulations and available data, a group of hazards has been selected that does not currently have legal regulations in Poland, and carries serious threats to the quality of water in reservoir and people using them on the beaches. The analyzes were carried out in the area close to the reservoir, in a 50mx50m grid. Three main types of hazards have been identified: biological (microorganisms, faeces), physical (glass, cigarette butts), chemical (e.g. sewage, painkillers).

Results and discussion

The results of the analysis of the types of threats have shown that the most common are environmental hazards (RMŚ, 2012) from the physical group (area of the entire analyzed area). In second place, the biological threat, mainly associated with the risk of leaving animal manure and organic waste residues. The beach area is unfenced, which further increases the risk of stray wild animals staying in there in the evening and at night (zone up to 150 m from the shore of the reservoir). The last, yet unconfirmed threat to the quality of water in the reservoir are chemical threats. Spillage sites are observed, e.g. after grilling, kindling, etc. This type of pollution is located in spots varying in distance from the shore of the reservoir. This group of pollutants will ultimately be verified by the results obtained by petrographic methods.

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Hairy vetch (*Vicia villosa* Roth) seed production in clear sowing and double cropping system

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Keywords: hairy vetch, triticale, yield, double cropping, row space

Hairy vetch (*Vicia villosa* Roth) is an annual, overwintering plant of temperate zone, native to pre-Asia. Taxonomically, the genus *Vicia* (vetch) belongs to the order of the legumes (*Fabales*), including the family of the *Fabaceae* or *Leguminosae* (Gondola and Szabóné, 2010). It began to be cultivated in Hungary in the late 1800's, mainly as green fodder (Jánossy, 1971). Recently, it is gaining importance as a green manure and mulch plant. Environmentally responsible and sustainable agriculture in Hungary also justifies increasing the planting area of hairy vetch in weaker areas, both in organic and traditional cultivation. The FAO estimates that in 2017, vetches were grown on 560 000 hectares worldwide, including 293 000 hectares in Europe (Faostat, 2017).

The aim of the research was to evaluate the effect of double cropping and clear sowing among the factors influencing the yield of hairy vetch. Our field experiment were carried out in the year of 2014/2015 and 2015/2016, at the UD IAREF Research Institute's experimental field in Kisvárd (48°14.14' N, 22°06.79' E; 106 m). The soil type of the area is a medium nitrogen content, acidic loamy brown forest soil. In our research we examined the hairy vetch (*Vicia villosa*) Hungvillosa variety's seed production in a clear- and double cropping system with triticale (*Triticum aestivum*) Szabolcs variety as a stake crop. In the mono cropping system, hairy vetch were sown with a seed rate of 20, 40, 60, 80 and 100 kg/ha, and 12, 24, 60 cm row space. In the double cropping system were two kind of row space, 12 and 24 cm. In case of 12 cm row space, hairy vetch's seed rate were 20, 40, 60, 80, 100 kg/ha, mixed with 100 or 150 kg/ha triticale seed. In case of 24 cm row space, we applied same hairy vetch seed rates with 100 kg/ha triticale seed. The experimental seeds were sown in 14. 10. 2014 and 26. 10. 2015 with a parcel sowing machine in a strip layout (plots of the same row spacing were behind each other). The treatments in the experiments were set up in four replicates, in the same arrangement in both years, after triticale forecrop, with a net plot size of 1.2 x 9 m. Harvesting was carried out with a plot harvester on 13.07.2015 and 07.07.2016 at the time of full ripening of the hairy vetch.

In 2015, none of the applied different vetch seed doses resulted a significant difference in seed production in case of double cropping system. In contrast, in clear sowing, lower seed doses (20 and 40 kg/ha) resulted statistically higher seed yields. In 2016, similarly to the previous year, no significant difference was observed between the effect of different doses of vetch seed on seed yield in case of double cropping. However, in the case of clear sowing, as in the previous year, the lowest seed doses resulted the highest seed yields. Significantly higher yields were obtained in 2015 at 60 cm row spacing, while there was no statistically proven difference between cereal row spacing and double cereal row spacing. But in 2016, 12 cm row spacing resulted the most favorable seed yield, while 60 cm row spacing yielded statistically less seeds than 12 and 24 cm row spacing in pure sowing. In the double cropping system, the seed dose of the stake crop was better in both examined years at the lower seed rate (100 kg / ha) in case of hairy vetch seed yield. According to our researches, a significant crop year effect should be taken into account in the cultivation of hairy vetch seed, which largely determines the efficiency of the applied cultivation method.

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The effect of different agrotechnical methods on the quality and the quantity of the hemp yield

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Keywords: cannabinoids, CBD, hemp, cannabis extract

Hemp is an ancient crop, cultivated for the fiber production and the psychedelic effect of it, depending on the location. In The Carpathian Basin it was a highly valuable fiber crop. That tendency changed in the near past as it was used for twofold purposes not only the fiber production, but the seed production parallel. In the last 6-8 years the aim of hemp cultivation changed again (Finta 2020), now the cannabinoid production (Citti et al. 2019) is in the focus. For that reason, it is important to know how the different agrotechnical treatments have effects on the cannabinoid productions and how it can be extracted on an efficient way.

The experiment was set in Szarvas at the NAIK Research Institute of Irrigation and Water Management, where we had the opportunity to irrigate the hemp canopy. Three treatments were used in the field experiment, namely the zero control, the irrigated, and one where was irrigation and nutrient supply together. The crop year was 2019, which was a moist year from the point of view of the hemp production. As we could collect enough yield we had the opportunity for different methods of the extraction of the cannabinoids.

As the different treatments seems to have effect on the yield formation of the hemp, we can see that smaller or bigger differences in the production could have been detected. In addition, some tendencies could be found in the field of cannabinoid production.

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Climate change and the environmental education

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Keywords: strategic documents, environmental politics, informal education, ecosystem services, sustainable development

Environmental education (EE) is (besides innovations and development) the most important pillar for combatting the global environmental crises and the climate change. This contribution aims to report the actual state of art, identify gaps and outline the most important trends within this area. Table 1 summarizes the broad area of EE dividing it into thematic packages with their appropriate educational concepts and ways (tools) of educational practices. The here described structure of the EE strategy leans on relevant strategic documents of the European and national environmental policies and on the several decades lasting experiences of public institutions, namely the Slovak Environment Agency, Slovak Academy of Sciences and the University of Applied Life Sciences in Prague. Taking into account the very complex and (methodically, didactically and conceptually) very diverse character of EE elsewhere, authors could not cover here for example broad scale of activities of non-government non-profit organizations but rather focus on state EE aiming to secure and promote the European and national environmental politics.

Table 1: The main themes and concepts of environmental education (EE) and the relevant strategic documents

Themes of EE	Educational concepts	Strategic documents	Tools for EE
Sustainable development	<ul style="list-style-type: none"> • Ecological footprint • Water footprint • Zero waste • Waste separation 	<ul style="list-style-type: none"> • Sectoral concept of EE up to 2025, • Agenda 2030 	Calculators, guidelines, containers, games, competitions, seminars, festivals (envirofilm)
Circular economy	<ul style="list-style-type: none"> • Waste as a resource • Cradle to cradle • Zero waste • Public-private partnerships 	<ul style="list-style-type: none"> • Europe 2020, • Environmental strategy 2030 	Portals, excursions Ecocentrums
Climate change	<ul style="list-style-type: none"> • CCH mitigation • Carbon footprint • Adaptation on CCH • Energy efficiency 	<ul style="list-style-type: none"> • National strategy for adaptation on negative effects of climate change 	Excursions, calculators, quizzes, leaflets, medial campaigns, animations, festivals (envirofilm)
Ecosystem services	<ul style="list-style-type: none"> • Ecosystem concept • Nature conservation • Production services • Non-production services 	<ul style="list-style-type: none"> • National strategy for biodiversity conservation up to 2020, • National strategy for adaptation on negative effects of climate change, • CITES agreement 	Enviro-games, excursions, experiential programs, audio and video shots, animations, festivals (envirofilm)

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Data to the assessment of soil aggregate stability based on long-term field experiment examinations

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Keywords: aggregate stability, mineral fertilization, organic fertilization, long-term field experiment, total soil nitrogen and SOC content

Introduction

The aggregate stability of soils, as the extent of the resistance against different types of soil degradation processes, are at the forefront of the soil physical researches. Higher aggregate stability values are essentially important for the maintenance and increase of soil fertility. From an agronomical aspect, besides the erosion processes, soil tillage and fertilization systems can influence the aggregate stability of soils. The effect of these management methods can be investigated reliably only in long-term field experiments. However, in the literature, only a few results can be found from long-term field trials (e.g. Aoyama et al. 1999, Blanco-Moure et al. 2012).

The aim of our investigations was to study the effects of soil tillage, farmyard manure application and straw+green manure incorporation as well as the increasing doses of inorganic N-fertilization on the macroaggregate stability of soil, in two long-term field experiments.

Material and method

A study was conducted in a 48 years old maize-winter wheat bicultural tillage experiment and in the 37 years old International Mineral and Organic Nitrogen Fertilization Trial (IOSDV) located in Keszthely, Hungary. The soil tillage experiment has two factors; the main factor is tillage, with three different cultivations: deep winter ploughing, shallow winter disking and disking just before drilling. The second factor is fertilization, the mineral N-rates in case of maize are 0-120-180-240-300 kg ha⁻¹.

In the IOSDV trial, the two factors are the complementary applications of different forms of organic fertilizers and increasing rates of mineral N fertilization. The organic fertilizers have 3 different variants: no organic fertilizer application, farmyard manure application (35 t/ha), straw/stalk (St) incorporation. After winter barley on the St plots, an extra green manure is applied. The N rates are 0-70-140-210-280 kg ha⁻¹ in case of maize.

During the vegetation period, samples were collected from the selected maize plots three times: firstly two weeks after emerging, secondly after flowering, lastly before harvesting. During the investigations, a „Wet Sieving Apparatus” distributed by Eijkelkamp Agrisearch Equipment was used. The total soil nitrogen and SOC content of the 1-2 mm soil particle size range was measured from all of the plots with an Elementar varioMacro Cube elemental analyser. For the statistical evaluation, ANOVA with Duncan post-hoc tests were performed.

Results

As a function of different soil tillage systems, aggregate stability decreased with the increasing intensity of soil tillage. Conventional ploughing resulted in the lowest, while minimum tillage resulted the highest values of stability. The stability values significantly decreased with sampling dates.

Considering the IOSDV trial, the additional application of FYM didn't result in a significant difference compared to the sole NPK treatment, even slightly lower values were measured. Opposing this, St+GM application significantly increased the stability of soil macroaggregates in the average of all sampling dates and N-supplies. When averaged over the variants of nitrogen fertilization and organic matter supply, with the time of sampling the WSA values increased, however, this increase was more considerable in the first half of the vegetation period.

Considering the total soil nitrogen and soil organic carbon content, there is a close connect between TN/SOC and aggregate stability values originated from farmyard manure application plots; however, there is no connection among these parameters in case of NPK only and straw+green manure application.

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Using Teachable Machine for weed identification in the agriculture

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Keywords: Teachable Machine, weed identification, agriculture, crop production, tensorflow.js

Introduction

In crop production one of the costliest agrotechnical interventions these days is crop protection. Chemical weed control is one type of plant protection where spraying of herbicides on weeds was adopted to control the distribution of unwanted growing plants. Spraying herbicides over the entire surface not only has caused waste of herbicide, but also ground environmental pollution which led to serious ecological problems such as chemical pesticide residue and evolving drug resistance of weeds. To prevent the negative effects of chemical weed control one solution could be applying precision agriculture and using variable spraying based on the weed flora of the treated field. For this solution the first step must be the automated identification of crops and weed species. Theoretically this can be solved easily by hardcoded image recognizer software, however with Artificial Intelligence the weed identification can be more precise. Deep learning can automatically learn the hierarchical feature expression of images by extracting the global features of the images and context information, which significantly reduces the error rate of image recognition (Tang et al., 2017).

During our current research we investigated the possible usage for weed identification the Google's new easily accessible web-based tool the Teachable Machine (TM) (<https://teachablemachine.withgoogle.com/>). The new platform uses Tensorflow.js, which is an open source Javascript based library for develop and train machine learning (ML) models. TM uses the transfer learning method where the user can train their own ML model with his dataset on the top of the Google's Mobilenets architecture. This system basically a convolutional neural network (CNN), which is a class of deep neural networks for analysing visual imagery. CNNs mostly used in image and video recognition, image classification and medical image analysis.

Materials and methods

For our experiment we collected a dataset of 3000 images with smartphones, cca. 400 pictures from each of the 7 selected weed species (*Ambrosia artemisiifolia*, *Chenopodium album*, *Cirsium arvense*, *Datura stramonium*, *Elymus repens*, *Setaria pumilla*, *Sorghum halepense*). The species were selected based on their hierarchy at the last Hungarian weed survey. At the data collection our goal was to take the most diverse photos about the selected species (with different angles, apertures and shutter speeds etc.) to prevent the similarities in the dataset and to test the TM system capabilities. At the training process we uploaded the 3000 images into the TM system into 7 different categories, and set the Epochs to 200, the Batch size to 16 and we left the Learning Rate on its' default at 0.001. The teaching process took about 5-10 minutes.

Results and discussion

The TM system uses the 80% of the uploaded dataset for training and 20% for testing purposes. After the training of the model the result of the loss was about 0.03% and the test accuracy was 86% by the system statistics. We tested the trained model with our own unused dataset after the training which showed us a lower 60-65% of accuracy. The inaccuracy was occurred mainly at one weed species (*Chenopodium album*) because the dataset of this category was too diverse, the photos were taken too far from the plants and because of the other weed in the background the learning accuracy was decreased at least 20%.

Based on our results it can be stated that the TM system can be used for weed identification, however the training dataset must be more accurate and other weed species must be mainly filtered out from the background. This can be carried out with a closer exposure or with a bokeh effect which most of the smartphones use nowadays. Our plan to continue the data collection about the currently selected species and select new ones as well. Also, we will try the system with weed seedling detection which results could be more valuable in the precision agriculture.

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Pros and cons of organic agriculture – an evaluation of sustainable production methods

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Keywords: organic agriculture, biodynamics, aquaponics, hydroponics, permaculture,

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987). The meaning of any sustainable systems or activities would refer to the maintenance of nature and to the conditions of that. However, all sustainable – or believed to be sustainable – systems may have diverse impacts on our environment (Kassai et al 2006). On one hand we do something good, on the other hand this may have negative side effects. Success has always been escorted by failures. There is an old proverb, a rudiment of wisdom, according to what “the road leading to the hell is often paved by goodwill”. The present study focuses on the utility and failures of various sustainable production systems. An assessment study has been done at the Szent István University, Gödöllő to evaluate the utility and efficiency of sustainable agricultural production methods regarding alimentation. The evaluation was based on FAO database (FAO 2019) and was focusing on the output of organic, biodynamic, hydroponic, aquaponic and permaculture production systems. In the processing of data agronomic, biometric, calorimetric, and population dynamic methods were used (Jolánkai et al 2002).

Results and discussion

From an ecological aspect, sustainability is the capacity to endure; it is how biological systems remain diverse and productive indefinitely. Long-lived and healthy wetlands and forests are examples of sustainable biological systems. In more general terms, sustainability is the endurance of systems and processes. An *ecosystem* is a community of living organisms in conjunction with the non-living components of their environment (things like air, water and mineral soil), interacting as a system. Biodynamic agriculture is a method of organic farming originally developed by Rudolf Steiner that employs what proponents describe as “a holistic understanding of agricultural processes.” One of the first sustainable agriculture movements, it treats soil fertility plant growth, and livestock care as ecologically interrelated tasks, emphasizing spiritual and mystical perspectives. The principles of organic farming include the use of onsite resources and an initiation to avoid chemical applications (IFOAM 2008). Hydroponics is a subset of hydroculture and is a method of growing plants using mineral nutrient solutions, in water, without soil. Aquatic effluents, resulting from uneaten feed or raising animals like fish, accumulate in water due to the closed-system recirculation of most aquaculture systems. The effluent-rich water becomes toxic to the aquatic animal in high concentrations, but this contain nutrients essential for plant growth. Permaculture is a system of agricultural and social design principles centered around simulating or directly utilizing the patterns and features observed in natural ecosystems. Permaculture (as a systematic method) was first coined by Australians David Holmgren and Bill Mollison in 1978. The word *permaculture* originally referred to “permanent agriculture”.

Conclusions

Organic or bio farming is based on intellectual initiations with respect to ecological principles aiming healthy food and environment. Organic cropping is a technological process whereby no, or only reduced chemical applications are used. Neglecting efficient plant nutrition and plant protection methods may cause phytosanitary endangering especially in the field of mycotoxins. Organic farming is less productive in comparison with state of art technologies. Due to the smaller output larger tract of cropland is required that may endanger natural ecosystems. Alternative agronomic production systems let them be environmentally sound and socially acceptable are non-compatible methods concerning the alimentation of the World.

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Evaluation of the change of tillage effected humus quality with remote sensing

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Keywords: tillage, humus, E4/E6, remote sensing

The adequate tillage improves the soil's air content, thus the microbial activity and the decomposition of the organic matter in the soil will be more rapid. As a result of degradation processes, the amount of humus can be reduced and the quality of humus can be change. The proportion of mature humic acids and humic substances may increase within the humus content. Microorganisms oxidize the fragments of more easily degradable molecules to CO₂ and water, as a result significantly more difficult to decompose these small molecules. If they are polymerized the new larger molecules will contain more nitrogen, aromatic and double bonds. The produced fulvic acids of lower molecular weight are light yellow, while humic acids and humic substances are dark in colour. The colour of the humus extracts has a strong correlation with the quality of the humus. The ratio of absorbance values between 465 nm and 665 nm (E4 / E6) is related to the amount of condensation of humus molecules, the presence of aromatic systems and carbon content (GHOSH and SCHNITZER, 1979). If the humus is younger with a higher proportion of fulvic acids, the E4 / E6 value will be higher (6-8.5), while the more mature humus has higher quality humic acids which are predominate, thus the E4 / E6 ratio is less than 5 (STEVENSON, 1994).

Our investigations were made in the soil tillage long term experiment on Calcic Chernozem soil (WRB, 2006). The experiment were established in 2002 in the Experimental farm of the Szent István University in Hatvan, Józsefmajor (BIRKÁS, 2010). We took our samples in the middle line of the plots. The long-term experiment was designed with 6 randomized striped treatments in four repetition. The treatments are: disking (10-15 cm), shallow tine tillage (15-20 cm), tine tillage (20-30 cm), ploughing (25-35 cm), loosening (30-45 cm) and direct drilling.

E4 / E6 values for humus quality were determined by three optical methods:

- based on the absorption of the soil extracts,
- analysis of reflectance spectra of soil samples under laboratory conditions by hyperspectral ASD FieldSpec ® 3 Max portable spectroradiometer
- based on analysis of georeferenced, atmospherically corrected raster image of the area provided by the Sentinel 2 satellite multispectral reflectance spectra of pixels.

The differences can also be seen in aerial views in RGB published by Google-Earth (Figure 1, left). On the picture which was taken on 01.16.2016, the for darkest strips showing the ploughed plots. The lighter colour of the other plots may be caused by the mulch on the surface. The different humus quality of the ploughed plots is shown in the figure depicting E4 / E6 reflection data calculated from the spectral data recorded with the Sentinel 2 satellite. The ploughed plots are characterized by lighter bars indicating that the lowest E4 / E6 values can be calculated there (Figure 1, right).

Figure 1.: Long-term soil tillage experiment in Józsefmajor, Hatvan.. Left: Google Earth imagery. Right: E4 / E6 values calculated from spectral data recorded by Sentinel 2 satellites.

As a result, we found a correlation between the reflectance spectra determined by two types of remote sensing methods and the calculated humus quality (E4 / E6) values determined with the help of absorbance analysis of the soil extracts.

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Introduction of the Curriculum for Teaching Social Farming

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Keywords: social farming, higher education, curriculum, teaching

Introduction

“Social Farming in Higher Education” (SoFarEDU) is an international, multilingual project with the participation of Eberswalde University for Sustainable Development (Germany), JABOK – Academy of Social Pedagogy and Theology (Czechia), University of South Bohemia (Czechia), Szent István University (Hungary), University College for Agrarian and Environmental Pedagogy (Austria), and Norwegian University College of Agriculture and Rural Development. The aim of the project is to compile a transnational curriculum and teaching material for higher education for the field of social farming. Previous to the elaboration of tactile teaching content and learning material, firstly it was indispensable to identify and concretize universal quality standards for social farming education. The quality standards were formulated based on the results of the preliminary project research, namely on the portrayal of social farming situation in the countries of the project partners, the professions associated with social farming and the qualification requisites, as well as the competences needed from the aspect of experienced social farmers. (Nobelmann *et al.*, 2020)

Objectives and structure

The objectives of the social farming curriculum can be outlined as follows: to ensure that graduates of social farming are highly competent in fields of social work, agriculture and farm entrepreneurship; to instil in students ethical values, professionalism, social responsibility, and sustainability; to nurture a collegial environment that supports personal growth and development, leadership skills, and career paths of students; to provide students with the opportunity to engage in social farming; to provide high quality educational and practical approaches to social farming. The social farming curriculum was established based on 3 pillars: Agriculture, Social Work, and Entrepreneurship. Every pillar serves as a basis for a particular educational topic that goes along each unit of the curriculum. The finalized seven threads can be outlined as follows: 1. Introduction to Social Farming 2. Basics of Social Work 3. Basics in Agriculture 4. Clients on a Social Farm 5. Adaptation of Farming Activities and Farms to Social Farming 6. Entrepreneurship 7. Practical Placements and Field Trips. (Steininger *et al.*, 2019)

Closing remarks

The curriculum for social farming was created on the basis of diverse approaches to the improvement of various competences, and, research on social farming. Therefore, the learning program is focused on the students, by respecting their autonomy, leaning on their experience and knowledge, and taking into account that their learning styles can be different. Additionally, the other features of the curriculum are goal-orientation, relevance, practicality, and motivation; it is standardized but flexible at the same time; promotes personal development, as well as the self-examination and self-improvement skills; stresses the role of reflection as a pivotal to efficient learning; appraises the advantages of working in team; applies evaluation to give feedback on quality. The social farming curriculum's long-term goal is to train farmers, social experts and teachers/educators that must have an impact on social farming and will bring it to a higher standard. The learner of the social farming curriculum will be qualified by theoretical and practical skills, enriched by knowledge and methods of cognition, and liable for personal acts and civil virtue.

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Abstracts of poster presentations

Allelopathy of invasive weed species on early development of maize

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Keywords: allelopathy, *Asclepias*, maize, *Sorghum*, *Xanthium*

Introduction

Invasive weed species are non-native plants, of which spreading area and population size can increase monotonously in space and time under suitable circumstances. Invasive adventives have serious danger on natural- and agro-ecosystems. These species often have allelopathic effect. The aim of our research was to study the allelopathic effect of three dangerous alien weed species: *Asclepias syriaca*, *Sorghum halepense* and *Xanthium italicum* on germination and early development of maize. These species are very noxious weeds in Hungary, which can cause hard damages in row space crops firstly. *Asclepias syriaca* is one of the twelve most dangerous weed species in Hungary. We investigated in another experiments the allelopathy of this species earlier (Kazinczi et al. 2004, Kovács-Nádasyné, 2014). Allelopathic effect of *Sorghum halepense* was proved in previous experiments too (Mikulás, 1981, 1984; Dobszai, 2010). *Xanthium italicum* also has allelochemicals, allelopathic effect mainly depend on the phenological phase of plants (Dávid-Radóczy, 2005; Böszörményi-Bagi, 2006).

Materials and methods

We collected samples from *Asclepias syriaca*, *Sorghum halepense* and *Xanthium italicum* on fields, and stored with deep-freezing. We made extracts from chopped roots and shoots with tap water in three concentrations: 2.5, 5 and 7.5 m/v%. Filtration of solutions was made after 24 hours. We used extracts immediately. Twenty-five pieces of maize seeds were placed into Petri dishes with eight replications, and treated with 15 ml solutions. In control dishes, we used 15 ml tap water. Petri dishes were held in thermostat at 20 °C in dark. We investigated the germination percentage, and measured primary root-, and shoot length. The method of statistical analysis was variance analysis (ANOVA). We determined the phytochemicals from *Asclepias syriaca* shoots after soil phase micro extraction (SPME) with gas chromatography-mass spectrometry (GC-MS) on two ways: volatile method and camomile method.

Results

Our results justified the allelopathic effects of examined weed species. Allelopathic effects depended on the donor species, as well as plant part, and extract concentration. Allelopathy became stronger with increasing concentration of solutions. We found inhibitory and a few cases stimulatory effect during our experiments. Shoot and root extracts of *Asclepias syriaca* could reduce the root growth of maize in more extent, than shoot. Rhizome extracts of *Sorghum halepense* expressed strong inhibitory effect on maize germination and development. Shoot extracts of *Xanthium italicum* hindered the root growth of maize strongly and higher degree than shoot. We could identify 12 volatile components from *Asclepias syriaca*. Analysis of allelochemicals proved, that numerous volatile compounds are responsible for the allelopathic effect collectively.

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Biology and control of *Armillaria* species, emerging pathogenic fungi of forests

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Keywords: *Armillaria*, biocontrol, genomics, *Trichoderma*

Armillaria biocontrol

Members of the basidiomycete genus *Armillaria* (honey mushrooms) are belonging to the most devastating soil-borne pathogens of forest trees, causing root diseases of fruit, timber and nut trees world-wide. Their immensely enlarged subterranean colonies are among the largest and oldest known terrestrial organisms of the Earth, at the same time their vegetative diploids are regular decay drivers of native forest ecosystems. The complex lifestyle of *Armillaria* colonies is supported by an abundant spread of unique, soil-borne rhizomorphs: shoestring-like structures which provide the mushroom with the ability to access multiple hosts and to form extensive ecological networks (Sipos et al. 2018). Most *Armillaria* species exhibit specialization towards either coniferous or broadleaf hosts: coniferous forests in the Northern hemisphere are most exposed to *A. ostoyae* and *A. cepistipes*, while broadleaf forests are predominantly inhabited by *A. mellea*, *A. gallica*, and *Desarmillaria tabescens*.

The growing number of fully sequenced *Armillaria* genomes is in the focus of intensive research efforts. Recent genomic studies shed light on a series of lineage-specific genes being expressed in rhizomorphs and developing basidiocarps. Furthermore, a unique repertoire of genes encoding, e.g., cell-wall-degrading enzymes, chitin deacetylases, plant pathogenesis-related proteins with supposed roles in *Armillaria* pathogenicity could also be identified (Sipos et al. 2017). Recent investigations of healthy and damaged forests in Central Europe (Austria and Hungary) resulted in the identification of both oak- and conifer-specific representatives of the genus. The collected *A. gallica* isolates were found to exhibit a significant genetic diversity, suggesting the possible existence of multiple biological species within this taxon.

The aim of our research was to isolate indigenous microbial strains from healthy and *Armillaria*-damaged forests, characterize them, screen their biocontrol potential in the laboratory, and to test selected strains under field conditions. As promising, environment-friendly alternatives to the application of environmentally harmful and polluting fungicides, bacilli and pseudomonads producing bioactive antifungal compounds, as well as ascomycetes from the genus *Trichoderma* capable of antagonizing the root pathogen by antibiosis, competition and/or mycoparasitism are potential biological agents for the control of the *Armillaria* menace. A series of *Trichoderma*, *Bacillus* and *Pseudomonas* strains were isolated from forest soils infested by *Armillaria*, identified to the species level, and screened *in vitro* for their antagonistic potential as well as plant growth promoting properties like phosphorous mobilization and the production of indole-3-acetic acid or siderophores, which resulted in the selection of candidate *Trichoderma* strains and pseudomonads for the biological control of *Armillaria* species. A field experiment was also carried out by applying two selected *Trichoderma* strains (*T. virens* and *T. atroviride*) on two-year-old European Turkey oak seedlings planted in a forest area heavily overtaken by the rhizomorphs of numerous *Armillaria* colonies (Chen et al. 2019): seedlings treated with biocontrol isolates displayed better survival under harsh soil conditions than the untreated controls.

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The role of *Panicum miliaceum* L. in the epidemiology of wheat viruses

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Keywords: millet, wheat, viruses, DAS ELISA

Introduction

Common millet is a dangerous weed in Hungary, not only on a maize field, but also in other crops like potato, sunflower, wheat, and other cereals (Pásztor-Nádas, 2016). It can widely spread because of the lack of seed dormancy (Magyar-Király, 2014). This weed is a close relative to wheat, so we wanted to investigate, which wheat viruses can infect of the common millet (*Panicum miliaceum*). In our work we aimed to investigate the viral contamination of the millet found in arable fields and to determine their epidemiological significance for major grain viruses. Our survey was conducted in cereal production areas in Keszthely and Lesencefalu in September 2014 and September 2015 and Zalaegerszeg in September 2018.

Material and method

35 millet (*Panicum miliaceum* L.) leaf samples were collected during the investigation in September of 2014 from Keszthely and 35 from Lesencefalu in 2015 and 64 samples from Zalaegerszeg in 2018. The collected samples showed signs of viral infection. The laboratory test requires, that all the samples need to be packed individually in polyethylene bags and stored at -20 °Celsius.

We used the most commonly used serological test, the double antibody sandwich DAS ELISA test. We used reagents from the LOEWE Biochemica (Brome mosaic virus, Brome dwarf mosaic virus, Brome streak mosaic virus, Barley stripe mosaic virus, Barley yellow dwarf virus, Wheat dwarf mosaic virus and wheat dwarf virus).

Results

Of the 134 samples, 70 were infected with any of the cereal viruses. The infection in the samples from Keszthely was lower than in the other two samples. Infections were found in all three experimental areas, but the composition of the viruses varied. Complex infections were also detected and we could detect the presence of 2 or 3 viral diseases in some plants. The results show that millet can be an important reservoir of cereal virus if we do not use protection against it.

Table 1: The number of the infected samples

	Keszthely	Lesencefalu	Zalaegerszeg
BStMV	0	1	21
BYDV	0	2	4
WDV	0	6	2
WSMV	0	10	8
BSMV	5	2	0
BMV	0	0	9

Figure 1: Number of the complex infections

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Molecular genetic markers linked to *Rm* and *Ns* gene locus in potato (*Solanum tuberosum* L.)

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Keywords: PVS virus, resistance, microsatellite, potato

Solanum tuberosum L. (potato) is the most popular non-cereal food crop in the world and the third most important food crop after *Triticum aestivum* (wheat) and *Oryza sativa* (rice) (FAO, 2018). The conventional plant breeding methods of potato are slow and quite difficult as cultivated potato is tetraploid and highly heterozygous. The development of molecular genetic markers can reduce the conventional plant breeding process time (Wenzel, 2006). *S. tuberosum* is a clonally propagated crop that is vulnerable to more than 30 viruses (Jeffries et al., 2006). *Potato virus S* (*Carlavirus* - PVS) usually causes latent or very mild perceptible mottle and faint banding, if it occurs alone (Marczewski et al., 2002). If its infection is combined with other viruses, the loss of the yield can increase up to 80%. Potato has two types of resistance responses to PVS, the extreme resistance (ER) and hypersensitive resistance (HR), which are controlled by *Rm* and *Ns* genes (Marczewski et al., 1998). Our research project focused on Cleaved Amplification Polymorphic Sequences (CAPS), Sequence-Tagged Sites (STS), Random Amplification of Polymorphic DNA (RAPD) and Internal Sequence Repeat (ISSR) markers which potentially linked to the *Rm* and *Ns* gene locus.

Genomic DNA was extracted from 30 potato clones (10 hybrid clones, 2 parent lines, 7 wild-type, and 11 other clones) with E.Z.N.A. Plant DNA Kit (omega Bio-Tek, USA) based on the manufacturer's protocol. The extracted genomic DNA quality and quantity were tested on Implen NanoPhotometer N50 (Implen, Germany) as microcapillary spectrophotometer. PCR amplification was performed with 1 µL genomic DNA (diluted to 10ng/µL concentration), 20 mM Tris-HCl pH 8.4, 2.5 mM MgCl₂, 0.1 mM of each deoxynucleotide, 0.1 µM of each primer, 0.5 U Taq DNA polymerase (Thermo Fischer Scientific, USA) in the final volume of 20 µL. The GP250 (*XapI*), GP283 (*DdeI*), GP189 (*HaeIII*) and CP16 (*HindIII*) from CAPS markers; GP126 from STS marker; OPH18 from RAPD marker; UBC822 from ISSR marker were used for PCR as primers (Marczewski et al., 2002; 2006). PCR conditions for the markers were according to Marczewski et al. (1998). PCR products were detected with Agilent Bioanalyzer 2100 (Agilent, USA) capillary electrophoresis on a microchip device.

Based on our results, we found PVS resistance in the *Solanum tuberosum* cv. Chile, Peru, Argentina, and Boglárka with GP250, GP283, CP16, GP126, GP189 and UBC822 markers. We amplified a 460 bp with GP250, 350 bp with GP283, 345 bp with CP16, 370 bp with GP189, and 710 bp fragment with UBC822 marker in the plant samples which carry the PVS resistance linked to the *Rm* and *Ns* gene locus. We amplified 710 bp and 726 bp fragments with GP126 marker in the *Solanum tuberosum* cv. Chile, Peru, Argentina, and Boglárka which potentially have a PVS resistance.

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Temporal variability of N₂O emission in agricultural field

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Keywords: Nitrous oxide, Greenhouse gas, N₂O efflux, Soil water content, N fertilizer.

Global climate is changing primarily because of anthropogenic greenhouse gas (GHG) emissions into the atmosphere which have driven large increases in the atmospheric concentrations of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) (IPCC, 2014). Agricultural soils release significant amounts of the N₂O to the atmosphere. Global N₂O concentration in the atmosphere increased at rates of 0.3% per year (Wang et al., 2013). That's why if we consider the importance of N₂O as a GHG and how much agricultural soils contribute to originate it, field examination of soil gas emission has particular importance. Hence the main objective of the present study was to measure N₂O emission on temporal variability from cropland called Kartal, which situated in Mid Hungary and has a continental climate.

N₂O fluxes were determined by small static (closed) chambers. The sampling was generally bi-weekly from November 2017 until November 2019. The concentration of N₂O was measured by gas chromatography (HP 5890) electron capture detector. Emission flux was calculated from the accumulation of N₂O gas in the chamber. According to our results we found a positive effect of both soil moisture and VIGreen on the N₂O emission. Croplands have significant GHG emission and there is a strong need to find correlations between the different biological processes of the soil for mitigating GHG emission of the agriculture and for biogeochemical modeling approaches.

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The effect of biotic and abiotic drivers on soil respiration in Kartal site

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Keywords: greenhouse gases, CO₂, N₂O, SWC.

The agricultural soils act as a source or a sink for atmospheric greenhouse gases such as (CO₂), (CH₄), and (N₂O). The agricultural soils act as a source or a sink for atmospheric greenhouse gases such as (CO₂), (CH₄), and (N₂O) (Vergé et al., 2007). Where the carbon dioxide loss from soil can be associated with microbial decomposition of organic matter and root respiration (Witkamp and Frank, 1969; Hanson et al., 2000). Soil CO₂ production is heavily influenced by environmental factors, including soil temperature, soil moisture, vegetations. (Lin et al., 2005; Jarvis, 2007; Hu et al., 2016). We did our measurements in Kartal site which is an agricultural soil and an eddy covariance station, a closed chamber method (LI-COR 6400 and EG4 automated soil CO₂ flux system) were used to measure the dynamic changes of CO₂ efflux from a topsoil depth of 0–5 cm and it was measured about bi-weekly/monthly between 2017–2019. The purpose of the study was to quantify the effect of vegetation, soil temperature and soil water content on carbon dioxide (CO₂) efflux in Kartal. According to our field results, different biotic (plant growth) and abiotic (Soil water content, N treatments) drivers play a principal role in the carbon cycle of the seasonally covered ecosystem in a temperate continental climate while the soil temperature was the principal factor influencing soil respiration.

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Enhancement of active constituents of *Eclipta prostrata* through the use of arbuscular mycorrhiza fungi

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Keywords: *Eclipta prostrata*, Arbuscular mycorrhiza fungi, active constituents

Eclipta prostrata one of the most important medicinal plant, belongs to the Asteraceae family, and it is distributed throughout the world in more than 83 countries (Holmet al., 1979). *E. prostrata* contains different natural compounds such as flavonoids, alkaloids, triterpenoids saponins, phenolic, essentials oil, thiophenes, wedelolactone and steroid (Liu et al., 2012). Arbuscular mycorrhizal fungi (AMf) are important beneficial micro- organisms living in the soil of most agro-ecosystems, and often increase the nutrient uptake and secondary metabolites of plants.

There is still gap's in our knowledge regarding how influence arbuscular mycorrhizal fungi (AMF) including *Eclipta prostrata*. There for our aim was to estimate the potential effect of AMF inoculation on polyphenols profile of *Eclipta prostrata*, moreover showing their qualitative and quantitative changes.

On the basis of pot experiments settled in climatic chamber and differenr mycorrhiza levelsthe known and non-known major polyphenols were identified using HPLC (Au et al.,2019).

Our results confirmed that mycorrhizal inoculation alters some secondary metabolites of *E. prostrata*, showing significant differences in polyphenol contents between the treatments.

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Comparison of two reference apple genomes by next-generation sequencing method

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Keywords: apple, Sanger, Next Generation Sequencing, whole genome bisulfite sequencing

Nowadays, researchers are concerned about several questions in molecular genetics, such as how changes in the genetic stock are caused by environmental influences and how a plant is able to adapt to these changes. In our experiments, we first investigated the epigenetic changes of the mother plants, *in vitro* cultures, and acclimatized plants of the ‘McIntosh’ and ‘Húsvéti rozmaring’ apple scions (Gulyás et al., 2019). The question then arises as to the differences between the results of different sequencing techniques, for example, by fitting the genome information of apples we have sequenced to two different genome reference genomes. We wanted to find out whether there is any difference between these techniques and, if so, which technique can be proven to be better. Therefore, we compared two first-generation (Sanger) reference samples with another reference sample made by hybrid (Illumina and PacBio) sequencing.

The quality of FASTQ files was checked by FastQC (Andrews, 2010). The index and Illumina adapter sequences were removed by Trim Galore (Krueger, 2012) and Cutadapt (Martin, 2011). The trimmed reads were aligned to the *Malus x domestica* v2.0 and GDDH13 Whole Genome v1.1 (<https://www.rosaceae.org/>, Washington State University) with Bismark (Krueger and Andrews, 2011) module. The Bismark module was used with the Bowtie 2 (Langmead et al., 2009) genome indexer to fit paired-end reads and to locate the methylated cytosines of the reads inserted into the *Malus x domestica* genome. DNA methylation differences and statistical calculations between the samples were performed with SeqMonk (Andrews, 2007). Omicsbox v. 1.1 was used for annotating the significantly differentially methylated genes.

By the Sanger sequencing, 30,294 genes were identified, and 45,116 genes were by the hybrid sequencing. Our sequencing results were plotted on both reference genomes to determine where the methylated cytosines are located in the CpG, CHG and CHH contexts. The greatest difference between the two sequencing types was in the CHH context, which resulted in 63,011 contexts for Sanger sequencing and 15,547 contexts for hybrid sequencing. With Omicsbox v1.1, we can get an idea of what functions our sequenced genes perform in the biological process, what molecular functions they perform, and what cellular components they make up. The two blasts are very much the same except in the case of hybrid sequencing, where the cellular component organization genes are different in the biological processes. Omicsbox v1.1 compared the CpG, CHG, and CHH contexts for both sequencing results. In the case of CpG and CHG, as mentioned above, there was a difference in cellular organization compared to Sanger sequencing. While in the context of CHH, a biogenesis process has already appeared and been added to biological processes. It can be said that there was no significant difference between the two sequencing types except for the cellular components. After fitting the apple varieties, we sequenced to the reference genomes, we did not find an important difference in the sequencing methods. Smaller differences may occur because the Sanger reference genome has 30,294 genes and the hybrid has 45,116 genes annotated.

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Adsorptive Capacity of Brewery Yeast from Romanian Manufactory

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Keywords: wastewater, adsorption, Remazol dye, brewery yeast, remediation

Diverse anthropogenic activities are known sources of water pollution, rapid population growth, becoming a consumer society, agricultural and industrial activities, contribute to adverse effects on water quality and water scarcity. According to the World Bank Group, 17-20% of all water pollution can be linked to textile dyeing treatments (A. Flood 2019). Global Industry Analysts, Inc estimated that global production of dyestuff is expected to reach 13 million tons of production by 2022 (Trent N. 2019; modorintelligence 2019). The biotechnological application of using the adsorptive capacity of yeast offers one way to clean the dye polluted waters. With a 25 L / person / year consumption ratio beer is one of the most commonly consumed alcoholic beverage (H-H. Lin et al. 2019; Chandrasekaran M. 2012). During fermentation process the brewery's yeast cells are constantly multiplying, but after repeated use, the rate of dead yeast cells is increasing, thus becoming waste. In recent times, many researches are looking for alternative solutions for wastewater treatment. Such techniques include the already practiced adsorption process, where the adsorption capacity of waste adsorbents is tested as alternative sorbents that can replace activated carbon.

Due to the fact that brewery's yeasts waste disposal as a sewage is quite expensive and unsustainable moreover, textile dyes can be carcinogenic, mutagenic and cause negative effects on aqueous ecosystem, their simultaneous management can be a promising method to eliminate them as wastes, moreover, remediation has many advantages from economic, environmental and practical aspects.

Our study aims to present the adsorptive capacity of lyophilized dead brewery yeast cells on two reactive, azo dyes: Remazol Red (RR) and Remazol Blue (RB), which are used in textile industry. During batch adsorption studies the optimal experimental conditions were determined by investigating the effect of initial dye concentration, adsorbent amount, water solution pH and temperature on the adsorption capacity and efficiency. In order to characterize the mechanism between the adsorbent and the dyes we studied the morphology of the yeast before and after adsorption with SEM analyses, determined the elemental composition with EDS analyses and calculated mathematical models (isotherm, kinetic, diffusion) from the equilibrium data. Adsorption efficiency reaching up to 99% lead to the conclusion that brewery's yeast is a strong candidate for cleaning textile dyes (RR, RB) from aqueous solutions.

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Yield Performance of transplanted quinoa in deficit irrigated condition

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Keywords: transplanting, deficit irrigation, harvest index,

Quinoa (*Chenopodium quinoa*) is one of those pseudo-cereal which shows tolerance to frost, salinity and drought and has the ability to grow on marginal soils. The experimental design used was RBD with 4 treatments and a control in 3 replications. The treatments were the different dates of transplanting grown with deficit irrigation in alkaline soil of 8.5 pH. Besides these the field was mulched with maize stalks to reduced evaporation and restore soil moisture. The yield performance of quinoa in all the treatments were assessed by measuring total seed yield and harvest index (HI). Best result was observed in treatment of 21 day old seedling transplantation but comparing with control direct sowing seems to be better.

Table1: Seed yield and crop harvest index of experimented treatments

Treatments	Seed yield (kg/ ha)	Crop harvest index(%)
7 th day after emergence	916	43
14 th day after emergence	1166	44.5
21 st day after emergence	1500	48
28 th day after emergence	583	31
control	1666	45

Figure1: Quinoa at initial flowering stage.

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Evaluation of Urea Containing Pyrazinoic Acid Derivative as Plant Growth Promotor

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Keywords: milk thistle; silymarin; abiotic elicitor; pyrazine derivative

Introduction

Silybum marianum L., commonly known as milk thistle or St. Mary's thistle, is an annual or biennial plant native to southern Europe, southern Russia, and northern Africa and belongs to the *Asteraceae* family. Cultivated fields for the production of raw material primarily for the pharmaceutical industry exist on a larger scale in Central Europe, China and Argentina. The major bioactive component of milk thistle, silymarin, is a natural complex compound that consists of seven flavonolignans (silibinin A, B; isosilibinin A, B; silychristin; isosilychristin, and silydianin). Moreover, the plant contains a flavonoid taxifolin (Kim, 2003). Although the whole plant is used for medicinal purpose, the highest content of silymarin is to be found in the seeds (1.5–3.0 %) (Arvind, 2008). Silymarin complex compounds have hepatoprotective, anticancer, and also hypocholesterolemic activity. *In vitro* flavonolignan concentration in cells is insignificant and the elicitation is one of the methods to increase production of these secondary metabolites.

Experiment

Elicitor, the pyrazine derivative 1-(2-chlorophenyl)-3-(pyrazin-2-yl)urea, was tested at three concentrations and at different culture times. More accurately, the elicitor was added to the cultures at three concentrations: c1 ($4.0314 \cdot 10^{-3}$ mol/L), c2 ($4.0314 \cdot 10^{-4}$ mol/L) and c3 ($4.0314 \cdot 10^{-5}$ mol/L). The elicitation was monitored at six-time intervals: 6, 12, 24, 48, 72 and 168 hours. 1 ml of ethanol 96% was added instead of elicitor for control samples and they were examined after 6, 24 and 168 hours. After withdrawal, the biomasses were dried at laboratory temperature (25 °C), pulverized and weighed. Subsequently, the flavolignans content was evaluated by HPLC. The content of flavolignans released into the nutrient medium was also analysed.

Results

The elicitor at all concentration c1 – c3 did not have a considerable effect on *S. marianum* calluses, since there was no statistically significant increase or decrease of flavolignans and taxifolin content in dry calluses. The elicitor probably affected the secondary metabolites production, but the substances have not remained in calluses, they have been released into nutrient media. There were three statistically significant increases in flavolignans and taxifolin production with c2, after 24 (3.1×), 48 (2.8×), and 72-hours (4.1×) elicitation, and one increase with c3, after 168-hours (2.9×) elicitation (in comparison with control).

The effect of the pyrazine derivative as elicitor has truly manifested in both suspension cultures and their nutrient media. In suspension cultures, there were two statistically significant results with c1, after 48 (3.1×), and 72-hours (3.2×) elicitation, and one with c2, after 168-hours (3.1×) elicitation, and one with c3, after 168-hours (4.0×) elicitation. In nutrient media of suspension cultures, there were two statistically significant results in production with c1, after 24 (3.0×), and 72-hours (2.8×) elicitation, and one increase with c3, after 168-hours (3.3×) elicitation (in comparison with control). The HPLC analysis shows that the majority of the detected contents corresponded to silicristin, one of the components of silymarin complex which the pharmacological activities of *S. marianum* and the uses in therapy are based on.

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Phosphatase activities in arable and polluted soils

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Keywords: phosphorus, phosphatase, soil, *phoD*

Phosphorus is an essential macronutrient for all living organism. Microorganisms and plants can utilize phosphorus as orthophosphate, which is a limiting factor in soil ecosystems. Plant phosphorus availability can be increased by soil bacteria producing phosphatases and/or using their P-solubilizing abilities (Margalef et al., 2017, Shen et al., 2011). Our goal was to investigate the phosphatase enzyme activities based on enzyme measuring and/or and its gene expression of different soils collected from Hungary and Vietnam.

Acid and alkaline phosphatase activity of five heavy-metal contaminated soils collected from riverine woodlands of Dráva river (Hungary) and six soil samples deriving from different plantations of Vietnam were determined. Bacterial species possessing the *phoD* alkaline phosphatase gene were isolated from each soil samples. Abundance of the *phoD* gene in soils collected from Vietnam was also investigated by qPCR analysis by calculating the copy number per gram per soil. Abundance was compared to the alkaline phosphatase activities. Besides, we attempted to find correlations between the phosphatase activities and soil chemical properties, such as pH, total phosphorus, organic carbon, total nitrogen, total potassium and different heavy metal contents.

In the case of soil samples collected from riverine woodlands of Dráva river, eight samples (including top and bottom samples of four soils) were polluted by at least four different heavy metals, while the control samples (top and bottom sample of the control soil) were only contaminated by one heavy metal. We found that samples collected from the top layer of each contaminated soils showed considerably higher acid and alkaline phosphatase activity than their counterpart collected from bottom layer. Interestingly, top sample of control soil showed significantly lower alkaline and acid phosphatase activity compared to all top samples from the contaminated soils. Bacterial species isolated from each soils were found to be different in all soils.

In the case of the soils from Vietnam, acid and alkaline phosphatase activities were also determined, and were compared to the abundance of *phoD* gene. Even though positive correlation was previously found in several reports (Chen et al, 2017, Fraser et al. 2015), we did not find any correlation between the abundance of *phoD* gene and the alkaline phosphatase activity. However, positive correlation was found between phosphatase activities (both alkaline and acid) and the total phosphorus, total nitrogen, and the organic carbon content. Bacterial isolates possessing *phoD* gene were identified in each soils, most of which belong to genus *Bacillus*, although some other species were also found.

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Monitoring of the nitrogen supply of different maturity maize hybrids in critical phenophases

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Keywords: SPAD-value, base fertilization and top dressing, yield, technical consultancy

Introduction

Applying the amount of base N fertilizer and top dressing in spring in accordance with the needs of the plant reduces nitrogen loss, increases the efficiency of nitrogen supply, improves the effectiveness of nutrient supply, the amount of yield, overall it improves productivity (Tóth, 2002; Nagy, 2019). Excessive or improper use is a major problem in terms air (Snyder et al., 2009) and water pollution (Quemada et al., 2013). Based on soil and plant analysis, the amount of N can be measured using conventional methods, but these methods are costly and time consuming. Fast and non-destructive methods based on optical properties are available as an alternative and provide a reliable estimation of plant condition (Padilla et al., 2018).

Materials and methods

Our experiments were carried out at the Experimental Station of the University of Debrecen, on chernozem soil, in a small-plot experiment, in rainy (2016) and average (2017) years, using Armagnac and Renfor hybrids. In addition to the treatment without fertilization, 60 and 120 kg N ha⁻¹ treatments were applied as base spring fertilization, which were followed by top dressing in the V6 and V12 phenophases (+30 and +30 kg N ha⁻¹).

Results and discussion

Significant effect of fertilization on SPAD was detectable in the V6 phenophase in a rainy crop year. The highest SPAD value was obtained in the case of the V12₁₂₀ treatment (51.8 SPAD; $P < 0.05$) for the Armagnac hybrid and in the case of the V6₁₅₀ treatment (52.8; $P < 0.05$) for the Renfor hybrid. In the V12 phenophase, SPAD value of the hybrids was not influenced by the crop year but the highest SPAD values were found at different nutrient levels. In the case of the later maturity Armagnac hybrid, the higher (V12₁₈₀) fertilization treatment turned out to be more efficient, while for the earlier maturity hybrid, the lower (A₆₀) nutrient treatment was more optimal. In the R1 phenophase, different effects of crop year and fertilization treatment were clearly visible. As the phenological phases progressed, the SPAD values increased at a significance level of 0.1%, and the correlation between the SPAD values and yield increased as well. By applying 60kg N ha⁻¹ base fertilization + 30 kg N ha⁻¹ (V6₉₀) in the V6 developmental stage, we achieved more efficient uptake and better utilization in rainy years for both hybrids. In the average crop year, top dressing did not result in a reliable additional yield for the Armagnac hybrid; the 120 kg N ha⁻¹ base treatment proved to be effective. In the case of the Renfor hybrid, early top dressing (V6₁₅₀) applied after a base dose of 120 kg N ha⁻¹ was more favourable. The effect of increased base fertilization and top dressing on yield and relative concentration of chlorophyll has been proven, however, its degree varied from year to year and hybrids. Based on SPAD values measured in fertilized small reference areas, top dressing requirement of maize can be determined in the V6 phenophase and its effect can be tested following application.

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Alternative, environmental friendly technology in *Robinia sp.* and *Populus sp.* plantations

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Keywords: plant, mycorrhiza, bacteria, micropropagation,

Arbuscular mycorrhizal fungi (AMF) and bacterial inoculation have the potential to be an useful biotechnological tool for benefiting plant development and health, increasing plant defense mechanisms to alleviate different stress effects during the method of micropropagation and pot experiment. Our aim was to investigate how influence different nutrient supplies on microbial communities settled in intensively cultivated acacia and poplar plantations.

The studied fields belong to the Monorierdő (Pest county), Hungary. The region has a moderately cold-dry continental climate with 10.5 °C annual mean temperature and 500-750 mm annual mean precipitation. *Robinia pseudoacacia* L. and *Populus x euramericana* L. were inoculated with bacterial and mycorrhizal fungi inoculant combined with fertilizer inoculation (Osmocote OSM, NPK, 14-7-21, Israel Chemicals, Tel-Aviv, Israel). In order to determine the enzyme activities of soil representing C, phosphorus and general microbial activities, 100 g of soil was collected (soil cores of 5 cm diameter and 25 cm length were collected, the top 5 cm of the cores was removed and the rest were mixed thoroughly. FDA hydrolysis activity test was used to determination of total microbial activity (Schnürer and Rosswall, 1982). Invertase activity was measured photometrically at 508 nm, with 3,5-dinitrosalicylic acid (Mikanová et al., 2001). Dehydrogenase (DHA) activity was characterized by the amount of 1,2,5-triphenyl formazan (TPF) formed from 2,3,5-triphenyl tetrazolium chloride (TTC) (Casida et al., 1964). Alkaline phosphatase activity (LFA) was measured by Tabatabai & Bremner (1969). On the basis of Most Probable Number (MPN) the ammonification and denitrification activity of soil microorganisms were estimated.

The number of soil CFUs in both AM fungi and bacteria were affected by soil inoculation, but the number of colonies that could be cultivated from soil was not solely influenced. The highest numbers of bacteria (CFU/g fresh weight) were found when plants were inoculated with 2,5x OSM and bacterial together with arbuscular mycorrhizal inoculants. The measured enzyme activities showed various activity depending on the inoculation of the plants. The measured higher microbiology activity in combination of bacterial and AM fungal inoculant is due to the fact that arbuscular mycorrhizal fungi and soil bacterial are also actively involved in increasing the microbiological activity of the soil.

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Technical characteristics of precision farming among Hungarian crop farms

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Keywords: precision farming, technical characteristics, Hungarian farms

Introduction

In precision crop production, various technical equipment facilitates the movement of machinery and the precise execution of operations in the field. More than 50% of precision farmers in Hungary use line guide, almost 30% use automatic steering, followed by machinery control, sowing and nutrient application (25%) (AKI, 2017). The professionalism of farming is indicated a fertilization method that takes into account the nutrient requirements of the cultivated plants and the nutrient supply of the given field. Working on this basis is called differentiated application (Husti, 2011). The work of the farmer is supported by harvesting machines, which collect yield data, and through sectioning crop protection is also realised following the survey of weeds (Pakurár, 2003).

Materials and methods

Our examinations were carried out at 25 Hungarian crop producing farms, in 2019. The sizes of the analysed farms are from 50 to 4600 hectares. Five size categories (CI - CV) were formed: 50 - 200 ha, 201 - 500 ha, 501 - 1000 ha, 1001 - 2000 ha, 2001 - 4600 ha. Aspects of the examinations were: existence of automatic steering/row guiding for power engines and automatic sectioning and differentiated application for machines as well as yield mapping for harvesting machines. Data collection was carried out via questionnaire and verbal interviews.

Results and discussion

Automatic steering is used by 50% of farms in CI (3 farms), typically for fertilization and application of chemicals. There was no example of sectioning, differentiation or yield mapping. There are 4 farms in the CII. In this case, 2 farms have automatic steering for major operations, 1 farm has automatic steering and row guidance at the same time, and 1 farm has only row guidance for fertilizer application and chemical treatments. Automatic sectioning is used by 2 farms for chemical treatments, but none of the 4 farms use it for sowing and fertilization. Differentiation is applied by 1 farm for spraying. There is no harvester suitable for yield mapping in this category. In CIII (6 farms), automatic steering is used by all farms for certain operations (mainly sowing and tillage). In addition, row guides are employed in 3 farms for chemical treatments. Sectioning is used for sowing and fertilizer spreading on 4 farms and for spraying on 5 farms. Differentiation is used in 4 farms for fertilization and in 2 farms for sowing. A combine harvester with yield mapping is used on 3 farms, but only 1 farm processes the data. In CIV (5 farms), each farm uses automatic steering for certain operations (each farm uses it for sowing and chemical treatments). Automatic steering is used for harvesting the least (only 2 out of 5 farms). Each farm uses automatic sectioning for specific operations: 5 farms for sowing, 4 farms for spraying and 3 farms for fertilizer application. Machines suitable for differentiation are in 4 farms, but only 1 farm utilizes this feature. Harvester suitable for yield mapping is only available on 1 farm, but yield data is not collected here either. In CV (4 farms), the automatic steering is found on all farms (used for most operations), but the harvester is equipped with automatic steering in only one of the farms. Automatic sectioning is used by 3 farms for spraying and 2 farms for sowing. Two farms are equipped with proper fertilizer spreaders, but only one of them uses this feature. Only 2 farms have machines suitable for differentiation - for sowing and chemical treatments - but they do not utilize the function. Yield mapping is used by only 1 farm.

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Results of precision fertiliser distributor field tests in a Hungarian crop farm

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Keywords: precision farming, spinning disc fertiliser distributor

Introduction

At the University of Debrecen, Institute of Land Utilisation Technology and Regional Development, different type of fertilisers and fertiliser distributor machines were examined by the authors within the framework of precision farming. These examinations were performed in field conditions. In precision crop production, various technical equipment of automatic steering wheel are used. The work quality examinations were conducted in different fields, following which machine settings were altered. Based on the conducted measurements, we concluded that the precise fertiliser spreading was significantly influenced by work quality.

Materials and methods

Our examinations were performed in a Hungarian crop production farm, Balogfarm Kft. in Tépe. The size of the analysed field area was 30 hectares. The examinations used automatic steering/row guiding for power engines and automatic sectioning and differentiated application for each machine. During the precision fertilisation work, the machine settings were controlled by a JD Greenstar. The plant in the arable land was wheat. Tractor: John Deere 6230; M RAUCH AXIS H 30.2 EMC + W mounted spinning disc type fertiliser spreader. The following fertilisers were used in our tests: - YaraMila 16-27-7 (NPK Complex Fertiliser) - YaraBela TM Sulfan 24 Nitrogen. One of the most typical correlations for determining the transversal distribution is the coefficient of variation (CV).

Results and discussion

Adjustment and calibration of the fertiliser spreader and tractor were performed for each application. Application rate ranged between 200 kg/ha and 500 kg/ha. The working width was 30.48 meters. Working speed was 10-13 km/h. The measuring trays are located on the plot positioned one after the other the same distance apart. At the beginning of the field, in the middle of the field, and at the edge of the field, fertiliser was distributed by M RAUCH AXIS H 30.2 EMC + W mounted type spinning disc fertiliser spreader. Trays were placed on the ground along the working width and the fertiliser was distributed forward and backward. The fertiliser is collected in the measuring trays and was weighed on a digital scale with an accuracy of 0.1 g. The resulting values were plotted on a chart. It can be stated that the coefficient of variation of the transversal way is less than the standard CV= 15% required by the standard, so that the standard deviation was satisfactory. At the edge of the field, the coefficient of variation of the transversal way was more than the standard CV> 15%. We have changed the setting parameters of the fertiliser spreader. It can be concluded that the mean difference in dosing was also satisfactory. If he applied dose rate was more or less than the planned amount, the spinning disc fertiliser spreader was corrected by the adjustment of the dosage mechanism. According to our measurements, the application rate was 500 kg/ha in the beginning of the field. Examining the data, the left and right discs have different speed (the rpm was 500-700 1/min). These parameters were changed, and the amount and inequality of dosing and the working width were accurate. As a matter of course, we also considered that the standard deviation was appropriate. It can be stated that our field tests have improved dispersion quality and dosing accuracy. Therefore, the uniformity of dispersion was also satisfactory.

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Comparison of soils by molecular methods focusing on the PGPB bacteria (chernozem, brown earth) of Hungary

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Keywords: PGPB, TRFLP, metagenom sequencing, chernozem, brown earth

Soil microbiom is one of the most important component of soil fertility cause it is able to influence meaningful the soil metabolic activities. The litter decomposition role of bacteria and fungi is necessary for nutrition mobilization, uptake and aggregate formation (Creamer et al., 2016; Heartgreaves et al. 2014). Microbial communities are highly adaptable to varying conditions and respond rapidly to changes as good as fingerprints of different processes (Nannipieri et al., 2018). Soil fertility in the World is decreasing; the understanding the biological properties of the soils and apply this as a tool against the fertility loss is a new way of soil management decisions and researches. Development in molecular techniques especially next generation gene sequencing based on DNA extraction from soil, showed presently abundance and diversity of soil microorganisms. Next-Generation Sequencing (NGS), is a promising method for community analysis (Poretsky et al., 2014) due to its precision and high-throughput capability (Schöler et al., 2017). Microbial community structure and dynamics can be examined in response to changes of different environmental variables (Fredriksson et al., 2013). To know the role and response of microorganisms in the dynamic of soil fertility driven by the environmental parameters (human activities also) is crucial to crop productivity and sustainability of agricultural ecosystems (Nannipieri et al., 2018). Several studies documented the significant role of soil microbes in the work out of soil properties (Gorbacheva et al., 2018; Fierer et al., 2003), land use and management (Paula et al., 2014; Ding et al., 2013) and process of composition.

The aim of this study is to describe the bacterial community of soils from four sites (chernozem agricultural utilized and abandoned, natural brown earth and natural acidic brown soil) and investigate the abundance of bacteria, which are effecting the crop growth aspects, i.e. PGPB (plant growth promoting bacteria) by next generation sequencing, metagenom analysis and the TRFLP fingerprint method. According to the TRFLP results the different soil types and the different utilizations are separating. Most diverse microbe community was observed in the non-utilized soils, while the intensively arable soils have less abundance communities with a different ratio among the genera. The ratio and diversity of the PGP bacteria were also investigated in each cases. The members of the *Bacillus* genus - especially phosphorus mobilizing bacteria - were the biggest number in the arable chernozem soil. The *Pseudomonas* genus members - specified siderophores producing bacteria - were present in the largest ratio in the natural brown earth soil. The members of the *Bradyrhizobium* genus - auxin inducing bacteria - were present in the highest abundance in the natural acidic brown soil.

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The effect of plant extract supplemented feed on intestinal microbiome of piglets

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Keywords: piglet, feed additives, intestinal microbiome, coliform, lactic acid bacteria

The gut microbiome plays important role in maintaining the health of the host animal. The beneficial microbes (mainly lactic acid bacteria) can act in many different ways: improve immune system, suppress pathogens, help in digestion and produce several beneficial compounds. *Escherichia coli* and other members of Enterobacteriaceae are part of the normal intestinal microbiome of humans and animals. They can be harmless or beneficial symbionts, but many of them are known as pathogens or disease causing bacteria. Disease-causing coliforms represent a risk in livestock breeding, especially in the case of piglets. Antibiotics has been used as feed supplements to preserve the health of farm animals for decades, but pathogens may develop resistances due to the overuse of antibiotics and in case of zoonotic bacteria this may cause human health problems. Another risk of the agricultural use of antibiotics is the presence of drug residues in food (Gioia and Biavati, 2018). The risk of using antimicrobial agents led to the prohibition of antibiotics as feed additives since 2006 in the European Union (EU). In case of swine, zinc oxide is very efficient against post-weaning diarrhoea, although increased use of it can cause the emergence of multi-resistant *E. coli* strains as well as environmental hazards. In 2017 the European Medicines Agency decided to ban the use of zinc. However, removal of these substances from animal feeding increases the pathogen pressure in livestock. Thus, pig breeders need to find new solutions against post-weaning diarrhoea, such as the use of pre/probiotics or herbal extracts.

In this study several different mixtures of herbal extracts and zinc oxide (as a positive control) were used as feed additives. Treated and control groups consisted of 20-20 animals and the experiments were carried out in four different times in 2018 and 2019. Stool samples were collected four times during an approximately 80-90 day long period: on the 10th day after the birth of the piglets, before and two weeks after the weaning and at the end of the pig breeding. The samples were homogenized and diluted in 1% trypton containing saline. Changes in the total number of coliforms (potential pathogens) and lactic acid bacteria (LAB, beneficial microbes) were determined in case of treated and control animals. The amount (CFU g⁻¹ faces) of bacteria was evaluated on semi-selective and differential agar plates: De Man, Rogosa and Shapre (MRS) and Eosin Methylene Blue (EMB) media were used in case of LAB and coliforms, respectively.

There was only a slight difference in the amount of LAB between the stool samples of treated and control animals. The amount of coliform bacteria has decreased continuously. Some treatments were as effective as control (ZnO), while other herbal extracts reduced the amount of coliform bacteria at a lower rate in vivo. Our results suggest that some plant extracts may prove to be suitable alternatives to prevent infection caused by coliforms without disturbing the beneficial microbes of the intestinal microbiome. To confirm these results and better understand the changes of the intestinal microbiome DNA were isolated from each stool samples and metagenomic analysis are in progress.

Acknowledgement

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New functional food based on egg white

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Keywords: egg white, lactose-free, dairy products, functional food

Introduction

Today's consumers have a lack of lactose- and whey protein-free products. An opportunity for protein intake is eggs. In our study egg white based dairy products are introduced.

Materials and methods

Due to a specific way of production the cottage cheese like product, ToTu is produced. According to a statistical model HHP treatment of ToTu was carried out for extending shelf-life of ToTu.

Results and discussion

Treatment of ToTu is extremely decreased by processing. Sensorial attributes, like colour and taste are not influenced by the applied pressure. Our results show that microbiological spoilage after a challenge test and HHP

Conclusions

From our study it is clear that a minimal processing technology, like HHP can be used for preservation of ToTu products.

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Our research is sponsored by the projects „Egg white based dairy product analogs with probiotic effects for allergic people and development of low-fat and carbohydrate products for people on a protein-dense diet” and „EFOP-3.6.3-VEKOP-16-2017-00005”. We are very thankful for that.

Agrotechnical factors of the nutritional values in medicinal herbs Title

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Keywords: medicinal herb growing, cultivation technology, weed control

Introduction

Growing, processing and trading medicinal and aromatic plants is considerable in Hungary, and the importance of their growing will probably continue increasing due to agricultural structures, the European Union rules and as a result of climate change. Medicinal plant production through cultivation, for example, can reduce the extent to which wild populations are harvested, but it may also lead to environmental degradation and loss of genetic diversity as well as loss of incentives to conserve wild populations (Anon. 2002). The number of plant species used for medicinal purposes is more than 50 000 (Govaerts 2001). More than 400 plants species used for production of medicine by the Indian herbal industry, fewer than 20 species are currently under cultivation in different parts of the country (Uniyal et al. 2000). In Hungary, a country with a long tradition of medicinal and aromatic plant (MAP) cultivation, only 40 species are cultivated for commercial production (Bernáth 1999). In Europe as a whole, only 130–140 MAP species are cultivated (Verlet and Leclercq 1999).

Materials and methods

During my research scented mayweed (“Hungarian chamomile” - *Matricaria chamomilla*) as an annual plant sown in the autumn, yarrow (*Achillea millefolium*) and oregano (*Origanum vulgare*) as a perennial plant sown in the autumn and dill (*Anethum graveolens*) as a spring-sown aromatic/medicinal herb are intended to be tested. By my examinations I wish to find answers how these cultures can be kept free of weeds under field conditions, whether the agents applied can be detected in the plant-based products, and how the certain technological elements can influence the essential oil content of the plants. Accordingly, I systematize the domestic and foreign cultivation practices and weed control technologies. I follow the changes in nutritional composition for the four subject plant cultures with special regard to the quality and quantity of essential oil. The residues of applied pesticides are also intended to be examined. In 2018 and 2019 there were a few chemical weed control trials in chamomile, which results is in progress. In 2019 seedlings of oregano 105 varieties were made and were also planted in the field and these varieties will be tested in 2020 in different aspects.

Through the effective application of methods, the following outcomes are expected after having carried out the research: Elaboration of a modern, integrated chemical and mechanical weed control technology; Cultivation technology for 4 plants based on elaborated practical criteria; Follow-up of changes in nutritional composition with respect to the applied weed control technologies.

Conclusions

In my consideration the outcomes of my research are of use to the whole Hungarian and European agricultural sector. The environmental protection, the integrated approach and the regulatory environment are all encouraging the growers to use a more diverse crop ratio and to work with more plant cultures than in the traditional system of 4 to 5 plants developed till now, which can provide also financial security for the farmers. The use of an effective cultivation technology may save costs and require less inputs. The latter is one of the main pillars of environmental protection. Hopefully, my results can be of service to the decision makers, crop buyers and end users in addition to the farmers.

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Methodology of creating precision deep ripping application maps

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Keywords: penetration resistance, soil moisture, bulk density, precision ripping, soil compaction

From among the processes that threaten soil condition, physical degradation of soil (compaction and structural degradation) has become a global problem. The soil is considered harmfully compacted if the soil mechanical resistance measured by the penetrometer exceeds 3-3.5 MPa and the bulk density of the soil is 1.5 g/cm³ (BIRKÁS, 2017). Soil compaction has a negative impact on processes that occur within the soil, impairs cultivability, increases energy demand for tillage, reduces crop yield. In precision agriculture, it is possible to treat unfavourable soil patches that are spatially separated. Our study was carried out with a hand-held, vertical penetrometer in a complex tillage long-term experiment. The device measures the position of the measuring points with the help of DGPS, soil moisture content through capacitive method ($v \ v^{-1}$), soil mechanical resistance (MPa) and probe depth (cm). The mapping of the experiment was carried out in 400 measurement points per hectare, from which the bulk density values of the measuring points were determined using an empirical formula, and mean values of 10 cm were determined. Depth values for bulk density higher than 1.5 g/cm³ (compacted soil layer) were separated from the calculated data. These depth values were interpolated using the Golden Software Surfer application using the kriging method. The resulting map was visualized using Quantum GIS (Fig. 1).

Figure 1: Precision deep ripping map of the complex soil tillage long-term experiment (Debrecen, 2018)

In summary, mapping of the soil compaction based on contact measurements carried out with a mechanical soil sensor is suitable for producing a precision ripping plan if it is performed with a suitable sampling strategy in accordance with the given soil tillage (e.g. strip tillage) and if soil moisture data for the measurement depths is available.

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The effects of thiamethoxam on stress enzyme production of tomato plants inoculated with arbuscular mycorrhiza

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Keywords: Arbuscular mycorrhiza, Tomato, Pesticide, Thiamethoxam, qRT-PCR

Although the outdoor use of three neonicotinoid pesticide (clothianidin, imidacloprid, and thiamethoxam) has been regulated by the European commission in 2018 due to their harmful effect on honeybees, their indoor usage is still permitted. The contact with these xenobiotics also causes stress to the plants so they naturally detoxify them by chemical modification and vacuolar compartmentation. Arbuscular mycorrhiza fungi are proven to increase overall plant vigor and resistance towards several stresses. Enzymes responsible for detoxification and oxidative stress tolerance are also enhanced. Salicylic acid (SA) is a key component in the regulation of stress response and various aspects of growth and development. Therefore SA may be a good indicator of overall plant condition.

To study the interaction of arbuscular mycorrhiza and thiamethoxam on tomato plant physiology a pot experiment was set up in Martonvásár in the spring of 2018. Plants were inoculated with Symbivit® and treated with a plant protection product with thiamethoxam as active agent. The experiment consisted of four treatment groups: Control (not treated in any way); Mycorrhized (inoculated with Symbivit®); Pesticide treated (treated with Actara); and Mycorrhized and Pesticide treated (treated with Symbivit® and Actara as well). Samples have been collected in five replications from each group. After harvest shoot and root biomass was measured, the expression of enzymes responsible for oxidative stress alleviation, and xenobiotic compartmentalisation (Glutathione S-transferase (GST), Monodehydroascorbate reductase (MDHAR), Cytosolic Ascorbate peroxidase (cAPX), Glutathione reductase (GR)) and a SA biosynthesis enzyme (Isochorismate synthase (ICS)) have been examined by qRT-PCR. $2^{-\Delta\Delta CT}$ method was used for relative quantification.

Shoot and root biomass showed significant differences between treatments. According to the qRT-PCR results, no difference was observable in the expression level of GST between treatments. In case of MDHAR and GR, an interaction was observable between mycorrhiza and pesticide treatment but statistical analysis revealed no significance between the results. cAPX levels significantly increased in pesticide treated plants compared to Mycorrhized and Mycorrhized and Pesticide treated plants. The expression of ICS showed significant difference in all treatments, with the highest alteration in pesticide treated plants. This change was significantly lower in inoculated plants.

Our results indicate that the presence of arbuscular mycorrhiza does alter the way how plants react to stress caused by xenobiotics in case of enzymes and hormones as well.

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Ecophysiological research of *Silene vulgaris* plants grown on soil contaminated with cadmium

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Keywords: *Silene vulgaris*, cadmium, metallophytes, ecophysiological indicators

Introduction

Silene vulgaris (Moench) Garcke is a perennial plant from the *Caryophyllaceae* family. The plant is a facultative metallophyte that shows multiple tolerance and co-tolerance to heavy metals (Ernst et al. 2006, Nadgórska-Socha et al. 2011). The species occurs on grasslands, fields and in forests, but it can also be found as an element of ruderal habitats such as post-mining areas and post-industrial sites (e.g. serpentinite or calamine heaps) (Koszelnik-Leszek et al. 2019). This is a bioindicator of heavy metal contamination and its presence has been recorded in areas both naturally rich in heavy metals and contaminated by human activity (Wierzbicka and Rostański 2002). The aim of the study was to compare the accumulation and translocation capability of Cd in organs of *Silene vulgaris* whose seeds came from the nearest surrounding of the Nonferrous Smelting Plant “Szopienice” (Szopienice population), vicinity of the zinc plant “Miasteczko Śląskie” (Miasteczko Śląskie population), a former zinc-lead (calamine) site in Dąbrowa Górnicza (Dąbrowa Górnicza population) and a calamine waste heap in Bolesław near Olkusz (Bolesław population). The seeds collecting area was located in southern Poland. The plants were cultivated on the soil with the addition of Cd: 100 and 300 mg·kg⁻¹ and without Cd in controlled conditions. Looking for ecophysiological indicators of stress caused by heavy metals, we studied the activity of selected antioxidant enzymes: guaiacol peroxidase (POD), superoxide dismutase (SOD) and catalase (CAT) as well as glutathione (GSH). We compared the content of particular macronutrients such as: P, Ca, Mg and K in the leaves of studied species. We also studied the potential bioavailability of Cd in the soil.

Materials and methods

Cd was extracted from the samples of soil using 0.01 M CaCl₂. After wet mineralization of plants material Cd and macronutrients were measured by inductively coupled plasma emission spectroscopy. The antioxidant enzymes activity and glutathione content were measured according to the spectrophotometric methods.

Results and discussion

The contents of CaCl₂-extracted Cd (potentially bioavailable) were low and they have been accounted for 2.85% and 8.35% of the doses added to the soil. Cd accumulation in the plant organs increased along with the increase of Cd concentration in the soil. The highest Cd bioaccumulation (concentration above 70 mg kg⁻¹) was found in the leaves of *S. vulgaris* plants of the Miasteczko Śląskie and Dąbrowa Górnicza populations and in the roots of the plants of *S. vulgaris* of the Szopienice populations. Cd Translocation factor values higher than 1 were found in *S. vulgaris* populations (from Miasteczko Śląskie, Dąbrowa Górnicza and Bolesław), indicating effective translocation of Cd from the roots to the aboveground parts. The increased level of glutathione in plant leaves of all analysed populations on contaminated soil in relation to control plants has confirmed the participation of this compound in detoxification processes. The comparable activity of antioxidant enzymes (SOD, CAT and POD) in plants from contaminated soil and control plants (except for the Dąbrowa Górnicza population) indicates that long-term exposure to pollutants did not cause measurable antioxidant stress. An increased or similar content of P, Ca, Mg and K was found in the leaves of plants of the studied populations cultivated on contaminated soil compared to that found in control plants, which confirms the increased tolerance of the studied metallophytes tested to Cd.

Conclusion

The studied *S. vulgaris* metalicolous population could constitute the basis for rational, fast and efficient revegetation of post-industrial area with the Cd excess in the soil.

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The influence of Cd, Pb and Zn on soil enzyme activity in the *Vaccinium myrtillus* L. rhizosphere and non-rhizosphere soil under different field conditions

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Keywords: soil pollution; forest soils; bilberry, root zone, heavy metals

Introduction

Vaccinium myrtillus L. (bilberry) is the most frequent and abundant dwarf shrub species in the understory of the conifer forests in Europe and Northern Asia and makes a significant contribution to the soil processes in this community type because it is a major contributor to the formation and accumulation of the humus layer and in the prevention of soil erosion (Matuszkiewicz et al. 2013; Liu et al. 2014; Kandziora-Ciupa et al. 2017). However, information about the rhizosphere effect of *Vaccinium myrtillus* L. on soil properties and activities soil enzymes, especially in heavy-metal contaminated soils, is still unknown. From the viewpoint of microbial ecology, the rhizosphere is a special unique hot spot in the soil where microorganisms are considerably stimulated by the activity of the roots (Jones et al. 2004; Hisinger et al. 2006; Egamberdieva et al. 2011). The rhizosphere is also an important site of material cycling and energy flow (Xiao et al. 2017) and has a significant influence on the availability or solubility of nutrients as well as on the availability of heavy metals (Orroño et al. 2012). The aim of this study was to determine the influence of heavy metals on soil enzyme activity in *Vaccinium myrtillus* L. rhizosphere soil as well as in non-rhizosphere soil from different polluted sites. The presented study was also conducted in order to determine any differences in the soil physicochemical properties between the *Vaccinium* rhizosphere soil and the non-rhizosphere soil.

Material and methods

The study was performed in a middle-aged Scots pine forest, which is mixed with birch, European beech and pedunculate oak that are growing on sandy acidic soils that are located at three differently polluted sites (the vicinity of the “Miasteczko Śląskie” zinc smelter, of the Mining and Metallurgical Plant in Bukowno and a main road with high traffic – Katowice-Kostuchna) as well as in an unprotected natural forest community in Kokotek. The content of heavy metals and their potential bioavailability, physicochemical soil properties, activity of arylsulfatase, β -glucosidase, dehydrogenase, acid phosphatase and urease were determined.

Results & conclusion

Soil organic matter, the levels of C, N and almost all enzyme activity were significantly higher in the rhizosphere soil than in the non-rhizosphere soil. At the most contaminated site, the content of heavy metals was also higher in the rhizosphere soil, but their bioavailability was lower than in the non-rhizosphere soil. The β -glucosidase and urease activity in the soil correlated most negatively with the examined metals. The levels of two enzymes were also strongly impacted by the organic matter – the C and N levels and pH.

β -glucosidase and urease were the most sensitive indicators of the adverse impact of Cd, Zn and Pb. The bilberry rhizosphere soil had stronger correlation coefficient values between the measured parameters than the non-rhizosphere soil, which suggests that rhizosphere soil is more sensitive and could be used in the monitoring and assessment of forest ecosystems.

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Impact of the *Vaccinium myrtillus* L. rhizosphere on the soil quality from areas with different degrees of pollution

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Keywords: Soil quality; QBS, heavy metal; *Vaccinium myrtillus*, rhizosphere

Introduction

Soil fauna participate directly and indirectly in the decomposition process, soil genesis and soil characteristics and are involved in nutrient cycling (Menta et al., 2014). Microarthropods are one of the most important groups in soil ecology, often used to provide soil quality indicators (Menta et al., 2018). From the viewpoint of soil ecology, the rhizosphere is also an important site of soil metabolism and has a significant influence on the availability or solubility of nutrients as well as on the availability of heavy metals (Orroño et al., 2012). In this study, particular attention was paid to the rhizosphere effect of *V. myrtillus* on soil quality especially in heavy-metal contaminated soils. *V. myrtillus* is the most frequent and abundant dwarf shrub species in the conifer forests in Europe and this is a species that has been reported to be a successful colonist of heavy metal contaminated soil (Kandziora-Ciupa et al., 2013). The aim of this study was to determine the influence of heavy metals on soil microarthropod communities in rhizosphere soil as well as in non-rhizosphere soil from different polluted sites.

Material and methods

The study was performed in a pine forest, located in different polluted sites: Miasteczko Śląskie, Bukowno, Katowice-Kostuchna, and Kokotek. The sampling sites were located in southern Poland. Samples of the rhizosphere and the non-rhizosphere soil for QBS calculation and determination of the concentration of selected metals have been collected in May and September of 2017. QBS index is based on the concept that at higher soil quality, the number of microarthropod groups well adapted to soil habitats will be higher (Parisi et al. 2005). The soil strongly adhering to the blueberry roots was considered to be the rhizosphere soil, while the non-rhizosphere soil was taken from areas without vegetation or with light vegetation but without *V. myrtillus*.

Results and discussion

Very high concentrations of Cd, Mn, Zn, and Pb were observed in the soils from Miasteczko Śląskie (respectively: 33.53 mg kg⁻¹, 124.82 mg kg⁻¹, 1697.5 mg kg⁻¹, 1584.58 mg kg⁻¹). In Miasteczko Śląskie, rhizosphere soils accumulated more heavy metals than non-rhizosphere soil, in turn, at the other sampling sites in most cases, heavy metal content was lower in rhizosphere soils than in non-rhizosphere soils. Wang et al. (2009) observed that rhizosphere soils accumulated more Cu, Pb, Cd, and Zn. The soils from site M had the low QBS, which can be explained by the very high concentrations of heavy metals at that site. Similar results were shown by Madej et al. (2011). The higher values of QBS were in rhizosphere soil independently from the contamination degree on particular sites

Conclusion

QBS is a sensitive tool to assess the degree of soil contamination with heavy metals. However, this method allows assessing the degradation level of soils, but it does not give an answer cause of the alteration, therefore it has to be accompanied by adequate indicators for example assessment of heavy metal pollution and soil enzyme activity.

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The application of innovative floating treatment wetlands with emergent macrophytes to removal nutrients in rainwater – experimental studies

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Keywords: Floating treatments wetlands, nutrient removal, macrophytes, waste materials

Introduction

Floating treatments wetlands (FTW_s) are an innovative engineering solution for treatment of surface and rainwater as well as industrial wastewater from biogenic elements. Another advantage of the islands is the possibility of colonization of their surface by various groups of organisms as well as their aesthetic values, which is especially important when they are installed in urban conditions (Keizer-Vlek et al. 2014; Weragoda et al. 2012). The paper presents preliminary results regarding the use of a floating island made of waste materials to remove nutrients in rainwater.

Methods

In order to assess the degradation of materials used to construct the island, a sample of each of them are placed in a separate glass vessel with distilled water (1 dm³) and pH, conductivity, NH₄-N, NO₃-N and PO₄-P content was regularly measured. In addition, the fiber structure was examined using an SEM microscope. To determine of the nitrogen and phosphorus removal, 24 natural nonwoven samples were placed in separate glass vases in rainwater taken from a small fire protection reservoir located in the Rybarzowice (Bielsko-Biala District, N Poland) among which 16 was planted with two species of macrophytes: *Typha angustifolia* and *Iris pseudacorus*. Concentrations of the nutrients was monitored weekly during the laboratory experiment.

Results and conclusions

The island's surface was spontaneously covered by plants in effect of natural succession. Laboratory experiment show that among all investigated materials, only the natural nonwoven fabric was biodegradable which results in the slight release of NH₄-N and NO₃-N into the water. However, that total concentration of N and P from the samples planted with *I. pseudacorus* and *T. angustifolia* were significantly lower than the values for total concentration these nutrients in control samples (only with natural non-woven fabric, without plants). These results suggest that FTW_s with these macrophyte species can be used to treat rainwater to prevent eutrophication of small reservoirs.

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Examination of the effect of tillage, fertilization and crop year on the starch content of maize

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Keywords: starch content, fertilization, crop year, tillage

Introduction

The use of maize, both as main and by-product, is extremely versatile and diverse (Nagy, 2007). The highest amount of carbohydrate within maize is found in the form of starch ($C_6H_{10}O_5$)_x. In terms of industrial starch, maize is the most important raw material. According to Ahmadi et al. (1976) and Alföldi et al. (1994), maize grain is an animal feed and important for human nutrition. The nutritional composition of maize is genetically determined, but it can be altered through agro-technical and ecological factors (Izsáki, 2005). Fodder maize is primarily an energy source due to its high starch content, and its protein and oil content are less important (Spitkó et al., 2003). Rátónyi et al. (2014) found that starch and protein content, which are negatively correlated with each other, are significantly affected by fertilizer doses.

Materials and methods

The Experimental Station of the University of Debrecen is located in the Hajdúság Loess Plateau, its soil is loess-based deep humus layered calcareous chernozem. The following treatments were applied in the scope of the polyfactorial experiment: Tillage: T₁ = winter ploughing (27 cm), T₂ = strip tillage (23 cm), T₃ = ripping (45 cm). Crop years: 2017, 2018 and 2019. Fertilization treatments: N 0 kg/ha P₂O₅ 0 kg/ha K₂O 0 kg/ha (control); N 80kg/ha P₂O₅ 60 kg/ha K₂O 90 kg/ha and N 160 kg/ha P₂O₅ 60 kg/ha K₂O 90kg/ha. Analysis of the nutritional component of the collected samples was carried out by means of a Foss Infratec TM 1241 Grain Analyser at the Institute of Land Utilization, Technology and Regional Development.

Results and discussion

In terms of fertilization treatments, the highest (64.42%) starch content was measured for the control treatment, while the lowest starch content was recorded in the case of the 160 kg/ha treatment (62.62%). The analysis of the crop year effect showed that 2018 was the most favourable year for the starch content of the examined samples (65.76%). The analysis showed that fertilization and crop year had a significant effect on the starch content of the examined samples. At the same time, the joint effect of tillage and crop year as well as fertilization and crop year were also significant in terms of the starch content.

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Dark septate endophytic fungi in the environment contaminated with phenol and polynuclear aromatic hydrocarbons

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Keywords: dark septate endophytic fungi, phenol, polynuclear aromatic hydrocarbons, next generation sequencing

Introduction

Dark septate endophytes (DSE) are conidial or sterile ascomycetous saprophytes that represent a diversified and frequent, although as yet poorly known, group of root colonizers. DSE are not mycorrhizal and their associations with plants balance between parasitism and mutualism, which are dependent upon different environmental factors. DSE are thought to occur more frequently in stressful environments. The aim of this study was to isolate and identify the DSE present in the environment contaminated with phenol and polynuclear aromatic hydrocarbons (PAHs) and assess their resistance to these contaminants in the laboratory conditions.

Methods

DSE were isolated on potato dextrose agar (PDA) from surface sterilized plant roots, collected from the shore of Kalina pond. The pond, located in the Silesian region (Poland) was industrially contaminated with phenol and the mixture of PAHs. Sampling was also performed from the shore of Kokotek lake, located in the same region, which was an uncontaminated control site. To assess the resistance of isolated DSE to the presence of contaminants, the fungi were cultured on PDA plates with different concentrations of phenol/PAHs mixture. Stains which showed the highest resistance to the contaminants were identified based on the ITS sequence. Moreover, roots of the collected plants were stained and examined under the microscope to assess the intensity of DSE colonization. In order to study the biodiversity of DSE communities in the contaminated site, the roots were subjected to DNA extraction. The DNA was used to prepare the metagenomic libraries based on the ITS2 fragment and sequenced using the Illumina MiSeq. The sequences were processed using Mothur programme.

Results and conclusions

Among the isolated DSE strains, the highest phenol and PAH tolerance was demonstrated by two *Phialocephala* sp. strains and one *Slopeiomyces cylindrosporus* strain. These fungi will be used in a further experiment to inoculate plants grown on the medium contaminated with phenol and PAHs, in order to evaluate their plant growth promoting potential. In accordance with the literature data, the DSE colonization was more intensive in the roots collected from the contaminated site, when compared to the control site. Moreover, the next generation sequencing revealed the higher biodiversity of DSE in the contaminated site, with the dominance of the order *Helotiales*. The presented research showed that DSE tend to colonize plants growing in stressful conditions. In this case it was the soil contamination. Our further research will be focused on studying the influence of contamination on the plant-DSE association, to reveal if it is either symbiotic or parasitic.

Mycotoxin effect on wheat protein content and animal behaviour

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Keywords: mycotoxins, protein determination, HPLC, rat behaviour

As it is impossible completely eradicate fungal contaminations of wheat in the fields, the goal has to be to decrease the possibility of the infection with good agricultural practice. Following different treatments at the fields, the protein content of different wheat samples were characterised using HPLC method. Parallel of these investigations the effect of subchronic treatment with combined fusariotoxins (DON, ZEA, FB1) on rat behaviour was also studied.

Acknowledgement

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The Impact of the Agrotechnology on the *Fusarium* Infection on Winter Wheat and the Mycotoxin Production

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Keywords: *Fusarium*, Winter Wheat, Mycotoxins

The genus *Fusarium* is comprised of a large, complex group of fungi with ascomycete teleomorphs and contains numerous species. This genus is known for its intimate association with cereals as a plant pathogen causing various diseases such as: Fusarium wilt (Naguib, 2018), Fusarium ear blight (Parry et al. 1995) and Fusarium head blight (Dexter et al. 1997) and has been isolated from maize (Adejumo et al. 2007), wheat (Jenkinson and Parry 1994) and barley (Salas et al. 1999). In addition to their pathogenicity, *Fusarium* spp. produce toxic secondary metabolites known as mycotoxins such as: fumonisin, deoxynivalenol and zearalenone. Fumonisin has been associated with oesophageal cancer in humans and liver cancer in rats (Marasas 2001). Deoxynivalenol has been associated with skin inflammation, nausea, vomiting, and diarrhea (Rotter et al. 1996). Zearalenone has been associated with disrupted conception, abortion, and other reproductive problems (Kurtz and Mirocha, 1978).

A study was conducted to test the effect of different wheat varieties (Alföld, Kolompos, Karék) and different nitrogen doses (0, 4, 8, 12, 18 g/m²) on the concentration of mycotoxins (fumonisin, deoxynivalenol and zearalenone) present on wheat kernels. For this purpose, samples were taken and tested using the Rosa FAST5 DON/ZEA/FUM Quantitative Test by Charm Sciences. To measure the concentration of mycotoxin, wheat kernels from each sample were ground and then 5g was weighed and added to a centrifuge tube. For deoxynivalenol distilled water (25 ml) was added to the ground sample in the centrifuge and for fumonisin and zearalenone 70% methanol (10 ml) was added to the ground sample in the centrifuge tube, followed by vigorous shaking and then settling. Supernatant and Diluted Buffer was mixed. After that the diluted extracts from samples were applied to the test strip, incubated for 5 minutes, and read in the Rosa-M Reader. Several correlations were found between the different agrotechnological methods and *Fusarium* infection or mycotoxin production.

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A rheological study of frozen-thawed liquid egg yolk

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Keywords: egg yolk, freezing, rheological properties, Herschel-Bulkley model, pseudoplastic

Introduction

Freezing increases the shelf life of liquid egg products for up to 1 year, but the egg yolk undergoes an irreversible phenomena called gelation, when it is cooled under -6°C. Functionality is affected by the fluidity loss. Gelation process is not completely understood, but most researchers agreed that ice crystal formation leads to the aggregation of proteins (Au et al., 2015; Primacella et al., 2018).

Materials and methods

In our study, industrially broken and homogenized raw liquid egg yolk (Capriovus Ltd, Hungary) was frozen in a laboratory freezer at -18°C in 100.0 ml sample containers. Sampling was carried out on days 0, 1, 7, 14, 30, 60 and 90 after thawing at room temperature. Rheological properties were examined by Anton Paar MCR 92 rheometer, where shear rate was adjusted from 1 to 1000 1/s. Herschel-Bulkley model was fitted to investigate the rheological properties and data were analysed by one-way ANOVA.

Results and discussion

The liquid egg yolk exhibited pseudoplastic and thixotropic rheological behaviour prior to freezing. Slow freezing and thawing resulted in a yield point, which indicates that a certain shear force is required for the sample to begin to flow. The consistency coefficient increased significantly (Table 1.), while the flow behaviour index decreased. Significant changes were also observed in all properties as the storage time increased.

Table 1: Rheological parameters (yield stress, τ_0 ; consistency coefficient, K and flow behaviour index, n) of raw and frozen-thawed liquied egg yolk samples (applied model: Herschel-Bulkley)

Storage time [days]	τ_0 [Pa]		K [Pa·s ⁿ]		n		R^2
	mean	S.D.	mean	S.D.	mean	S.D.	
0	0.00 ^a	0.00	0.21 ^a	0.01	0.93 ^a	0.00	1.0000
1	14.17 ^b	4.88	13.07 ^b	1.17	0.56 ^b	0.02	0.9999
7	27.56 ^{bc}	6.65	14.73 ^{bc}	0.97	0.54 ^{bc}	0.01	0.9998
14	23.03 ^{bc}	2.20	14.53 ^{bc}	0.80	0.54 ^{bc}	0.01	0.9999
30	36.43 ^c	3.07	19.31 ^d	1.60	0.52 ^c	0.01	0.9999
60	32.17 ^c	6.54	15.56 ^{bc}	0.92	0.54 ^{bc}	0.01	0.9999
90	39.25 ^c	3.07	16.15 ^c	1.11	0.54 ^{bc}	0.01	0.9998

a, b, c Within the same columns, values with different letters are significantly different ($P < 0.05$)

Conclusions

Our results showed that slow freezing drastically changed the rheological properties of liquid egg yolk. This is due to the gelation that occurs in egg yolk at temperatures below -6°C.

Acknowledgement

Our research is sponsored by the project „Egg white based dairy product analogs with probiotic effects for allergic people and development of low-fat and carbohydrate products for people on a protein-dense diet VÁLLALATI KFI_16”, the Doctoral School of Food Sciences of Szent István University and Capriovus Ltd.

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The use of a qualitative assessment system for the purposes of protecting geological objects in post-mining areas

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Keywords: brownfields, land use again, cultural landscape, post-mining objects, revitalization,

Introduction

Even advanced technologies for producing material goods and energy are still dependent on access to mineral resources. There are currently about 7,000 opencast mining plants operating in Poland, extracting almost 40 various mineral resources (Kasztelewicz et al., 2015). The exploitation of minerals always changes dramatically the environment. Despite the obligation of reclamation resulting from legal regulations, until recently, post-mining areas were treated as permanently degraded (brownfield), predisposed only to perform marginal functions in the city's structure. In the conditions of urban deficit, quarries are found in the sphere of interest of business and local communities. However, there are still no general rules for the valorisation of post-mining facilities for the purpose of restoring functionalities not related to mining activities (Wojnarowska 2019). The aim of the presented research is to create tools for identification and qualitative assessment (Henzel et al., 2009) dedicated to post-mining areas, taking into account the protection of unique geological objects and landscape forms which were revealed or were arising in the process of exploitation.

Materials and methods

The analysis covered the area of the city of Jaworzno, with an area of 150 km². Located in The Silesian Voivodeship, on the border with The Lesser Poland Voivodeship. The area was analyzed in terms of the typology of mineral resource deposits (Henzel et al., 2009) exploited by the opencast method in terms of their new functions in the city structure. The data was obtained from the database of the Polish Geological Institute - National Research Institute - MIDAS and the resources of the State Mining Authority in Katowice, the State Archives in Katowice and the Museum of the City of Jaworzno. Within the city, 12 significant deposits of raw materials were identified in various stages of access, their characteristics were distinguished, specific features describing key natural, cultural and functional values conditioning the process of determining the directions of restoring their use value in the post-exploitation phase. As a model area for qualitative assessment, based on the tools created, a partially developed 32 ha Sadowa Góra quarry was selected.

Results and discussion

The test method was taken from POE (Post - Occupancy Evaluation) qualitative research, applying it to both reclaimed post-mining and non-reclaimed facilities. POE is a proven, comprehensive and coherent method of researching public spaces (Niezabitowska 2008). This method aims to check to what extent users are satisfied with the object, as well as what its features and adopted solutions may arouse their dissatisfaction. The method assumes three basic assessment criteria: technical, functional and behavioral quality. Technical quality relates directly to the conditions of use (safety, quality of infrastructure, facilities made available); functional quality means adjustment to function, and behavioral quality refers to the user's perception related to aesthetics or a sense of uniqueness of the place. The following were distinguished as important features in the research process: location and accessibility; infrastructure; security conditions; natural conditions (mainly in inanimate nature); historical and cultural value, surrounding and accompanying infrastructure. These features were considered key in the process of valorisation of post-mining areas. It was assumed that the satisfaction of users of post-mining objects in new functions can be a method of supporting the protection of valuable natural geological objects and mining landscape.

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Wild medicinal plants - diversity in the northern part of the Silesian Upland (southern Poland)

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Keywords: Silesia Upland, vascular plants, medicinal plants, natural resources

Introduction

The importance of medicinal plant crops in the world is still growing. In Poland over 90% of medicinal plant species are obtained from Nature, from natural ecosystems. Raw materials are harvested from 66 species of vascular plants listed in the Polish Pharmacopoeia XI, which is translated from the European 9. Some of the medicinal crops are species endangered at a regional or national scale in Poland and even in Europe. Rational use of plant resources on natural positions requires prior recognition of their resources. Any use of plants regardless of their durability in nature is a robbery economy.

Materials and methods

A study on the geographical distribution of vascular plant species on the area of eastern part of Tarnogórski Hump (Silesia Upland) has been conducted since 1990. During the study special attention has been paid to medicinal plants. The data has been collected based on the records of plant species occurrence in the field and based on the revision of bibliographical data. The research area covered about 600 km². It has been divided into research plots 2 x 2 km. In total, the data about the distribution of medicinal plant flora has been collected in 174 research plots of the Tarnogórski Hump.

Results and discussion

The results obtained show that the flora of the eastern part of Tarnogórski Hump consists of 1011 species of vascular plants. The recorded plants were classified into groups of medicinal plants depending on which herbal materials they are providing, based on Polish and European Pharmacopoeia. The wild medicinal species confirmed during the field study, which afford herbal stock, were classified into 7 groups according to their frequency. The additional information has been provided about the distribution of the species localities and the way how the stock is harvested.

Conclusions

The analysis of the data revealed the list of medical plant species of which the population is abundant enough and maybe harvested with no danger to the resources of their wild populations.

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The preliminary petrographic analysis of beach sands from a recreational area

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Keywords: petrographic analysis, sand, pollution

The use of optical petrography to determine the amount of impurities in solid fuels (Jelonek, 2018) has shown new possibilities for qualitative and quantitative analysis of the content of various impurities found in these products. The use of petrographic methods to determining the content of solid impurities such as plastics, metals, coals, glass, cellulose and other impurities of organic origin found in sands and soils of recreational areas has resulted in satisfactory results.

The petrographic analysis of sand samples obtained from the beach at the “Sosina” resort provided valuable data about anthropogenic and natural pollution sources. The analysis of microscopic images allowed determining undesirable inclusions affecting the quality of the recreational area used by both adults and children.

The petrographic analysis of samples used a Zeiss Axio Imager M2m polarizing microscope with a point counter. It was possible to determine the percentage concentration of impurities in 1000 measurement points. A triangulation mesh (with a square grid of 50m x 50 m) was generated (the area was covered with 8 squares); then about 1 kg of samples were taken from the central place of each of the 8 squares. The samples were collected to a depth of 30 cm. The microscopic polished sections were made after averaging and sieving the samples through 1-05 mm sieves.

The lowest content of impurities was recorded for microscopic samples made of material collected away from the water reservoir, while the most contaminated were the sands in the central part of the beach and then moderately contaminated sands in the vicinity of the water reservoir.

The samples, in addition to admixtures in the form of plastics, rust, glass, cellulose, and metals, also contained impurities of organic origin, i.e. parts of coniferous and deciduous plants, and, in one case, animal faeces.

While some amounts of organic matter contribute to the color change of the tested sand samples, plastic and metal particles in the samples pose a serious threat to users of the recreational area. Cuts and scratches, combined with organic contamination of soil, may lead to hard-to-heal (infected) wounds.

The preliminary microscopic analysis (oil immersion) of samples collected from the beach located in the vicinity of the “Sosina” reservoir in Jaworzno provides valuable data about the nature of the examined site. The administrators of recreational areas can use the obtained data on the contamination of beach sands when organizing clean-up actions.

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Examination of fusarium head blight contamination in different winter wheat genotypes

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Keywords: winter wheat, fusarium head blight, artificial inoculation, seed weight

In winter wheat cultivation, *Fusarium* contamination of wheat grains is a serious problem, with its toxins is a potential source of danger both in the food industry and in animal nutrition. Cultivated winter wheat varieties have a controversial fusarium resistance/tolerance, but the crop year has a dominant effect on the development of infection. The effectiveness of chemical spike protection treatments is also somewhat questionable, so knowledge of the natural contamination parameters of varieties has an increasing importance.

Our investigations were carried out at the University of Debrecen Institutes for Agricultural Research and Educational Farm Research Institute of Nyíregyháza in the 2016/2017 crop year. In the experiment 20 domestic and foreign winter wheat genotypes were included. Genotypes were sown in single-row plots in randomized four replicates. In addition to the natural infection of the genotypes, a single induced inoculation was used in a similar implementation. For induced inoculation, a suspension of the lyophilized culture of *Fusarium graminearum* L. was prepared by bubble culture (Mesterházy, 1975). In plots, 20 spike were selected per replicate for the control and once inoculated head blights. The individual flowering time of the genotypes was monitored, we made the inoculation on the day after the appearance of the anthers. After harvesting the spikes, the seeds were threshed and the weight and ratio of the visual symptoms were determined.

The infection rate of the examined genotypes in this year varied from 0.00-7.62%. Based on the results of the natural infection, we found less than 1% infection in case of the *Bánkúti 1201 x Mentana* genotype, *Nagykállói* landrace, *SE 15*, *SE 16/2* and *SE 16/1* breeding lines. We also found favorable values in case of the *GK Élet* variety and the *Gégényi* genotype. The *Bánkúti 1201 x Mentana* genotype alone did not show any visually detectable infection. The highest spontaneous infection rates were measured for the *PS Julka* (7.62%), *PS Sunanka* (7.61%) varieties and *Nagysurányi 211* landrace (6.03%). Significant differences were found between the genotypes in case of application of induced infection. The weight ratio of infected grains ranged from 3.54 to 27.06%. Similarly to the spontaneous infection, the *Bánkúti 1201 x Mentana* genotype had the lowest grain infection (3.54%). Below 5% infection rate were characterized by *Gégényi* (4.31%), *SE 16/2* (3.70%) and *SE 16/1* (3.85%) genotypes. Above 15% infection was characteristic of *Bánkúti Marquis* (17.90%), *PS Julka* (16.12%) and *PS Sunanka* (17.31%) genotypes, the maximal infection rate was found for *KG Kunhalom* (27.06%) variety.

Our studies have shown that the differences are distinct by fusarium sensitivity between the genotypes, it can be observed in the unfavorable crop year in case of infection. Based on our results, we concluded that there are potential genotypes among traditional landraces and after successful technological adaptation, they are useful as the effective bases for genetic control against fusarium.

Acknowledgement

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Impact of citric and lactic acid on microbiological proprieties of liquid whole egg during refrigerated storage

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Keywords: Whole Egg, Citric Acid, Lactic Acid, Sensorial properties

Introduction

For the time being, egg and its products act the part of major sources of protein in the Human diets. This due to high protein content of egg and low price comparing to the other protein sources. Nevertheless, it is the target of many food-borne microorganisms such as *Listeria monocytogenes*. To decrease the exposure of egg to microbiological contamination, sterilization of the whole egg could be carried out through using heat treatment. As it's known about the egg protein it starts to coagulate at 70°C. The recommended heat treatment by the USDA for the liquid whole egg is at least 60°C for no less than 3.5 min. Accordingly, to reduce the damage of heat treatment the ad of additive is a necessary and the most common one that has been used in poultry diet and egg products industries is the citric acid and lactic acid.

Materials and methods

To determinate its effect on Liquid Whole Egg, citric and lactic acid was added to the raw liquid whole egg until obtaining the pH of 5.0-5.5; this conintiesly done to until reaching pH7. The whole liquid egg heat treated at a water bath (70°C for approximately 3 minutes). For each pH, the measurement was performed each 3 days for a storage period of 15 days. Microbiological samples of liquid whole egg were sent to Capriovus Company respecting the cold chain for the same duration, each 3 days. Only the viable cell was counting by culturing on Agar plate.

Results and discussion

Comparing the pH values of citric and lactic acid before and after the heat treatment, the difference is barely noticed. While for both of acids, the fluctuation of pH values can be seen form the curves. During 7 days of storage, the viable cell count of citric and lactic acid was $2 \cdot 10^5$ CFU; despite the raw liquid whole egg showed the highest number of viable cell count 10^9 CFU. For this reasons, the measurements for the raw liquid whole egg were stopped. Starting from the 10th day the growth of microorganisms is importantly notice. Until the last day of storage, both of acids showed a viable cell count for liquid whole egg pH 7 between $9.7 \cdot 10^5$ CFU for lactic acid and $1.2 \cdot 10^6$ CFU for citric acid.

Conclusions

The ad of additives to the liquid whole egg reduced the side effects of heat treatment at the results shows. While the pH difference was almost seen for citric acid samples this indicates that it is efficiency is not that important as the lactic acid to reduce the microorganisms on liquid whole egg.

Acknowledgement

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Edible wild plants - diversity in the northern part of the Silesian Upland (Southern Poland)

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Keywords: edible wild plants, Silesian Upland, species diversity, crops

Introduction

Food and medicinal plants are the most important for people. Recently, especially wild edible plants have been the subject of research in different regions of the world (e.g. Benítez et al., 2017, Shaheen et al., 2017). Therefore, the main purpose of the preliminary research was to study the diversity and resources of wild edible plants in the selected areas of the Silesian Upland in southern Poland.

Materials and methods

The subject of the analysis was the spontaneous flora of vascular plants of the eastern part of the Tarnogórski Hump - mesoregion of the Silesian Upland (S Poland) investigated mainly in the years 1990-1996 (Nowak 1999) with supplementary research to 2015. The area covered about 600 km², and the research unit (locality) was adopted square with a side of 2 km. The total number of 174 research plots have been analyzed. The list of the most popular wild edible plants was adopted after available studies for Poland (Łuczaj 2004, Fleischhauer et al. 2016, Fijolek 2017).

Results and discussion

As a result, 223 wild edible plant species that belong to 55 plant families has been recorded in the eastern part of the Tarnogórski Hump. Among them Asteraceae (26 species), Rosaceae (17 species), Lamiaceae (13), Brassicaceae (12 species), Apiaceae (9 species) and Fabaceae (9 species) families were the most represented. However, the most common were, among others the following species: *Galium mollugo* (170 localities), *Heracleum sphondylium* (170 localities) and *Medicago lupulina* (170 localities). On the other hand, the least frequent were e.g. *Cardamine hirsuta* (1 locality), *Viola odorata* (1 locality) and *Potamogeton crispus* (5 localities). Reported plant species are a source of basic nutrients (carbohydrates, fats, proteins) and are used as spices as well. In addition, many of them are medicinal plants. Edible wild plant species localities were recorded in both natural and semi-natural and anthropogenic habitats.

Conclusions

Due to the recorded air and soil pollution in some regions of the studied area, the suitability for the consumption of plants occur in the region analyzed should be included in the study. The list of wild edible plants should be verified due to the presence in some of the ingredients that may pose a threat to human health and thus their usefulness. However, it is worth emphasizing the importance of local gene resources, which may be the starting material for obtaining new varieties of plant species cultivated in the future.

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Investigation of the relationship between the induction of superoxide-dismutase enzyme activity and the infection of *Pyrenophora teres* f. *teres* in barley genotypes

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Keywords: *Hordeum vulgare*, *Pyrenophora teres*, biotic stress, superoxide-dismutase, antioxidant enzyme

Introduction

The incidence and importance of barley leaf diseases has increased and one of the most important pathogens is *Pyrenophora teres* f. *teres* (PTT), which causes the net form of net blotch disease. Depending on the susceptibility of varieties, the estimated yield loss is 10-30% (Steffenson *et al*, 1991), but in the case of susceptible barley genotypes the damage can be up to 100%. This necrotrophic fungus forms longitudinal and transversal necrotic lesions with chlorotic border on the leaves. The disease of the pathogen reduces the assimilation surface, resulting in qualitative and quantitative yield loss. The most effective method of controlling plant diseases is the cultivation of tolerant and resistant varieties, therefore the susceptibility of barley genotypes against biotic stress factors is one of the most important selection criteria in plant breeding. PTT grows intercellularly in the plant tissues and destroy the cells, which are not in direct contact with the intercellular mycelia. It can be inhibited by the hypersensitive reaction (Able, 2003). Superoxide-dismutase (SOD) is an antioxidant enzyme is responsible for the elimination of the toxic superoxide radicals caused by biotic and abiotic stress.

Materials and methods

Six barley genotypes (BC5, BC6, BC52, BC74, BC106, BC168) and four monosporic PTT isolates (H-502, H-618, H-774, H-949) were selected in order to investigate the PTT infection induced change in superoxide-dismutase activity. Plants were inoculated by spraying conidia onto the leaves at two-leaf stage. Control plants received only 0.01% Tween 20. Inoculated and control plants were grown under the same greenhouse conditions. The necrotic lesions caused by the fungal isolates were evaluated on the second leaf, using the Tekauz scoring scale (Tekauz, 1985). Leaf samples were collected at 0th, 1st, 2nd, 3rd days and in the case of isolate H-949 at the 7th and 15th days after the inoculation. Preparation of the leaf extracts and analysis of the SOD enzyme activity of the extracts were carried out by spectrophotometer as described by Sigma-Aldrich® measurement protocol.

Results and discussion

Different SOD activity pattern was observed in the case of infection by isolate H-502, H-618 and H-774 on the 3rd days after the inoculation. The SOD activity highly increased from 7th day to 15th day in the samples from BC5, BC6 and BC168 varieties, while in genotypes BC52, BC74 and BC106 the increase of SOD activity was slower or remain approximately the same as it was on the 7th day, in the case of H-949 infection. On the basis of disease scores, genotypes BC6 was tolerant and BC5 was susceptible in case of all PTT isolates, whereas the reaction of other genotypes seemed to be isolate-dependent. The results confirm the importance of investigating the SOD activity in case of the PTT infection in seedling stage to study the mechanisms of resistance during biotic stress.

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Metatranscriptomics of soil as a tool for unraveling the links between plant functional diversity, soil microbial community and soil carbon allocation: an ongoing project

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Keywords: metatranscriptomic of soil, carbon budgeting, functional diversity, microbial community

Introduction

Recent studies have highlighted the importance of the soil microbial community, together with the aboveground vegetation, in the soil carbon budgeting. A more diverse plant community induces a more active, abundant and diverse soil microbial community whose activity increases the turnover rates of detritus. Slow-cycling SOM pools are thus accumulated as a consequence of the increased microbial respiration, ending up in products such as microbial necromass (Lange et al, 2015). However several aspects of the chain “plants - soil microbial community - SOM pool” are not yet fully understood and the spontaneous succession at the post-mining sites offers an important opportunity to perform further investigations. Plant community diversity could be investigated under a taxonomical point of view as well as functional point of view. In the present project we will analyze, by means of a metatranscriptomic approach, the relations between different types of vegetation patches, characterized by a various degree of species and functional diversity (intended as the value, range, and distribution of functional traits of organisms in a community), and the belowground microbial communities. Our hypothesis are as follows: the “functional diversity of the vegetation patches” vs. “plant species richness/abundance of the patches” exert a different influence: 1) on the composition, structure and thus diversity of the soil microbial community in a spontaneous succession process, 2) on the metabolic pathways related to the soil microbial community, 3) on the soil carbon budgeting.

Research project methodology

Data recorded on coal mine spoil heaps were used to select appropriate vegetation patches characterized by four combination of plant species diversity and functional diversity. Soil cores were sampled from each vegetation patch selected and used for the analysis of the microbial community as well as for the physico-chemical properties of the soil, including SOM. The analysis of the microbial community will be performed by means of a metatranscriptomic approach. Total RNA from soil was extracted to be used for cDNA libraries preparation. Sequencing of cDNA libraries will generate an amount of reads in terms of millions. Reads will be processed by means of bioinformatics tools to characterize the microbial population under a taxonomic and functional point of view. Statistical analyses will be conducted to test taxonomic and functional differences between microbial communities as well as the correlations with the other variables considered in the study.

Expected outcomes

The outcomes of the research will provide more knowledge about how microbial communities respond to the different components of plant community diversity and how they functionally interact in the carbon budgeting of the soil. In addition, the findings of the study would prove useful in the interpretation of data from more complex environments. Furthermore, a better understanding of the plant community dynamics governing the belowground microbial diversity would provide useful information relevant to developing effective reclamation strategies.

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