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Soil Science Institute, Belgrade, Serbia

BOOK OF ABSTRACTS

The 1st International Congress on Soil Science
XIII National Congress in Soil Science

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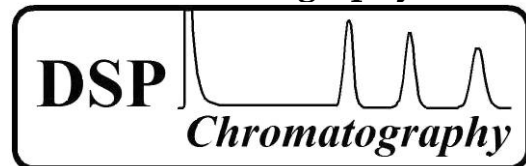
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PLENARY LECTURES

PLENARNA PREDAVANJA

**INTRODUCTION OF CONTINUOUS MONITORING OF AGRICULTURAL LAND OF
REPUBLIC OF SRPSKA**

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ABSTRACT

Strategy of sustainable agricultural development is impossible without monitoring changes in the soil as an integral part of environmental monitoring. From 1992 to 1997, the monitoring of land is introduced respectively: Bulgaria, England, Finland, Czech Republic, Norwign, Slovakia, France, Holland, Hungary, Austria, Spain and Germany. Slovenia introduced it in 2007, and Croatia in 2010. Because of the many specifics of land in relation to water and air, this job is very complex and expensive, and the importance of protecting land was not sufficiently recognized by decision makers in the RS and FBiH. However, the importance of monitoring land is stressed by the EU, which is by the implementation of Section 6 Programme of Action for the Environment, raised the importance of land protection at the level of protection of water and air. (*"Environment 2010: Our Future, Our Choice"* - *Decision of the European Parliament and Council of the European Union 2002*). European Commission in 2006 proposed to the European Parliament and the Council of the European Union Water Framework Directive for soil protection COM (2006) 232 aimed at ensuring the protection of land based on the principle of conservation of its function, prevention of soil degradation, mitigation of degradation and repair of degraded land. Agricultural Institute of RS, i.e. Department of Agrochemistry and Agroecology from 2002 to 2011 completed several major projects aimed at the introduction of continuous monitoring of agricultural land, the only monitoring within environment monitoring that is not introduced in RS. This paper presents the results of previous research and implemented projects that were aimed at finding the most appropriate model for establishing a permanent monitoring of agricultural land in the RS. Also, it presented a model for establishing a permanent monitoring of pollution of agricultural land of the RS, which will meet all EU requirements and is acceptable for the economic situation of the Republic of Srpska.

Keywords: monitoring, agricultural land, pollution

**THE BEHAVIOR OF CA AND SR IN THE SOIL-PLANT SYSTEM FROM LIMING
WITH A STRONTIUM-CONTAINING AMELIORANT**

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ABSTRACT

The behavior of Ca and Sr in the soil-plant system from liming with a strontium-containing ameliorant was studied in two long-term liming pot experiences and in a series of simulation experiments. It was established the waste lime containing 1.5 % of stable strontium is possessed a high chemical activity, and the full dissolution of the ameliorant added in considerable quantities was reached 3–4 years after its application. The scope of strontium migration in the loamy sand soddy-podzolic soils was determined in columns in a series of simulation experiments. It was found that the amount of leached strontium to depend on its initial content in the soils, the humus content and the volume of percolated moisture. The artificial enrichment of soils with strontium increases the losses of the element due to its leaching. However, strontium is not completely removed even upon repeated water percolation. It was found what the HA1 fraction plays a leading role in the fixation of strontium in the non limed soil; it contains about 50 % of the total soil strontium. Differences in the accumulation of strontium by plants from different families were revealed. It was found that the transition of Sr to the generative and vegetative organs of plant was followed with different mechanisms.

Keywords: calcium, stroncium, liming, ameliorant

**DEVELOPMENT OF THE FUNDAMENTALS OF MINIMUM TILLAGE SYSTEMS OF
CHERNOZEM SOIL OF NORTHERN KAZAKHSTAN**

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ABSTRACT

Kazakh Research Institute for Soil Science and Agricultural Chemistry named after Uspanov in recent years is doing an experimental research in Kostanai Agricultural Research Institute, Kazakhstan, to develop a theoretical framework for minimizing tillage systems in order to study effective water accumulation, reducing the mineralization of soil humus and to improve farming technologies.

The studies were conducted on the southern chernozems in Kostanai region using the minimum and zero tillage.

The research results showed that under conditions of frequent drought in May and June on Chernozem an application of the direct seeding into stubble technology makes it possible to save more productive moisture.

Keywords: minimum tillage, zero tillage, Chernozem, soil moisture, soil humus

RHIZOBIA AS INOCULANTS AND THEIR USE IN AGRICULTURAL PRODUCTION

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ABSTRACT

Nitrogen (N) is an essential plant nutrient whose deficiency in the soil limits crop yield. In spite of its huge quantity in the air, nitrogen (N₂) is relatively inert, but particular soil bacteria so-called diazotrophic can uptake (fix) N₂ into a form that plants can use to make amino acids, proteins and nucleic acids. Efficient biological N fixation (BNF) between soil bacteria named rhizobia (family *Rhizobiaceae*) and leguminous plants (fam. Fabaceae) provides about 50% of total N amount fixed on Earth. According to this fact, this symbiotic association is the most efficient agricultural association. However, symbiotic associations are characterized by variable efficiency due to biotic and abiotic factors. Therefore, artificial inoculation of seeds or soil with rhizobial inoculants as microbiological N fertilizer represents important agro technical measures in agricultural legumes production. The inoculation refers to the addition of selected, highly effective rhizobial strains to legume seed prior to sowing. Improvement of N fixing potential of soil, as well as compensation for the absence of sufficient numbers of effective autochthonous rhizobial strains in the soil are the main reasons for inoculation with the aim to improve crop yield and achieve reductions of both cost and mineral N fertilizer. This is very important for sustainable agriculture due to environmental protection. The main goal of this paper is to underline the importance of application of microbiological N fertilizer particularly its development in the Republic of Serbia. Rhizobial inoculants have been successfully used in world agriculture for more than a century. A microbiological N fertilizers influence increase of quantity and quality of plant yield and significantly provide their needs in nitrogen. Effect of their application depends on many factors including plant cultivar, bacterial strain and their interaction as well as soil type. However, some researchers have shown that, due to rhizobial plant growth promoting abilities, permanent legumes inoculation gives significantly higher yield of grain and hay in comparison with uninoculated plants. Azotofiksin is one of the oldest, confirmed in practice, microbiological N fertilizer in the Republic of Serbia and it has been applied to economic important legumes, especially soybean. It provides more than 60% of legumes needs in nitrogen. Simultaneous selection of both rhizobial strains and legume cultivars should be a continuous process because only high compatible genotypes of legumes and rhizobia can reach high potential in N fixation. Results indicate that rhizobial inoculants in agricultural production would, at least, complement mineral N fertilization.

Keywords: Symbiotic N fixation, rhizobia, legumes, inoculants, microbiological N fertilizer, crop yield

ROLE OF PLANT PRODUCTION IN WATER VIRTUAL TRADE

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ABSTRACT

Society development and population increasing lead to increased demand for water. Water is a natural resource of great importance, and agriculture is the largest consumer of water - 70% of water resources are spent in agriculture. Demand for water in agriculture is increasing, not only due to the increase in production volume, but also because of climate change, which is reflected in the increase in plant water requirements. The concept of *Water Footprint* is developed with the main goal to provide a better assessment of water demand and water consumption in different countries. Author of this concept, A.Hoekstra, used this quantity to describe the relationship between water management, consumption and trade. The basic idea of the concept is that the *Water Footprint* considered as an indicator of the level of use and the pollution of water can be used to assess the wear of water resources and water demand in the context of different directions of economic development. Although *Water Footprint* does not indicate clearly whether water consumption makes positive or negative impact on water resources, it can still help in a more efficient and rational use of water and the protection and conservation of water resources.

Water Footprint adjoined to an industrial product is the amount of water consumed in its production. In addition to the water that the product really contains there is water used (consumed) indirectly - the so-called virtual water. The virtual-water content of the product (commodity, good or service) is the volume of freshwater used to produce the product, measured at the place where the product was manufactured. This refers to the sum of all water consumed in the different steps of the production chain. This water is called virtual because most of the water used in production is not physically contained in the product. It's a wasted water and its quantity is much higher than the actual water content. Therefore, trade in agricultural products (and other products and services) actually implies the virtual water trade.

Water Footprint can be viewed at different levels: for any defined group of consumers, individuals, families, cities, nations or the manufacturer, factories, farms, etc..

Water Footprint is made up of three components: blue, green, and gray water. Blue water is the amount of water that evaporates from the resources of surface and ground water in the production of goods and services (or built into the product during the manufacturing process). In agronomic terms, this water is used for irrigation.

Green water is the quantity of water originating from precipitation that accumulates in the rhizosphere layer, which evaporates or is incorporated into the product. In agronomic terms, this is the amount of water that plants use in the conditions of natural water consumption.

Grey water is the amount of contaminated water that is associated with the production of goods and services for individuals or for the community. It can be estimated as the amount of water required to reduce pollution to the extent in order to receive a satisfactory water quality. From agronomic point of view it is difficult to define the amount of grey water, and this component is usually ignored in the assessment of virtual water trade.

Although the concept of Water Footprint is often disputed, cooperation between global institutions in this area has led to establishment of Water Footprint Network in 2008, in order to coordinate the further development of this concept and the development of appropriate research methods and applications.

Some studies suggest that developed countries export more virtual water than imported, and have high water productivity, as opposed to developing countries which import more virtual water (in agricultural products) than it exported. Developing countries use their water reserves mostly groundwater for irrigation and by channeling those resources in more profitable agriculture production, it could lead to better management of water and its conservation. This depends on various factors, mostly political, then economical, educational, etc.

Despite the fact that general understanding is that Serbia has a large water potential, it is not actually true, because most of the surface water are the water flowing and they may only be used in accordance with international protocols, as it is related to the possibility of using the water for irrigation. Serbia has a very good potential of green water, which can be very productively used with advanced agro-technical practices. The purpose of this paper is to present a general procedure for calculating the green and blue water, on the example of implementing of this procedure in one region.

Keywords: Water, water potential, agriculture, concept of Water Footprint

BEHAVIOR OF PHOSPHORUS IN STAGNOSOL

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ABSTRACT

In soil the dynamic transformations of phosphorus between the forms occur continuously to maintain the equilibrium conditions. Low concentration and solubility of P in soils make it critical nutrient limiting plant growth. This paper was devoted to explanation of mechanisms and distribution of different forms of phosphorus, its transformations and dynamics in the soil based on 40-years field experiments in phosphate fertilization. The sequential extraction procedures were applied to identify the different forms of soil P (Chang & Jackson, and BCR methods). After extraction, P was determined by spectrophotometry. Trace elements were determined with an ICAP 6300 ICP optical emission spectrometer.

Formation of the forms of soil P and binding largely depends on soil pH. The bounds Al-O-P forms much more labile forms than formations with double bounds of P. Al bound P is the most labile form that supplies the plants with P-nutrient, and is the most responsible form for the movement of P along the soil profile and replenishment of other soil P-fractions.

Keywords: phosphorus, sequential extraction, microelements

PEDOLOGICAL AND PEDOGEOCHEMICAL MAP OF SERBIA

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ABSTRACT

This paper shows the soil map of Serbia, which are consistent mapping units, both between provinces and within central Serbia. In central Serbia, mapping soil lasted for decades, using different classifications, and the southeastern part (700 000 ha) is mapped only two years ago. Based on maps of scale 1: 50 000, made by the Institute of Soil Science, Belgrade, Institute for Agricultural Research, Novi Sad, and Institute for Water Resources „Jaroslav Černi“, Belgrade, made a unique map of Serbia. The map shows 20 mapping units, referring to most soil types. In addition to the soil map the results of years of research of heavy metals in central Serbia are discussed. It is recorded that Ni, Cr, Pb and As are more frequently present as potential pollutants. Also the areas of potential contamination are given on the maps. The content of heavy metals in each soil types were used for differentiation by their content.

Keywords: soil, mapping, pollution

SECTION 1

SOIL USE AND SOIL QUALITY MANAGEMENT

- **Evaluation and Land use planning**
- **Soil Fertility and Plant nutrition**
- **Soil Degradation Control**
- **Organic Farming**
- **Soil Microbiology**

POTENTIALS AND REQUISITES OF NON-AGRICULTURAL LAND USE FOR THE ESTABLISHMENT OF FOREST PLANTATION

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ABSTRACT

This paper points to the need for better utilization of land that is not used for agricultural production and could be used for establishment of forest tree plantation. The characteristics of soil on locality "Potok" near town Crvenka in Vojvodina province are shown. Investigated site is located in the agricultural region. According to the criteria of the current pedological classification, soil belongs to chernozem, but due to the unsuitable configuration of terrain is not used for agricultural production. The textural composition of the soil is very favorable. According to the determined ratio of granulometric fractions soil belongs to sandy loam and loam classes. Chemical properties are also very favorable. Investigated chemical properties indicate that this soil is medium alkaline, very humic, moderately provided with nutrients and does not contain salt. Since, studied soil on the locality "Potok" has high fertility and production traits; it is suitable for establishment of hardwoods plantations. By afforestation of this site, as it is not used for agricultural production, will be achieved the optimal utilization of the investigated soil.

Keywords: non-agricultural land, land use, afforestation

**DIFFERENTIAL APPROACH FOR MODELING OF THE SOIL NUTRITION
REGIMEN**

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ABSTRACT

In last year's conducted research in different countries, results showed that an improper assessment of the necessary soil nutrition regimen of different agricultural plants can pollute the soil and reduce the biological activity and productivity of the soil. That is because in different countries, especially in developed European countries, there are thousands of hectares of soil that have lost their fertility through the use of chemical fertilizers [FAO, 2011]. The main reason for this problem is that the mineral fertilizers were the norm; the norm was defined by a calculation of the absorbable nutrition value. Sometimes it is not considered that different plants, through the use by its physiological properties and ecological demands, can absorb different forms of nutrition (potential and absorbable). For the new methodology for proper assessment of the soil's effective and potential fertility leans towards N.I. Qorbunov's methodology (1978).

For Qorbunov, all of the nutrition reserved in the soil is called "the Total Nutrition Reserve." The total nutrition reserve consists of Immediate Nutrition Reserve, Intermediate Nutrition Reserve, and Potential Nutrition Reserve.

Immediate Nutrition Reserve (ImNR) is the value of the nutrition that can be defined through the agrochemical methods in the water solution and is absorbed by the plants during years 5-10.

Intermediate Nutrition Reserve (InNR) is the value of ash elements in the existing silt fraction of the soil and can be absorbed when there is not an existing immediate nutrition reserve.

Potential Nutrition Reserve (PNR) includes nutrition value existing in the soil fraction that has particles more than 0.001mm in size. Nutrition of this reserve form is hypoactive and needs more time to be absorbed by the plant. In terms of time and space this nutrition form can convert to immediate and intermediate nutrition reserve forms.

Our conducted research took place in the last 20 years for modeling soil fertility in Azerbaijan, the preparation was either regional or conceptual modeling, different soil types nutrition regimen were considered the main modeling blocks. Entering all forms of nutrition reserves to the nutrition regimen blocks in the fertility modeling, in terms of anthropological soil formation soil formation, creates opportunities controlling the nutrition regimen changing property and it's prognosticate.

Out of practicality, it is useful to utilize soil nutrition forms (immediate, intermediate, potential) in the preparation and drawing up of soil documents and agrochemical cartographies in the following aspects:

- Lifecycle of soil and agrochemical documents is prolonged up to 20-25 years and those documents are not renewed every 5 years, so, investment of million manats and time are saved;
- Amount of fertilizer rates are precisely fixed and the carried out overdose fertilization problem (input of toxic substances to topsoil) from previous years is alleviated;
- Application rate of commercial fertilizers, which are very costly, is decreased.

Keywords: Immediate nutrition reserve, intermediate nutrition reserve, potential nutrition reserve, water solution

PODZOLS AND THEIR FLORA IN THE EASTERN PART OF REPUBLIC OF SRPSKA

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ABSTRACT

Forest soils and their flora in the Republic of Srpska are not explored enough. Podzols occupy less than 1% of the total area of forest soils of Bosnia and Herzegovina. Exact data about this percent in the Republic of Srpske does not exist. Due to the specific conditions of formation as well as specific acidophilic flora that is associated with podzols protection of this soil type in terms of habitat diversity is needed. Study was conducted in the eastern part of the Republic of Srpska, on following areas: Kalinovik (Dobrevode), Jahorina Mountain (Saračpolja) and Javor Mountain (Partizansko polje). Soil profiles were opened between 983 - 1395 meters above sea level. Podzols are found on the northern exposures and slopes with different inclinations. This type of soil is related with siliceous parent material such as quartz sandstone - quartz. Profiles are morphologically very different. Generally there is no many plant species. At all investigated sites *Vacciniummyrtillus* was dominant in the shrub layer, as a typical acidophilic species. However, this medical and edible plant is intensively exploited by man, which is why it is endangered. Therefore, it is very important to adopt the necessary measures for its protection and sustainable exploitation.

Keywords: podzols, flora, Republic of Srpska, protection

INFLUENCE OF SOIL QUALITY ON YIELD OF THE LATEST GENERATION OF ZP MAIZE HYBRIDS IN LAND CONSOLIDATION AREA OF OBRENOVAC

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ABSTRACT

During two years (2010-2011) in system of land consolidation area of Obrenovac, we investigated influence of soil type and quality class on average yield of the newest (VI breeding cycle) generation of ZP maize hybrids from FAO 600 (hybrids ZP600, ZP 606, and ZP 666).

Land consolidation area (8.801 ha) covers north-west part of cadastral district shall of Obrenovac and it is consisted of the following cadastral municipalities (CM): Zvečka, Urovci, Krtinska, Brgulice, Ratari and Skela. Land consolidation in wide area of Sava river valley (alluvial plain) was conducted 1988.

Investigations were carried out on automorphic soil types: sand (arenosol), chernozem, brown forest soil (euteric cambisol) and leached soil (luvisol), as well as on hydromorphic soil types: alluvial soil (fluvisol), meadow black soil (humofluvisol), pseudogley, humogley (humogley) and marshy gley soil (eugley) I, II, III, IV, and V quality class.

Out of the total area of Obrenovac (cadastral district shall), which covers 40,995 ha total, maize is grown on about 11,500 ha. Total surface under cereals generally is 18,000 ha. Domestic ZP hybrids dominate with 60% of the area under the maize.

The average yield of the ZP maize hybrids belong to the last generation FAO 600 was 8.28 t / ha in hydromorphic soils (alluvial, meadow-land semiglay, humogley-humogley, pseudogley and marshy land eugley) while on automorphic soils (sandy soil, chernozem, brown forest-eutric cambisol and leached soil - luvisol) their average yield was 7.04 t / ha.

Since hydromorphic soils dominate in land consolidation area of Posavina, average maize yields were statistically significantly higher, compared to automorphic soil types in drought affected 2011.

Keywords: automorphic and hydromorphic soils, maize, grain yield, ZP hybrids, land consolidation area.

THE IMPACT OF VEGETATION ON ARENOSOL PROPERTIES AT DELIBLATO SAND

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ABSTRACT

Deliblato Sand is characterized by extreme and specific ecological habitat conditions, with dominant pasture and forest ecosystems on different stage of development of Arenosols. The role of vegetation, particularly forests, has a positive role in the process of pedogenesis. Forest trees with their root systems and a crown mitigates extremes habitat conditions, creating a specific of microclimate. Pastures have also a positive impact on the land, but the impact on microclimate significantly lower. In this paper analyzed a role of vegetation type on soil properties. The soil was sampled from soil profiles at depths of 0-5; 5-10, 10 -20 and 20 - 40 cm. Physical and chemical soil properties are analyzed according methods by JDPZ (1966, 1997). Analysis of Variance (one way ANOVA) used to show differences between soil properties under different vegetation type.

Keywords: Arenosol, soil properties, pasture, forests, Deliblato Sand

**THE RESPONSE OF AGRICULTURAL CROPS TO INOCULATION WITH GLOMUS
INTRARADICES**

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ABSTRACT

The arbuscular mycorrhiza is a symbiotic association formed between the roots of members of over 80% of terrestrial plants and a small group of common soil-borne fungi (*Glomales*). In general, this association is beneficial for both partners. Therefore, arbuscular mycorrhizal (AM) fungi are potentially important tools in agricultural production. The response of wheat (*Triticum vulgare* L.), maize (*Zea mays* L.), lettuce (*Lactuca sativa* L.) and English ryegrass (*Lolium perenne* L.) to inoculation with AM fungi were tested in controlled conditions. Inoculation treatments included two commercially available inoculums containing *Glomus intraradices*. Plant material was taken 30 days after inoculation. Mycorrhizal root colonization and plant growth (stem length, root length, plant dry mass) were analyzed. Internal hyphae of the fungi were observed in the roots of all four investigated plants. The AM fungus did affect significantly the growth of maize plants. The results of this investigation showed the potential of using inocula containing AM fungi in sustainable plant production. Further research needs to be carried out in order to increase the benefits of AM inoculation in semi controlled and field conditions.

Keywords: mycorrhiza, wheat, maize, plant growth, root colonization.

DIRECT AND RESIDUAL EFFECTS OF APPLIED FERTILIZERS ON NO₃-N DYNAMICS IN THE SOIL AND TOMATO YIELD IN GREENHOUSE EXPERIMENTS

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ABSTRACT

NO₃-N dynamics in the soil as dependent on applied fertilizers and their effect on tomato yield was observed in greenhouse experiments set up on experimental fields of the agricultural advisory service station in Sombor in 2011 and 2012. In order to determine the impact of the application of different fertilizers, mineral fertilizers and organic and mineral fertilizers combined (mature cattle manure (MCM) 20 t/ha; composted pig manure (CPM) 20 t/ha; mature cattle manure 20 t/ha + mineral fertilizer 11:11:21 (500kg/ha); composted pig manure 20t/ha + mineral fertilizer 11:11:21 (500 kg/ha); and unfertilized- control), two greenhouse experiments were conducted so as to monitor the direct and residual effects of the applied fertilizers on NO₃-N dynamics and on tomato yield. Organic fertilizers have a residual effect in plant nutrient supply and they enhance chemical, physical and microbiological properties of the soil. The combined application of organic and mineral fertilizers is instrumental in securing better nutrient supply in early stages of plants' development. In the present study residual effects of organic fertilizers were studied in one of the experiments, where tomato was grown in 2012 as the second crop (fertilized in 2011, under previous crop). In the experiment where fertilization was performed under tomato, the measured amounts of NO₃-N with all treatments are statistically significantly higher than in the experiment where fertilization was performed under the previous crop. The residual effects of fertilization (of the previous crop) were monitored at all sampling times. In the experiment in which we monitored the residual effects of fertilization, no correlation was found between the measured amounts of NO₃-N in the soil at planting time and tomato yield. At later sampling times, especially at the first harvest, we found a high correlation ($r= 0,69$) between soil NO₃-N and the yield. In the experiment in which fertilization was done under tomato, a high correlation between soil NO₃-N and the yield was observed at all sampling times.

Keywords: fertilization systems, mineral nitrogen dynamics in the soil, yield of tomato, organic fertilization

**NH₄⁺-ZEOLITE/RAW PHOSPHATE COMPOSITE AS A NATURAL FERTILIZER
AND SOIL REMEDIATION AMENDMENT**

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ABSTRACT

The application of raw phosphates for soil fertilizing is economically cost-effective and environmentally eligible then industrial phosphorous fertilizers, but it is limited on acid soils. Our investigations is focused on design of novel multifunctional material based on the synergistic conjunction of ammonium modified zeolites and raw phosphate, contributing to greater phosphor-mobilization in various soil conditions and in a wide pH range, through the Ca²⁺ cation exchange. The results indicates that an addition of zeolites to the rock phosphate contribution the release of phosphorus in the first 24^h for about 60%, while modified NH₄⁺ - zeolite increases the release of phosphorus for an additional 150%. Released phosphate ions could have a dual role as a nature fertilizer and soil remediation amendment through phosphate-induced stabilization of heavy metals. The efficiency of aluminosilicate composites, as a nature fertilizer, was investigated through the vegetation experiments setup with maize on soil type distric cambisol. On the other side we investigate the acceptor properties of composite through phosphate precipitation of heavy metals and reducing their bioavailability. The obtained results indicate that NH₄⁺-zeolite/raw phosphate composite has multifunctional properties applicable in sustainable agriculture.

Keywords: modified zeolite, phosphate rock, nature mineral fertilizers, soil remediation amendment

**THE OPTIMISATION OF SUBSTRATA COMPOSITION FOR PRODUCTION OF
MARIGOLD SEEDLINGS (*Tagetes patula* L.) USING THE RESOURCES OF
DOMESTIC RAW MATERIALS**

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ABSTRACT

Since Serbia has significant resources of peat and mineral raw materials (zeolite, perlite), the application of which ensures not only economically but also ecologically justifiable production, this paper investigates the possibility of using domestic raw materials for the preparation of substrata suitable for growing one of the most common flower species in the country, *Tagetes patula* L. – marigold. We tested the influence of 14 variants of substrata, which were prepared using Tutin peat, perlite and zeoplant, on the development of marigold seedlings. The tests were conducted in the glasshouse of the Faculty of Agriculture in Belgrade during 2010. Marigold seedlings were produced by applying modern technologies of growing and using the seedling system and the pot system containers.

It was determined that examined substrata, with their physical and agrochemical characteristics, exerted a favourable influence on the growing of marigold seedlings. The results of the research showed that the best development of marigold seedlings, examined using the root-shoot ratios, was recorded on substrata in which Tutin peat accounted for 60-80%, perlite 10-20% and zeoplant 10-20%. Using substrata of such a composition, the substitution of the imported substratum is guaranteed. Since domestic raw materials are used, the price of substrata and therefore the price of the final product would be lower.

Keywords: substratum, seedling, annual flowers, marigold, Tutin peat, perlite, zeoplant

**INFLUENCE OF LONG-TERM APPLICATION OF FERTILIZER AND
AMELIORATIVE MEASURES ON CHANGES OF PSEUDOGLEY SOIL PROPERTIES
AND GRAIN YIELD OF WINTER WHEAT**

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ABSTRACT

Long-term year treatment by fertilizer and pedo- ameliorative measures shows a significant effect on the changes of agro-chemical properties, especially extremely in acid soil pseudogley type, which has a poor ability of buffering, unfavorable and unstable chemical properties. The most significant changes in agrochemical soil properties are present in the soil pH, soil adsorption complex composition and content of biogenous elements (phosphorus, potassium, calcium, iron, manganese and zinc), as well as the content of toxic amounts of aluminum.

Long-term years of periodical using chemical ameliorative substances (limestone, phosphate and manure) together with the regular use of fertilizer has significantly reduced soil acidity (0.6 to 0.8 pH units), are increased amount of adsorbed base cations for 3.7 m.ekv./100g, V% for 22.89% and enhanced composition of adsorption complex. It also gave an average increase of content and most nutrients (phosphorus accessible to 8:38 mg, 10.8 mg of potassium, calcium, from 48 to 83 mg), and the mobility of iron reduced for about 24% manganese for over 100%, zinc for 41 % and particularly aluminum in which the content is reduced from 13.61 to 0.14 mg). As a result of improving soil fertility the grain yield of winter wheat was increased in average for about 45%.

Keywords: fertilization, amelioration, pseudogley, grain yield

THE INFLUENCE OF MINERAL NUTRIMENT ON GRAIN QUALITY OF WINTER WHEAT CULTIVATED AT GROUND OF VERTISOL TYPE

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ABSTRACT

Examinations were held at stationary field experiment with fertilizing during period of three years (2004/2005, 2005/2006 and 2006/2007) at vertisol type ground, the property of Center for small grains in Kragujevac.

The experimental examinations, beside control, included six fertilizing variants: 1) N₀ P₀ K₀; 2) N_{80, 120} P₀ K₀; 3) N_{80, 120} P₆₀ K₆₀; 4) N_{80, 120} P₁₀₀ K₆₀; 5) N_{80, 120} P₆₀ K₀; 6) N_{80, 120} P₁₀₀ K₀; 7) N_{80, 120} P₀ K₆₀. During experiment individual fertilizing were implemented as follows: KAN (as nitrogen fertilizing), superphosphate (as phosphate fertilizing) and 60 % of potassium salts (as potassium fertilizing). Apart from above mentioned variants of mineral nutrition, in experiment were included seven cultivars of winter wheat: Takovčanka, Ana Morava, KG 100, Lazarica, KG 56S, KG 4 and KG 5.

The aim of this work was to examine the effect various dosage and relation mineral fertilizers on grain quality (1000 grains mass and hectoliter mass) of different cultivars of winter wheat cultivated on ground of vertisol type.

The highest value mass of 1000 grains in triennial period of examination on the ground of vertisol type obtained cultivar KG 56S (46,25 g) at NP₂K variant of fertilizing at higher dosage of nitrogen.

The highest value hectoliter mass in triennial period of examination obtained cultivar Ana Morava (74,50 kg) at NP₁ variant of fertilizing at higher dosage of nitrogen.

Keywords: wheat, 1000 grains mass, hectoliter mass, fertilizing, vertisol.

**ESTIMATION OF POTENTIALLY MINERALIZABLE NITROGEN FROM
FERTILIZERS USED IN ORGANIC AGRICULTURE**

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ABSTRACT

Due to great diversity of materials that can be used as N fertilizers, a simple, cheap and efficient procedure is required for their characterization. An incubation experiment was set up in order to determine the mineralization potential of different organic N fertilizers (seabird guano, forage pea meal, soybean meal, sunflower meal, vermicompost, mushroom compost, sheep manure and farmyard manure), and kinetics of mineral nitrogen release. The highest value for net N mineralization at the end of the incubation was obtained for guano (77.56 %) and it was followed by sunflower (46.6 % of total N) and soybean meal (41.23 %). The lowest value for net N mineralization was obtained for mushroom compost (19.5 %) and vermicompost (21.8 %). Net N mineralization was linearly correlated with total N content, and square correlated with C/N ratio. The mineralization rate constant, k, had a square correlation with total N content and a linear correlation with C/N ratio of the tested fertilizers. The results show that total N content and C/N ratio of organic N fertilizers are good indicators of their N release. These interactions could be a starting point, besides other factors, in determining an appropriate rate of fertilization for an efficient use of N inputs, especially in organic production where environment protection and product quality are some of the fundamental principles.

Keywords: organic fertilizers, mineralization, potentially mineralizable N

THE EFFECT OF PLANTING IN BENCH TERRACES ON CARBON SEQUESTRATION IN SOIL

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ABSTRACT

Deforestation leads to degradation of former forest soil mostly due to inappropriate usage in agriculture. Degraded soils are unsuitable for agricultural production and require the application of ameliorative measures to control degradation. One of the effects of ameliorative afforestation is the carbon sequestration in biomass and soil, which contributes to the reduction of CO₂ concentration in the atmosphere and climate change mitigation.

This paper describes the effects of ameliorative afforestation methods on carbon sequestration in soil and litter. This research was conducted on soils of Grdelička gorge and Vranjska valley afforested in mid-1950's with black pine (*Pinus nigra* Arnold) applying the pit planting method and planting in bench terraces method. Estimation of sequestered C in soil and litter is based on equations recommended by Good Practice Guidance for LULUCF (IPCC, 2003).

The results showed that sequestered carbon was considerable higher in the soil profiles in bench terraces both in relation to soil profiles between the bench terraces and the soil profiles planted by pit planting method. It was found that the thickness of A-horizon and sequestered carbon are directly correlated and the influence of thickness of A-horizon exhibits differently on soils planted by different afforestation methods. It was also found that the slope angle influences the carbon sequestration in litter on soils afforestation by pit planting method pit, and the influence of slope angle on the carbon sequestration in litter is not confirmed in soils planted in bench terraces afforestation method.

Keywords: ameliorative afforestation, bench terraces, carbon sequestration, soil

**EFFECT OF INOCULATES ON ABUNDANCE OF FUNGI AND ACTINOMYCETES
IN ALFALFA RHISOSPHERE**

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ABSTRACT

Alfalfa (*Medicago sativa* L.) is the most important legume that, in addition to high yield potential and quality of biomass, is characterized by an intense process of biological nitrogen fixation. Various microorganisms that can have a positive or negative effect on plant development are present in the rhizosphere of alfalfa. Certain rhizosphere microorganisms such as *Rhizobium meliloti* and *Azotobacter chroococcum* have nitrogen-fixing role and the role of bio-stimulators. But in addition to beneficial microorganisms, phytopathogen fungi can also occur.

The aim of the research was to investigate the effect of inoculating alfalfa with two nitrogen-fixing bacteria (*Azotobacter chroococcum* and *Rhizobium meliloti*) and two species of the phytopathogen fungus *Colletotrichum* (*Colletotrichum trifolii* and *Colletotrichum destructivum*) on the number fungi and actinomycetes in the alfalfa rhizosphere.

The highest number of fungi was determined in the treatment of inoculation with *Azotobacter chroococcum* + *Colletotrichum trifolii* (isolateCC 657), while the lowest number was recorded in treatment where *Colletotrichum trifolii* (isolateColl-68) was applied. In the control treatment (without inoculation) there was the highest number of actinomycetes and the lowest abundance of these microorganisms was determined in the treatment with *Rhizobium meliloti* + *Colletotrichum trifolii* (isolate CC 657) inoculation.

Keywords: rhizosphere, fungi, actinomycetes, nitrogen-fixing bacteria, phytopathogen fungi

STABILITY PARAMETERS OF WHEAT YIELD OF WEAK ACID SOIL

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ABSTRACT

The investigation was carried out on the experimental field of Small Grains Research Center, Kragujevac. This paper presents the results of winter wheat varieties (Takovčanka, KG 100, KG 56S, Ana Morava and Lazarica). Grain yield, 1000 kernel weight and test weight in grain the investigated wheat cultivars was determined in a two-year field experiment.

Average grain yield of wheat cultivars ranged from 3.011 t/ha to 3.774 t/ha. Grain yield differed significantly between years and the average of all cultivars was higher in 2006/07. compared to 2005/06. By examining the physical properties of grain, Ana Morava was achieved the highest average yield in both growing seasons (3.049 t ha⁻¹; 4.499 t ha⁻¹). Average values of 1000 grain weight of wheat cultivars varied in the range from 36.23 to 42.70 g.

Analysis of the data revealed that the genotype is very significant impact on the 1000 grain weight. The difference found between the significance of the impact on the quality of grain and test weight of wheat cultivars was significant for grain yield.

Keywords: 1000 grain weight, grain yield, wheat

**THE EFFECTS OF FORTY YEARS OF DOUGLAS FIR CULTIVATION IN A ZONE
OF BEECH FOREST ON MT. MALJEN (SERBIA)**

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ABSTRACT

This study investigates the effects of the cultivation of Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) on floristic composition, physical and chemical soil characteristics, and the intensity of organic matter decomposition in a zone of mountain beech forest (Mt. Maljen, north-western Serbia). The forty-year cultivation of Douglas fir has resulted in the drastic impoverishment of herbaceous cover at the research site, as well as changes in the soil, which were most pronounced in the top soil layer (0-10cm). In comparison to the beech stand (control), there were found to be lower substitutional acidity ($p < 0.05$), cation exchangeable capacity ($p < 0.001$), depletion of the adsorption complex in base cations ($p < 0.001$), and lower levels of the most important nutrients (N, $p < 0.001$; P, $p < 0.001$; K, $p < 0.01$) in the Douglas fir stand. The higher C/N ratio of Douglas fir litter ($p < 0.001$) impacted on it decomposing more slowly than beech litter ($p < 0.05$). The long-term cultivation of conifers in a deciduous habitat has caused a reduction in biodiversity, the acidification and nutrient depletion of soil, and metabolism deceleration, which has led to degradation and a reduction in this ecosystem's productivity.

Keywords: degraded habitat, Douglas fir plantation, beech, soil characteristics, biodiversity.

EFFECTS OF DIFFERENT TILLAGE SYSTEMS ON THE AGGREGATE-SIZE DISTRIBUTION IN PLOUGH HORIZON OF CHERNOZEM

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ABSTRACT

In order to determine effects of different tillage systems on the aggregate-size distribution in plough (Ap) horizon of Chernozem, the field trials have been performed in the experimental fields of the Maize Research Institute, ZemunPolje under conditions of south-eastern Srem. The aggregate-size distribution has been established at the 0–10 cm and 10–30 cm depths in spring prior to maize sowing in the following variants: conventional tillage (shallow ploughing, autumn ploughing, and seedbed preparation), reduced tillage (shallow cultivation prior to sowing) and zero tillage (no-till farming).

Results obtained on dry soil sieving indicate that a crumbly-granular structure was established in the Ap horizon of Chernozem in all trial variants. From the agronomic point of view, such a structure is the most favorable in regard to the form and the size of aggregates. The content of the 0.5–10 mm aggregates ranged, on average, from 78.18% to 86.66%. However, the obtained results point out to very significant differences in the presence of the fractions of structure aggregates among variants. The content of the 0.25–10 mm fraction in the conventional tillage variant increased on account of the decrease of the finest soil aggregates–microaggregates (< 0.25 mm) and significant decrease of cloddy (>10 mm) – from 9.28% to 7.20%. There were no significant differences in the presence of fractions smaller than 1 mm and larger than 10 mm in the reduce tillage variant, but at the 10–30 cm depth there was a significant decrease of 1–5 mm fractions (from 53.51% to 49.73%) on account of the increase of 5–10 mm fractions (from 25.42% to 28.33%). In the zero tillage variant, the content of the microaggregates did not changed with the depth, while the percentage participation of remaining fractions changed very significantly and significantly. The content of 0.25–5 mm fractions increased with the depth, while fractions larger than 5 mm decreased with the depth. The structure coefficient – Ks, which is calculated as the ratio between the amount of the agronomically most valuable structural aggregates, i.e., aggregates with a diameter between 0.25 and 10mm and the total amount of the aggregates > 10 mm and < 0.25 mm separated by dry sieving, were higher for the conventional tillage and reduced tillage treatments with Ks = 7.7 and Ks = 7.1, respectively, than for the zero tillage treatment with Ks = 4.5. High Ks values imply better soil structure.

Keywords: tillage systems, aggregate-size distribution, structure coefficient, Chernozem

NEMATODE COMMUNITY STRUCTURE AND THEIR FUNCTIONAL CHARACTERISTICS IN VIRGIN AND ARABLE CHERNOZEM OF NORTHERN KAZAKHSTAN

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ABSTRACT

The paper refers to the effects of treatments to Nematode community structure. The Nematode community structure and their functional characteristics were investigated in virgin and arable Chernozem of Northern Kazakhstan.

The soil ecology and their different functions are exposed of different forms of destruction due to anthropogenic factors. The soil flora and fauna reflect damage to ecosystems (Peterson, Luxton, 1982). Nematodes perform many different functions in soil ecosystems. They are links of the food web and involved in the mineralization of the soil.

Nematode communities were used as bioindicators of changes in agroecosystems caused by anthropogenic factors (Bongers, 1990). The maturity index (MI), based on the nematode fauna, is reflected of the condition of soil ecosystem. The use of this index in environmental studies is discussed. Soil nematodes can be classified according to their food habits. Yeates trophic classification is being used (Yeates et al, 1993), which is based on the definition of nematodes community composition. This classification includes nematodes that feed on bacteria - bacteriovores, fungi- fungivores, plant parasites, herbivores, omnivores, and predators. Bacteriovores are the most abundant group in the agricultural lands. Nematodes that feed on fungi are abundant in old-growth (no-till) and natural ecosystems with suitable conditions for the growth of fungi. Bacteriovores contribute to the accumulation of nitrogen.

The study of soil nematodes as bioindicators of soil ecosystems is one of the important direct. There are changes in nematode complex that reflect the pollution and other disturbance of the soil (Ettema et al 1998, Ferriset al 2001, Wasilewska 1997, Nahar et al 2006). Indexes which characterize the nematode fauna reflect changes in communities with variations in environmental conditions. Ecological and trophic grouping of nematodes is used. Analysis of nematodes associated with plants contributes to a better understanding of the relationship between the plants and the processes occurring in the soil. More diverse plants composition contributes to the qualitative and quantitative enrichment of nematode fauna.

Keywords: nematode, Chernozem, bioindicator, ecosystem

**RESPONSE OF MAIZE TO INCREASING RATES OF NPK-FERTILIZER IN
POTKOZARJE AREA**

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ABSTRACT

In spring 2008 was conducted field trial on acid soil (pH in KCl 4.32) of moderate fertility (below 5 mg P₂O₅/100 g of soil according AL-method) in Potkozarje area (Brekinja, municipality Kozarska Dubica, Republic of Srpska, Bosnia and Herzegovina). NPK 7:20:30 fertilizer was added in the amounts 0, 1560, 3120 and 6250 kg/ha on conventional fertilization (kg/ha: 128 N + 80 P₂O₅ + 120 K₂O) in three replicates (basic plot 50m²). Different amount of N added by NPK fertilizer were equalized by correspondingly amounts of CAN (calcium ammonium nitrate: 27% N + 4,8% MgO). Maize (hybrid OsSK444) was grown in the experiment during the 2008 and 2009 growing seasons. Maize was sown in third part of April and harvested in middle October. In 2009 residual effects of ameliorative fertilization were tested and the experiment was fertilized in level of conventional fertilization. By ameliorative fertilization maize yields were increased for 13 % (2008) and for 15 % (2009) with emphasis that the first amount of applied fertilizer was satisfied for correspondingle yield increases. Moderate effects of applied fertilization could be explained by favorable weather conditions in both years of testing and probably by acid reaction of soil. By leaf testing (the ear-leaf at silking stage in 2008) were found on the control treatment 2.48 % N, 0.15 % P and 1.72 % K (on dry matter basis). As adequate ranges are from 2.80 to 3.50 % N, from 0.25 to 0.50 % P and from 2.00 to 3.50 % K, maize was moderate supplied by these elements. By ameliorative fertilization, N and P status were increased to level of adequate supplies (means 2.74 % N and 0.26 % P). However, K status was inadequate in spite of ameliorative fertilization and high supplies of soil by available K (mean 1.74 % K).

Fertilization management practice for this and similar soils is adding the higher P amounts (for example from 250 to 300 kg P₂O₅/ha every either three or fourth year and conventional fertilization of every year. Also, part of NPK fertilizer could be added by band fertilization together with sowing and by top dressing by cultivation.

Keywords: NPK-fertilization, maize, grain yield, leaf composition, nitrogen, phosphorus, potassium

STRUCTURE OF SOIL IN ORGANIC PRODUCTION

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ABSTRACT

The main objective of sustainable agriculture is to food production which leads to preserving and enhancing soil fertility and prevents soil degradation. One of the ways to prevent the negative impacts of agricultural production on the environment and wildlife is expansion of organic production.

Soil structure has an extremely important impact on water, air and thermal regime of soil, the chemical and biological properties of soil, the root growth and suitability of soil for cultivation. Soil structure is an indicator of soil fertility and productivity. Soils with stable aggregates have a high resistance to water and wind erosion and leaching of nutrients.

This paper presents aggregate size distribution and aggregate stability of chernozem at 8 locations used in the system of organic and conventional production. Aggregate size distribution was determined by the method Savinov (1936) and aggregate stability by the modified method according to Elliott (1986), which was adapted for the interpretation of the concentration of soil organic carbon (SOC) as one of the most influential factors on the aggregate stability. Aggregate size distribution is expressed by the structure coefficient while mean weight diameter (MWD) is used to estimate aggregate stability.

The results indicate that the soil used in organic production is characterized by a lower structure coefficient (2.6) in relation to the soil used in conventional production (5.5), the higher humus content (4.3%) and increased aggregate stability (MWD 0.95 mm) in relation to the soil used in conventional production (2.7% humus and MWD 0.73 mm), which indicate a positive effect of organic production as a land use which tends to increase soil fertility.

Keywords: Aggregate size distribution, aggregate stability, organic production.

MICROBIOLOGICAL PROPERTIES OF KALKOCAMBISOLS IN REGION OF WESTERN SERBIA DEPENDING ON EXPLOITATION WAY

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ABSTRACT

One of the most represented types of soil in the hilly- mountainous region of Western Serbia is the Calkocambisol or brown soils in limestone. Aiming to establish biogenity of such type of soil, representation of the total microflora, fungi, actinomycetes, ammonifiers, azotobacters and oligonitrofills has been examined as well as dehydrogenase activity of the stated type of soil. The samples were taken from soils used in four different ways: plough-fields, orchards, meadows and forests. The standard microbiological methods of introducing in certain decimal dilutions on the appropriate nutritive medium were used. The obtained results have shown the highest prevalence variation of total microflora in the plough-fields, while other exploitation way showed rather equable prevalence. No correlation between other groups of microorganisms and the way of using of soil was determined as well as correlation between dehydrogenase activity of tested samples and total microflora

Keywords: biogenity, Calkocambisol, microflora

**STATUS OF AVAILABLE P AND FE AT VERTISOL SOIL TYPE IN THE
CONDITIONS OF LONG TERM APPLICATION OF PHOSPHORIC FERTILIZERS**

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ABSTRACT

The trials have been done on a part of two-fields long term experiment in the vicinity of Kragujevac. The experiment has been formed in the year 1978, at the soil type Vertisol, characterized with highly acid reaction, low content of available P_2O_5 and very high concentration of available Fe. The crops in the experiment have been wheat and maize. The objective was to determine influence of continuous 33 years application of two doses of phosphoric fertilizers (60 kg and 100 kg P_2O_5), on a basic soil properties, as well as an influence on the content of available P_2O_5 and Fe. Variants of the experiment have been set up that phosphoric fertilizers have been applied individually (P_{60} i P_{100}), than in combination with Nitrogen ($P_{60}N_{80}$ and $P_{60}N_{120}$) and in combination with Nitrogen and Potassium ($P_{60}N_{80}K_{60}$ and $P_{100}N_{80}K_{60}$). With variant without fertilizing by the experiment have been treated 7 combinations in total, with 4 repetitions. Chemical analyses have been done in the year 2010, and gained results show that long term application of phosphoric fertilizers has multiply increased initial level of available phosphorus. At the same time, content of available Fe, instead of expected level, it has been slightly increased. The other parameters of fertility (pH, humus, available K_2O i.e.) have been mainly remained on a same level compared to initial status.

Keywords: Phosphorus, Iron, Vertisol, fertilizing

ASSESSMENT OF THE PRODUCTION POTENTIAL OF THE SOILS IN SOME FOREST TYPES IN THE AREA OF THE NATIONAL PARK "KOPAONIK"

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ABSTRACT

This paper presents the results of the study of the production potential of land in different forest types in the area of Nationalnog Park "Kopaonik". Evaluation of the production potential of the land is given based on the study of physical and chemical properties of the soil. As stand productivity indicators are in direct correlation with the soil ecological and production potential, this paper evaluates the site production potentials based on mean maximal heights. Also, the correlation analysis shows to which extent some characteristics of the study soils affect the mean maximal heights.

Keywords: soil, production potential, means maximal heights, Kopaonik

**COMPARING OF THREE METHODS FOR DETERMINATION ORGANIC CARBON
IN SOIL USING SELECTED SOILS FROM SERBIA**

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ABSTRACT

For the analysis of parameters obtained from long-term experiments and monitoring the quality of soil in an area or region, it is essential comparability and traceability of results. The amount of organic matter is one of the important parameters of soil fertility. Years of testing content of humus in the soil samples from the Republic of Serbia, with the methods Kotzman and the Tyurin, obtained high-quality databases. New methods (CHNS analyzer, TOC analyzer) allow faster analysis of samples. The transition to modern techniques for determination the organic matter in the soil caused the comparison method. The result that is obtained by using a CHNS analyzer represents the amount of total carbon in the sample. It must therefore be determined coefficient which is the ratio of the results obtained old and new methods. Based on the analysis of selected samples of the two types of soil from Serbia, determining the amount of humus by method by Kotzman and the analysis of the soil with the instrument CNS analyzer, with and without prior removal of carbonate from the sample, which is determined coefficient can be compared to these methods.

Keywords: humus, soil organic carbon, Kotzman, CNS analyzer, rendzina, fluvisol

THE RESULTS OF FERTILITY CONTROL IN THE MUNICIPALITY OF PANČEVO

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ABSTRACT

For the purpose of the establishment of the fertility of the soil in the course of the year 2002, an analysis was carried out of four types of soil from several localities at a distance of 10,000m from the industrial complex (Petrochemical Industry "Petrohemija", Fertiliser Factory "Azotara" and Oil Refinery) in Pančevo.

In the study, the results were displayed of the fertility analysis of the following soil types: alluvium, decarbonated swamp chernozem, carbonated chernozem on loess plateau and chernozem with the signs of gleisation.

In those soil samples, laboratory analyses were performed of chemical soil properties. Apart from that, on the mentioned samples, volumetric weight, specific weight and total porosity were established.

In total, 36 samples were analysed at a depth of 0-30cm. On average, the highest percentage of humus (4, 33%), nitrogen (0.233%) and organic carbon (2.51 %) was discovered in chernozem on loess plateau.

Keywords: soil, industrial zone, fertility analysis.

THE MONITORING OF POTATO AND SUGAR BEET CYST NEMATODES IN THE SOIL IN SERBIA

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ABSTRACT

Soil is the habitat of many parasites which have harmful influence on cultivated plants, significantly causing yield loss. The cyst nematodes are among the most dangerous pests worldwide, especially those of potato (*Globodera rostochiensis* and *Globodera pallida*) and sugar beet (*Heterodera schachtii*). These microscopic worms, feeding on roots, are adapted by cysts for long-term survival in the soil in the absence of a suitable host. Quarantine nematodes *Globodera rostochiensis* and *Globodera pallida* have been present in Serbia since 1999 and 2005, respectively. In order to prevent their spread, an official surveillance of the presence of these species in soil, originated from the potato growing areas of Serbia, has been carried out. *Heterodera schachtii* is most frequent in the sugar beet growing areas of Vojvodina, and many beet producers have been reporting the wilting and early death of beet in the last few years. The monitoring of *Heterodera schachtii* and their population densities (counts of viable cysts) in soil were necessary in order to offer the farmers a proper recommendation on how to control sugar beet cyst nematode. This paper presents the results of the inventory of potato and sugar beet cyst nematodes in soil in the period between 2009 and 2012. In total, 4196 soil samples were taken from the potato and sugar beet fields of Serbia. Cysts of nematodes were extracted from soil by Fenwick Can and identified under a dissection microscope. In order to determine the population density, an electric device for crushing cysts was used. *Globodera rostochiensis* was detected in 0.94 % soil samples. The highest percentage of infested samples was found in the district of Mačva. *Heterodera schachtii* occurred in 2.11 % of soil samples with the most infested fields in the district of Bačka. Current occurrence of potato cyst nematodes indicates that *G. rostochiensis* is the dominant species in western Serbia whereas *Heterodera schachtii* became a problem in the sugar beet growing areas of the districts of Bačka and Srem as a result of intensive sugar beet cultivation with narrow crop rotation.

Keywords: soil, monitoring, *Globodera rostochiensis*, *Heterodera schachtii*, Serbia

IMPORTANCE OF TILLAGE SYSTEMS ON SOME IMPORTANT PHYSICAL PROPERTIES OF SOIL UNDER CLIMATE CHANGE IN SERBIA

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ABSTRACT

On the basis of many researches for future of agriculture development in XXI century, as alternatives of conventional obtrude sustainable agriculture. It is considered that future in agriculture will be on the flexible cultural practice, developing of biotechnology and appreciation of basic ecological principles in soil usage. Crop production systems are influenced by a complex array of factors combining various crops, soil water, climate and management parameters.

Detail analysis of climatic factors in the multi-year period for the Belgrade region, which may be representative of the wider area of central Serbia, it can be emphasised that some changes in terms of temperature and precipitation occurred. The causes of drought mainly come from the atmosphere and affect our country and show clearly that the climate is changing in our area. Based on these facts, we must have the right answers in order to mitigate if not to completely eliminate these effects. Agronomic aspect of looking into the problem requires a good knowledge of our crop needs for primary vegetative factors as well as temperature and moisture. It is necessary to consider the adaptation of many cropping practices that indirectly can reduce damages from drought starting from the adequate tillage systems, dates, depths, methods and densities of sowing, fertilising, and cultivation methods during the growing season and selection of hybrids resistant to drought stress or vice versa in weety conditions.

Crop production based upon high mechanical and chemical inputs (deep tillage, high fertilizer and pesticide rates etc.) are becoming less rational because of economic and environmental problems. Economic inputs have decrease and offer many possibilities for production systems conversion from the conventional toward low-input systems.

Conversion from high conventional to low-input sustainable systems requires changes in management practices. Rational technology in different crops with all these elements can protect soil from erosion, more effective and significantly decrease production expenses with no decrease of yield quality and quantity.

The limiting factor for the successful agricultural production on this plot is over-wetting of the soil. This fact does not allow the respect optimum time for application cultural measures like tillage, seeding, and normal conditions for growth and development of plants or crop-harvesting. Poor infiltration or permeability of soil is the reason of water logging, which leads to suppression of crops, lack of normal operation of machinery (jamming and deterioration of the tractor up to the height of the wheels on some depressions).

Keywords: climate change, tillage systems, physical properties of soil, yield, Serbia

MONITORING OF FERTILITY OF THE SOIL IN THE REPUBLIC OF MACEDONIA

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ABSTRACT

Experiences gained so far in monitoring of soil fertility in the Republic of Macedonia will be presented in this paper, with particular reference to the soils intended for tobacco growing. The paper also presents the legal regulations required to perform monitoring on soil fertility and environment protection in the Republic of Macedonia.

Keywords: soil, fertility, tobacco

**PLANT RESIDUE CARBON INFLUENCE ON SOIL ORGANIC MATTER CONTENT
IN A LONG-TERM EXPERIMENT ON CHERNOZEM**

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ABSTRACT

The aim of our research was to investigate role of plant residual carbon (C) deposition on soil organic carbon (SOC) change in a long-term experiment. For the estimation of C deposit 9 different cropping systems was accessed in the 0-20 cm, 20-40 and 40-60 cm depth and adjacent non-agricultural soil. Plant carbon deposition was evaluated considering grain yield, harvest index, C content (root, shoot and rhizodeposit), and distribution among plant organs. The arable soil samples were collected from a long-term experiments “Plodoredi” and IOSDV carried out at the Rimski Sancevi experimental station, Novi Sad (N 45°19', E 19°50'). The experimental site has annual average temperature of 11,3 °C and sum of precipitation 611 mm. Higher net primary production (NPP) was observed at the fertilized 3-year rotation (maize, soybean and winter wheat) 700, 91 g C m⁻² year⁻¹ and lowest NPP was found at the unfertilized 2-year rotation (maize-wheat) 167,92 g C m⁻² year⁻¹. Regression analyses showed that C in plant residues significantly affected SOC in 40-60 cm (r=0,70), 0-20 cm (r=0,63) and 20-40 cm (r=0,62) (p<0,05). This indicates dynamic processes of C transformation in plow layer compared with the undisturbed subsoil (40-60 cm) were C accumulation with root system may occur. Based on obtained results, for preservation of 3% organic matter in 0-30 cm of Chernozem it is estimated to incorporate 756 g C m⁻² below and above ground crop remains. To attain such amount of residue it is necessary to have higher yields which in turn increase C removal from arable fields. This finding point out that the addition crop residues without manure and mineral N was not sufficient for soil C preservation. Obtained results could be valuable for monitoring SOC change and to recommend measures for SOC conservation.

Keywords: soil organic carbon, plant C rhizodeposit, winter wheat, yield

**BIOLOGICAL ACTIVITY AS ONE OF THE INDICES OF THE FERTILITY OF SOIL
WITH THE ORGANIC SYSTEM OF AGRICULTURE IN THE REPUBLIC
KAZAKHSTAN**

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ABSTRACT

In the territory of Kazakhstan, according to the data of aerospace survey and expert estimation, the medium degraded soils compose 35%, highly degraded soils up to 15%. Furthermore, the previously developed zonal systems of agriculture do not consider entirely the adaptive ability of agricultural crops, their soil-protective role and the medium-forming characteristics, and also the soil-ecological conditions of plowed land of the specific farms.

Carrying out the tasks of the Republic's government to develop the energy- and resource-saving technologies with diversification the product line and obtaining ecologically clean output the Kazakh Research Institute of Agriculture and Plant Growing, since 1996 has been conducting the comprehensive experimental studies on the study of the cultivation of agricultural crops with the maximum biologization of agriculture, which ensures, in the first place, the reduction in the negative impact of the intensification factors of production on the fertility of soils, the optimum reproduction and possibility of wide use in the conditions of contemporary land tenure, and also obtaining ecologically clean outputs.

In this paper there are established the basic biological parameters when using the different methods of biologization for changing in direction and activity of microbiological processes during the mineralization of the plant residue entering the soil; there are revealed the significant differences on the content of humus, the dynamics of the propagation of the microorganisms of basic taxonomic and physiological groups in soil (ammonifiers, amylolytic, cellulose degrading bacteria, actinomycetes, fungi, bacterium) and the productivity of agricultural crops in the green-manure components of the biologized crop rotations.

The intensity and regularity of processes of mineralization, humus-formation and transformation of humus substances affected by microorganisms, allows the possibility of regulation of soil processes, which are defined in many respects by a quantity and the quality of plant residue, and in the first place, determines soil fertility. The study of these factors has fundamental importance for further development of the biological agriculture.

Keywords: biologization, soil fertility, plant residue, microorganisms

SOIL FERTILITY OF ASHESAI RURAL AREA IN WEST-KAZAKHSTAN REGION

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ABSTRACT

In the dry-steppe zone of West-Kazakhstan the zonal soils are Chestnut soils, where the main agricultural crops are cultivated. The soil is formed under the deficiency of water in the non-percolating water-regime, and under the scrubby fescue-feather grass-white *Artemisia* association. Chestnut soils are characterized by low productivity with humus content of 2-4%; CEC 25-35 mg/eq.100 g soil. The exchangeable cations are calcium, magnesium and sodium, where in the upper horizons the highest portion composed by calcium and magnesium while in the deeper horizons the amount of exchangeable sodium increases. The cationic-anionic complex is composed by water-soluble forms of calcium, magnesium, sodium, carbonates, hydro carbonates, chlorides and sulphates.

Keywords: fertility, humus, solublesalts, CEC, sodicity, pH, total nitrogen

GREENING AGRICULTURE IN THE REPUBLIC OF KAZAKHSTAN

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ABSTRACT

Reconnaissance soil survey was conducted at foothill plains near Almaty and Zhambyl region. There are allocated 5 typical for soil and geomorphological conditions lands in agricultural landscapes of the region. Accordingly a large-scale (1:10000, 1:5000) soil maps and maps grouping of elementary soil structures were developed. For Karasai, Jambul and Talgar district of Almaty region have also been compiled the geomorphic and soil-landscape maps in the scale 1:200 000. On a typical areas the agro-ecological assessment were held by the main indicators of soil fertility (humus, mobile and gross forms of N, P, K, absorbed bases, pH, dry residue, CO₂, particle size distribution, specific and volumetric weight, the maximum water absorption, wilting point, field capacity, morphology), the risk of erosion and erosion.

On the elementary areoles of agricultural landscapes (EAA) of agro-environmental group of eroded lands also was held an evaluation of adaptability of various methods of primary tillage and grain crops - winter wheat and spring barley. This allowed for the differentiation of their application depending on the geomorphological conditions of the area, which provided the increase of soil fertility, and the grain yield - for 15-20% from the adaptation of the basic processing and for 15-40% - from of the adaptation of crops. The developed maps and the results of the adaptation of the basic processing of soil and crops by EAA are the basis for the further development of adaptive landscape agriculture at typical environmental conditions of the land plots and identify the need for similar studies on other EAA and typing lands.

Keywords: greening, adaptation, agriculture, areole, landscape

**THE EFFECTIVENESS OF BARE FALLOW WITHOUT IRRIGATION IN
KAZAKHSTAN**

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ABSTRACT

The greatest effect of bare fallow as a precursor of winter wheat is shown on the non-irrigated gray soils. The yield of winter wheat after fallow in comparison with non-fallow predecessors in average-humid years was twofold, and in dry years, more than three fold. Cultivation of winter wheat in this area without bare fallow is almost impossible due to the absence in most of the years of productive moisture in the seed layer during the sowing of winter wheat. On light chestnut soils in semi-rainfed area the efficiency of bare fallow is significantly lower.

A best practice of the basic cultivation of bare fallow on non-irrigated area in south-east Kazakhstan is the minimum – till without turning the layer to a depth of 10-12 cm. The increase in yield of winter wheat in this treatment compared to the standard at deep plowing (25-27 cm) was from 0.05 to 0.11 t / ha.

Adding to the fallow field of 30 t/ha of manure increases the yield of winter wheat: on a non-irrigated area in medium humid years for 0.50-0.53 t/ha, and in the favorable rainfall years for 1.27 -1.29 t/ha, on the semi-rainfed area respectively 0.43-0.49 and 0.65-0.66 t/ha.

The manure on non-irrigated dry land should be applied only in the fallow field of the crop rotation as the most secured with moisture. Manure application for permanent sowing of winter wheat is inefficient; since the yield increase is not always justify the costs associated with its transportation and application.

For the first time the effectiveness of a surface manure application was established. Compared with the traditional method - plowing it into subsoil - an yield increase amounted to 0.06-0.08 t/ha. This improves the water regime and soil main agrophysical properties.

Keywords: bare fallow, manure, non-irrigated dry land

**THE EFFECT OF THE APPLICATION OF COMPLEX AND MIXED FERTILIZERS
ON MAIZE YIELD AND SOIL FERTILITY STATUS OF LAND**

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ABSTRACT

The subject of this paper was to determine, from several aspects, the fertilization value of different mixed fertilizers compared to complex fertilizers.

By field experiment on the soil types pseudogley and eutric cambisol, maize as cultivated crops, it was shown in which way the distribution of mixed and complex fertilizers affected their total fertilization effect, and if the soil treated by mixed fertilizers could get the necessary nutrient amount and formulation uniformly throughout the area.

The research shows that there are no statistically significant differences in the total effect on the yield between complex and mixed fertilizers, as well as between different mixed fertilizers, applied manually in the same quantity of water-soluble NPK nutrients.

The effect of compound fertilizer distribution method on total fertilization effect was significant. Manual handling of mixed fertilizers, thanks to the more homogeneous spreading of nutrients, compared to mechanized cyclone spreading, showed a better fertilization effect. Also, mechanized application of complex fertilizers showed a statistically significantly better effect on the yield compared to the application of granular mixed fertilizers of the same nutritive NPK composition. By machine spreading of mixed granular (NPK) fertilizers, the formulation of nutrients (NPK-15:15:15) was not uniformly applied over the area.

After three-year application of complex and mixed fertilizers in the experimental soils (pseudogley and eutric cambisol), there were no statistically significant differences in the contents of the applied NPK nutrients in the soil, and in the homogeneity of their distribution.

Keywords: fertilization value, compound fertilizers, mixed fertilizers, formulation of nutrients.

STATUS OF NUTRIENTS IN VINEYARDS OF ĆEMOVSKO POLJE (MONTENEGRO)

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ABSTRACT

The results of investigation of nutrients vineyards of Ćemovsko polje in are shown in this paper. In order to provide a more reliable basis for the definition of nutrient status and the relationships between grapevine (nutrients in leaf petiole – P, K, Ca, Mg, Fe, Mn, Cu and Zn) and soil properties (pH, total carbonates, humus (organic matter), exchangeable Mg and available P, K, Fe, Mn, Zn and Cu), factor and correlation analyses were applied.

According to Ankerman, in the top layer (0 – 30 cm), these highly calcareous and alkaline soils had high concentration of nutrients exceptionally for iron which was on the limit between low and medium level, and for phosphorus on low level. In the underlying soil layer (30 – 60 cm), nutrient contents were low. The content of Cu was very high in the both soil layer, due to its accumulation through agronomic practice, where Cu as a common ingredient of the plant protection products used especially in vineyards. In average, the level of P, K, Ca, Mg, Zn and Cu in leaf petioles indicated optimal supply of grapevine. However, the deficiency of Fe and Mn was detected. A common cause of chlorosis is a deficiency of these elements, which are needed by plants to form chlorophyll and to complete photosynthesis.

Four factors determining soil chemical characteristics were identified by factor analysis. They accounted for about 78% of the total variance. The communalities of parameters, considering four factors, varied from about 59% for available K to 85% for humus and exchangeable Mg. Two main factors represented the statuses of: 1) mutually complementary available fraction of Zn and Mn (positive pole) and pH and carbonate (negative pole), and 2) humus and available Fe. Directly proportionality was found between the content of Mn in petiole and the score of first factor ($p = 0.037$). It means that the status of Mn in grapevine depends directly on the available fraction of Mn in soil (DTPA-Mn), as well as indirectly on the pH value and CaCO₃ content. The availability of Fe (DTPA-Fe) depends on the content of humus, since positive significant correlation was found. The management practices which can influence on availability of Fe and Mn are the increase of organic matter (humus) and modification of the soil pH. The use of Fe and Mn fertilizers is recommended.

Keywords: soil, petiole, deficiency, factor

PCR DETECTION OF ANTIBIOTIC PRODUCTION GENES IN INDIGENOUS PSEUDOMONAS ISOLATES FROM RHIZOSPHERIC SOILS AND SEVERAL MUTANTS FOR PCA PRODUCTION

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ABSTRACT

Various strains belonging to fluorescent pseudomonads are present in natural soils and rhizosphere of various plants. Some of them have been found to produce metabolites deleterious to fungal pathogens. Secondary metabolites include antibiotics, cyclic lipopeptides and hydrogen cyanide (HCN), hydrolytic enzymes (proteases, chitinase, cellulase, and β -glucanase). Those antimicrobial metabolites are considered important suppressors of phytopathogens. To detect *Pseudomonas* strains able to produce antibiotics, we isolated indigenous pseudomonads and tested for the presence of several antibiotic genes: 2,4-diacetylphloroglucinol (DAPG), phenazine-1-carboxylic acid (PCA), pyrrolnitrin (PRN) and pyoluteorin (PLT). Indigenous isolates from diverse rhizospheric soils were plated onto a King's medium B (KB) and 112 fluorescent colonies were selected. The presence of antibiotic genes was confirmed by PCR amplification with the gene-specific primers: Phl2a/Phl2b (phlD) for 2,4-DAPG, PCA2a/PCA3b for PCA, Prncf/Prncr for PRN and PltBf/PltBr for PLT. The phlD gene was used as a genetic marker to detect 2,4-DAPG producing isolates and 12 isolates showed ~750 bp amplicons of phlD genes. The presence of PCA was confirmed by PCR amplification in 17 isolates and the presence of PRN in 24 isolates. Isolate Q16 identified earlier as *Pseudomonas chlororaphis* subsp. *aurantiaca* showed the presence of 2,4-diacetylphloroglucinol, phenazine-1-carboxylic acid and pyrrolnitrin. We induced several PCA mutants without ability to inhibit phytopatogenic fungi. The antibiotics production may be the reason for the strong inhibition of numerous phytopathogenic fungi in vitro detected earlier and was selected for field testing of the biological control ability of phytopathogens.

Keywords: *Pseudomonas*, 2,4-diacetylphloroglucinol, phenazine-1-carboxylic acid, pyrrolnitrin, pyoluteorin

SECTION 2

SOIL- WATER- ENVIRONMENTAL PROTECTION

- **Soil and Water Conservation**
- **Drainage and Irrigation**
- **Soil Erosion**
- **Soil Contamination and Environment**
- **Climate change and Soil Remediation**
- **Soil Reclamation and Land use change**
- **Soil Monitoring**

EVAPOTRANSPIRATION AND WATER USE EFFICIENCY OF WINTER WHEAT IN SOUTHERN SERBIA

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ABSTRACT

Water deficiency during winter wheat vegetation is an important limiting factor in achieving high and stable grain yield. Irrigation is the only efficient measure against drought, but limited water resources can be rationally used only if water use efficiency is improved. For that reason, the experimental investigation through field trials has been carried out in the river valley of Southern Morava, municipality of Merošina, on the alluvium soil type, during the period 2009-2011. The trials included three irrigation variants with pre-irrigation soil water content of 60%, 70% and 80% of FWC, as well as un-irrigated control. The highest winter wheat grain yield of 7110-7480 kg ha⁻¹ was observed at the variant with pre-irrigation soil humidity 70% of FWC. Evapotranspiration value of 346.0-410.7 mm was observed in the conditions of irrigation, while such value at the un-irrigated control was from 289.5 mm to 372.2 mm. The highest values (18.65-19.03 kg ha⁻¹ mm⁻¹) of water use efficiency (WUE) were found at the variant where pre-irrigation soil humidity was kept at 70% of FWC. At the other two irrigated variants we observed WUE values in the range of 15.46-18.32 kg ha⁻¹ mm⁻¹. The established values of WUE have a potential use in planning irrigation practice with the aim of rational winter wheat production.

Keywords: evapotranspiration, water use efficiency, winter wheat, irrigation, grain yield.

**CONSTRUCTION OF COMPOSTER ON PRODUCTION AND PROCESSING UNIT
OF THE INSTITUTE FOR MEDICINAL PLANT RESEARCH " DR JOSIF PANČIĆ"**

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ABSTRACT

This paper presents the procedures and goals of construction of composter in the Production and Processing Unit of the Institute for Medicinal Plant Research "Dr Josif Pančić". Annually, during production and processing of medicinal and aromatic plants (MAPs), 25 t of various plant residues remains unused as by-products. According to the law on the waste management ("Sl. glasnik RS", br. 36/2009 i 88/2010), such a generated waste must be stored, treated and disposed of in a manner which does not endanger human health and the environment. Detailed analysis of the current state in our Production and Processing Unit, provided us with information on the number of MAP species and physico-mechanical state following their processing procedure, as well as with the approximate quantities of the wastes created in the various processing procedures.

Storage, treatment and disposal of the waste from the MAP residues is carried out within the place of the waste producer, i.e. within the Institute's land surfaces; determination of proper location, construction of composter, and development of procedures and methods of the waste disposal, are specified in the document entitled "Biological Waste Management Plan". For the waste treatment procedure, biological treatment that makes biodegradable organic waste decomposition useful material for soil conditioning (compost), was selected. Composting belongs to treatments of organic wastes under the action of microorganisms aimed to create compost, which is carried out in the presence of oxygen and under controlled conditions. The construction of composting, apart from the proper disposal of the waste, will provide us with compost - a potentially highly valuable organic fertilizer, which in addition to its primary use as an organic fertilizer, could also be used as a soil structure improver as well as raw materials for production of various substrates and mulches. Development of clean technologies, such as composting, by-products or wastes resulting from MAP production and processing, will be once again recovered and recycled.

Keywords: compost, plant residues, medicinal plants, biological treatment of waste, composter.

**CONTENT OF HEAVY METALS IN SOILS FORMED ON LIMESTONE AND
DOLOMITES ON JABLANICA MOUNTAIN**

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ABSTRACT

The scope of the investigations was to determine the quantity of total (Cu, Zn and Pb) and available forms of heavy metals (Cu, Fe, Mn and Zn) in soils formed on limestone and dolomite on the Jablanica Mountain in Macedonia. Dissolution of soil samples was performed by concentrated HCl and HNO₃ in a ratio 3:1. The available forms of heavy metals were extracted by the DTPA method. Determination of the content was performed with AA spectrophotometer Agilent 55 and Agilent graphite furnace 240 Z. The results of the investigation showed that the total zinc content in all soil samples are slightly higher than the reference, but lower than the intervention value, while the total lead content is lower than the reference value. Total copper content is lower than the reference values, except for two soil samples with a higher content of the reference values, but much lower than intervention value.

The quantities of available copper are in the ranges of high to very high, of iron are between low to very high, while the quantities of available zinc are very low to very high. The quantities of easy available manganese in all soil samples are very high.

Keywords: soils, heavy metals, lead, zinc, copper, iron, manganese

**MAIZE IRRIGATION IN FUNCTION OF REFERENCE POTENTIAL
EVAPOTRANSPIRATION**

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ABSTRACT

Variation of maize grain yield in different soil water regimes was the subject of this study. The objective was to determine the most favorable ratio of the actual or maximal real (ET_{Rm}) to the reference potential (ET_o) evapotranspiration which enable maximal grain yield expression.

Experimental studies were carried out in the environmental conditions of eastern Srem in Zemun Polje on chernozem (low carbonated) soil type, (2003-2005.). The case study was medium late (FAO 600) maize hybrid ZP 677, grown in three different densities: D₁-54 900 plants / ha; D₂-64 900 plants / ha and D₃-75 200 plants / ha under different water regimes achieved by three ratios of maximal actual and potential evapotranspiration reference: ET_{Rm} = 1:1; ET_{Rm} = 1:0,8 and ET_{Rm} = 1:0,6, plus control (natural soil water regime). Reference evapotranspiration (ET_o) was calculated after Penman-Monteith method.

Obtained results indicate very significant effect of applied irrigation regimes on expression of maize grain yield. The highest average yield (14.03 t / ha) was obtained in the variant with the maximum ratio of the real and the reference potential evapotranspiration ET_o: ET_{Rm} = 1:0,8 by water consumption in range from 420mm to 445 mm, depending on the year of study. Plant density as factor in our study had very significant impact on maize grain yield level, so that the highest average yield (13.16 t / ha) was obtained under maximal plant density in variant D₃ of 75 200 plants / ha. Analysis of the interaction of soil water regime and plant densities shows that the highest yield (15.22 t/ha) is obtained by implementation of highest plant density under the water regime characterized by ET_o ratio: ET_{Rm} = 1:0,8.

Keywords: maize, evapotranspiration, irrigation regime, plant density, grain yield

**POSSIBILITY OF RECLAMATION MARLY SUBSTRATE IN SPACE PIT
“BOGUTOVO SELO” UGLJEVIK**

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ABSTRACT

The paper focuses on one-year research of reclamation possibility (resolvability) of marly substrate (deposol) at the Great Western depot PK "Bogutovo Selo" Ugljevik by establishing grass and clover crops, to comparative studies of biological cultivation methods (direct or indirect). The results show that the shale reclamation deposol grass and clover is possible. Of all investigated variant, the variant with hybrid sorghum and Sudan grass (*Sweet Sioux*) from the viewpoint of the total production of green mass is the best option for both indirect and direct the reclamation, while alfalfa shows most promising and economical culture.

Keywords: marly substrates, possibility of reclamation, biological cultivation, grass and clover.

**THEORETICAL AND METHODOLOGICAL SUBSTANTIATION OF THE
ECOLOGICAL AND AGRO-AMELIORATIVE MONITORING OF IRRIGATED
LANDS**

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ABSTRACT

The thesis substantiates the theoretical and practical principles of the organization and practical implementation of a new kind of monitoring of reclaimed lands (MRL) - ecological and agro-ameliorative monitoring (EAMM). It solves the pressing scientific problem of the integration and efficiency of using different types of monitoring of irrigated lands in the integral geo-information system (GIS) of the EAMM.

The methodological support of the EAMM and the combination of databases and knowledge that characterize the EAMS of lands are based on the principles of systems approach to the integration of data from different types of monitoring of irrigated lands in a single, integrated geo-information system of EAMM: integrity, structuring, interdependence of the EAMS system and the environment, hierarchy, specialization and integration, feedback, etc., and the developed methods of EAMS of lands.

The theoretical generalization of the results of monitoring studies provides the opportunity to offer different models of water management for irrigated areas of the southern region of Ukraine (the adaptation of different irrigation regimes to the corresponding conditions of the EAMS of lands), the implementation of which improves the EAMS, increases the stability and efficiency of irrigated land use. The application of the extended list of EAMM indicators ensures the integrity of the process of forming the EAMS of lands.

Keywords: irrigation, lands, soils, soil fertility, stability, yield, ecological and agro-ameliorative monitoring, GIS technology, modeling, prediction.

THE EFFECT OF IRRIGATION AND FERTILIZATION TECHNIQUES ON SPECIFIC WATER CONSUMPTION OF GREEN PEPPER CROP

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ABSTRACT

The effect of different irrigation and fertilization techniques on specific water consumption of green pepper crop (*Capsicum annum* L. var. *Bela dolga*), were investigated in experimental plastic house in Northern part of the Republic of Macedonia. The field trials were conducted near by the Faculty of Agricultural Sciences and Food in Skopje, during the period of May to October in 2005, 2006 and 2007. The main aim of this investigation was to determine specific water consumption in two-stem pruned (“V” system) green pepper crop under different irrigation and fertilization techniques and regimes. Also, the evapotranspiration (ETP) and green pepper yield were determined during this investigation. Therefore, four experimental treatments were applied in this investigation. Three treatments were irrigated by drip irrigation and drip fertigation (KK1, KK2, KK3), while the last one was irrigated by furrow irrigation with conventional application of fertilizer (control treatment ØB). From the average results for specific water consumption obtained in the investigation, it can be concluded that there are not statistically significant differences between the treatments KK1 and KK2 (drip fertigation every 2 and 4 days), what is result of closer irrigation interval of these two treatments. As a result of longer frequencies between the irrigations, the treatment KK3 (drip fertigation scheduled by tensiometers) showed 15,2-18,7% higher specific water consumption in comparison with KK2 and KK1. The results showed statistically significant differences. The effect of the irrigation and fertilization techniques on specific water consumption is presented by the comparison of the results from the treatment KK3 and ØB. Namely, the control treatment showed 107,44 liter of used water per kilogram tomato yield or 31,7% higher value in comparison with KK3. The results are statistically significant at 0,01 level of probability.

Keywords: specific water consumption, potential evapotranspiration, drip fertigation, furrow irrigation, green pepper

A POSSIBILITY OF ORGANIC BUCKWHEAT PRODUCTION UNDER IRRIGATION

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ABSTRACT

Buckwheat (*Fagopyrum esculentum* Moench) is an alternative crop in our country. Due to low yields in comparison with those of the major cereals, it is grown on a relatively small acreage. Buckwheat growing is nevertheless profitable on account of low inputs in its production. Because of that, as well as because of a high nutritional value and favorable chemical composition of grain, buckwheat is increasingly used in human nutrition. Organic buckwheat production is attracting attention, especially because literature data claim that yields of organic buckwheat are significantly higher compared with those obtained in conventional production.

Besides the choice of cultivar and proper cultural practices, buckwheat production is considerably affected by soil and climatic conditions. In dry conditions, the lack of water affects the nutrient supply of plants. Transport of nutrients to actively growing branches and flower buds is reduced, which in turn lowers grain yield and quality.

A local buckwheat cultivar is grown at the experiment field of the Institute's Department of Organic Farming and Biodiversity in Backi Petrovac, on a soil with favorable water-physical and chemical properties. Irrigation is performed when needed, using irrigation water of good quality. The production itself and irrigation water quality are controlled in accredited laboratories. In 2012, which was dry and extremely warm, buckwheat plots were irrigated two times with the irrigation norm of 60 mm. The yield of irrigated buckwheat was 1235 kg/ha, i.e., 7.35% higher than without irrigation, which was not statistically significantly.

Keywords: buckwheat, organic production, chernozem, irrigation

WATER-YIELD RELATIONSHIPS OF POTATO UNDER DIFFERENT IRRIGATION REGIMENS

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ABSTRACT

Yield response to irrigation of different crops is of major importance in production planning. The study aim was do determine the effect of different irrigation regimens on potato yield and water use efficiency in terms of water used on plants evapotranspiration and water applied by irrigation. The study was carried out at the experimental field of the Institute of Field and Vegetable Crops in Novi Sad in the period 2002-2003. The trial included three irrigation variants (pre-irrigation soil moisture of 60, 70 and 80% of field water capacity – FWC), and the non-irrigated, control variant. The trial was established in a system of random blocks and adapted to technical specifications of the sprinkling irrigation. Water used on evapotranspiration of potato was determined by balancing the amounts of water taken up from the soil layer of 2 m and the amounts received from natural rainfall and irrigation. To assess the irrigation effect on potato yield, irrigation water use efficiency (I_{wue}) and evapotranspiration water use efficiency (ET_{wue}) were determined. Irrigation regimens significantly influenced tuber yield ($P < 0.05$). The highest yield of potato was obtained on the variant with pre-irrigation soil moisture of 70% of FWC (43.158 t ha^{-1}), significantly higher compared with yield achieved both in the control, non-irrigated variant (16.362 t ha^{-1}) and irrigated variants of 60% of FWC (30.887 t ha^{-1}) and 80% of FWC (36.925 t ha^{-1}). The amounts of water used on evapotranspiration under irrigation (ET_m) and non-irrigation conditions (ET_a) ranged from 451.4 to 501.4 mm, and 373.4 to 381.2 mm, respectively. The values of I_{wue} and ET_{wue} varied from 6.9-8.7 kg m^{-3} and 6.5 do 9.7 kg m^{-3} respectively, mostly depending on the favourableness of the year for the potato production and irrigation water applied. Having in mind that the highest values of yield, I_{wue} and ET_{wue} of potato were obtained in the variant of pre-irrigation soil moisture of 70% of FWC, it could be concluded that this level of soil moisture represent the lower limit of optimum soil moisture, it means when is needed to start with irrigation if potato is grown in a soil with medium soil texture.

Keywords: potato, irrigation regimens, water use efficiency

**WATER SUPPLY AND BIOMASS PRODUCTION OF
Miscanthus × giganteus Greef et Deu.**

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ABSTRACT

Biomass as a fuel represents an easily available, renewable energy source that is acceptable in technical and ecological sense. *Miscanthus* is identified as one of the best low input bioenergy crops in Europe. It is a perennial grass crop for biomass production, the whole aboveground mass of which may be used as energy raw material for combustion. *Miscanthus* is very adaptive to different agro-ecological conditions, which makes it promising for cultivation even on less fertile land areas.

Sufficient water supply is necessary to ensure good rates of establishing and satisfactory biomass production. *Miscanthus* is highly productive in moist environment, but it is very susceptible to insufficient moisture. Within the wider area of the Balkan Peninsula, environmental conditions are determinative for the dynamics of *Miscanthus* growth. Drought may cause significant retardation of the crop growth and development. Seasonal yield differences are noticed in the majority of plots and are mainly the consequence of drought stress. Namely, certain regions in Serbia belong to steppe areas, with the precipitation quantity below 600 mm. In this paper, we examine the impact of water supply for *Miscanthus* biomass production in a multi-year trial on chernozem soil, in Zemun, Serbia (44°51'N, 20°22'E).

Keywords: biomass, fuel, *Miscanthus*, moisture

WATER EROSION AND TORRENTIAL FLOODS - SIGNIFICANT FACTOR IN LAND DEGRADATION

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ABSTRACT

Water erosion and torrential floods, as its consequence, are considerably widespread degradation processes in Serbia. Practically, the whole territory of Serbia is under the attack of water erosion of different intensity which causes great damages such as: the loss of soil, the loss of soil fertility, the loss of water, the damage inflicted to the environment, etc.

Extremely ramified network of torrential streams which exists on the territory of Serbia is the consequence of intensive erosive processes creating over 12,000 torrential streams registered so far.

Damages caused by torrential streams are many: catastrophic torrential floods creating damages in settlements, industry, road infrastructure, agriculture and complete economy, and society as a whole, siltation of accumulations and other water management facilities by sediment, traffic interruptions, etc.

For the purposes of preparing spatial plans and other development plans, it is necessary to have an updated erosion map and torrential stream cadastre. Erosion map which exists in Serbia was prepared in 1975 applying the Method of Erosion Potential by Prof. S Gavrilovic and the map's partial alteration and amendment made in 1996. Having in mind that field properties change over time, it would be necessary to prepare the new erosion map applying some of the methods generally accepted in Europe and in the world. As for torrential streams, there are cadastres compiled in 1960s applying outdated methods. Also, field conditions changed and it is necessary to prepare new torrential stream cadastres applying contemporary methods and tools at our disposal.

Keywords: water erosion, torrential streams, torrential floods, erosion maps, torrential stream cadastre.

**AVAILABILITY OF SOME HEAVY METALS (FE, MN, ZN, CU, NI I PB) IN
RELATION TO THE PROPERTIES ON THE PRODUKTION PLOTS OF THE CITY
OF KRAGUJEVAC, SERBIA**

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ABSTRACT

Recently, heavy metals concentrations increased in some agricultural areas due to the consequences of anthropogenic impacts. The aim of this study was to determine the level of heavy metals (Fe, Mn, Zn, Cu, Ni and Pb) and also to evaluate the influence of some soil properties on heavy metals concentrations. The research was conducted in several localities of the city of Kragujevac, where the dominate soil type Vertisol acid soil reaction. Most soil samples presented medium to high available heavy metals (Fe, Mn, Zn i Cu) concentrations, indicating that such soils are sufficient to supply to plants. A correlation analysis between extractable heavy metals form, and soil general properties showed that the significant dependence was for Fe_{DTPA} vs. pH ($r = -0.56^*$, -0.55^*); Mn_{DTPA} vs. pH ($r = -0.85^{**}$, -0.83^{**}), P₂O₅ ($r = -0.73^*$); Zn_{DTPA} vs. pH ($r = 0.87^{**}$, 0.85^{**}), P₂O₅ ($r = 0.91^{***}$), K₂O ($r = 0.77^{**}$), N ($r = 0.80^{**}$), humus (0.65^*), Cu_{DTPA} vs. K₂O ($r = 0.53^*$), humus ($r = 0.55^*$), Ni_{DTPA} and pH ($r = -0.68^*$, 0.66^*), P₂O₅ ($r = -0.63$).

Keywords: Iron, manganese, zinc, copper, lead, nickel

THE PRESENCE OF HEAVY METALS IN THE NON-AGRICULTURAL SOIL IN THE LOCALITIES OF “PETROHEMIJA” AND “AZOTARA” IN PANČEVO

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ABSTRACT

In this study, the results were displayed of the quality of non-agricultural soil in the industrial areas of the Petrochemical Industry “Petrohemija” and the Fertiliser Factory “Azotara”. The samplings were carried out from two depths: 0-30cm and 30-60cm. The sample preparation was performed by the Krishnamurty Method, and the establishment of heavy metal content was performed by the atomic absorption spectrometry in the flame of acetylene/air.

The established content of heavy metals (zinc, lead, chrome, copper, cadmium) in the soil samples in both localities and from both depths was significantly lower than the maximum allowed value. The locality of “Petrohemija” is more polluted compared to the locality of “Azotara”, because there was established a higher average content of heavy metals. It was established that, in the locality of “Petrohemija”, there was the highest content of zinc of 36.9 mg kg⁻¹ and the lowest content of cadmium of 0.3 mg kg⁻¹.

Keywords: heavy metals, soil, industrial zone, atomic absorption spectrometry

**MONITORING CONDITION OF SOIL AND EFFECTS ON GROWING VEGETABLES
ON THE TERRITORY OF THE TOWN OF PANCEVO**

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ABSTRACT

This thesis analyzes characteristics of soil for growing vegetables on the territory of the town of Pancevo. Since there is high level of emission of acid oxides, heavy metals and other toxics in nearby industrial zone, possible accumulation in environmental resources and plant material has been studied. Following indicators of quality have been studied: soil fertility, presence of heavy metals and metalloids in soil and vegetables. According to the analyses of all relevant parameters, the overall state of fertility shows that $\frac{3}{4}$ of the area have values that indicate highly fertile soil. Established values of heavy metals and metalloids in each sample of soil analyzed were lower compared to the regulations of maximum levels (in average Cd 0,77 mg/kg, Pb 19,93 mg/kg, Hg 0,24 mg/kg, As 2,33 mg/kg, Cr 26,42 mg/kg, Ni 33,21 mg/kg, Cu 22,92 mg/kg, Zn 73,86 mg/kg). Current regulations on maximum levels specify reference values for 4 elements (Pb, Cd, Hg and As) and samples of vegetables from various locations in Pancevo had lower values than specified (in average Pb <0.05 mg/kg, Cd<0.03 mg/kg, Hg<0.02 mg/kg, As<0.01 mg/kg). Values of elements (Cu, Zn, Fe, Mn in vegetables and Fe and Mn in soil) that were subject to the analysis but not specified by the Republic of Serbia regulations are lower than specified in documents. Results obtained indicate that conditions for growing vegetables on the territory of Pancevo are favorable regardless possible sources of environmental pollution.

Keywords: soil, vegetables, soil fertility, heavy metals

"AGRO KAPILARIS" – A REVOLUTIONARY METHOD OF IRRIGATION

ZLOH Zdenko

ABSTRACT

After twenty years of research on hydro-physical properties of the soil, the author of innovation has explored and developed an original concept of delivering optimum amount of water to the plants. This method is classified as sub-surface irrigation.

This method was named "Agro kapilaris" as the water is delivered to plants in the form of rising damp.

The main characteristics of the concept of "Agro kapilaris", which distinguishes it from all other existing irrigation methods, are:

- High energy efficiency (very low working pressure - low energy consumption)
- Long life of the system (predicted life span over 50 years).
- Low water consumption (evaporation losses are minimized)
- High ecological safety while performing fertirrigation
- Applicability to small plots, as well as on the large complexes
- Applicability for irrigation as well as for drainage

In conditions of extreme drought in 2012 year, the system installed on an experimental plot showed excellent results for various agricultural plants, indicating possibilities of use of Agro kapilaris in semi arid, arid and desert conditions.

Keywords: irrigation, energy efficiency, drainage

SUCCESSFUL APPLICATION OF THE CONCEPT OF "AGRO KAPILARIS" IN AGRICULTURAL PRODUCTION IN THE OPEN FIELD AND GREENHOUSE

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ABSTRACT

On the experimental plot in Boljevci - Belgrade, preliminary experiments were carried out in the open fields and in greenhouses in 2009. The aim was to investigate the effects of new ways of subsurface irrigation system "Agro kapilaris" related to the vegetable and field crops production. The application of "Agro kapilaris" in a protected area indicated the need to change the agro technique for planting when compared to the traditional way to get maximum effect: powerful and increased root system of plants and significant increase in yield.

A two-year study in the open field was a novel application of this subsurface irrigation system has shown numerous advantages of subsurface over traditional surface irrigation.

In conditions of extreme drought, in 2012 year, the results of comparative monitoring "Agro kapilaris" versus surface irrigation confirmed multiple positive effects in favor of "Agro kapilaris".

Keywords: irrigation, "Agro kapilaris", greenhouse

**INFLUENCE OF CLIMATE FACTORS ON RICE YIELD IN THE SOUTH OF
UKRAINE**

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ABSTRACT

Rice - the culture of tropical origin, which has increased demands on the temperature regime of air and water, humidity and lighting conditions. Period of rice ontogenesis involves the development of culture from its beginnings (sowing) to the end of life (harvest). Varieties of rice grown in the South of Ukraine, which belong to the northern region of the world rice cultivation, adapted to the temperate climate, the culture is lightweight of temperature conditions along the growing season. In different phases of growth and development plants require different levels of heat. In the development of rice distinguish these vegetation phenological phases: germination, sprouts, tillering, exit in tube throwing bunches, maturation.

According to the results years of research found a direct relationship between the average air temperature during the year ($R^2 = 0.39$), especially during the growing season ($R^2 = 0.42$), and yield of rice.

Constructed model based on the yield of rice average air temperature during the growing season. During ontogenesis of rice role of influence of temperature on yield of rice distributed as follows: the main meteorological factors influencing the productivity of rice are as follows: average temperature in June ($r = 0,61$), and July ($r = 0,72$) (direct relationship - the higher the temperature, the greater the yield).

You should also note the importance of temperature in the last decade of April, which has a strong influence on the germination of seeds. At the same time one of benefit of nice factor is the presence of a certain amount of precipitation that accelerates sprouts of rice.

Feedback observed between rice harvest and amount of precipitation during the growing season: wet years is directly connected with a decrease in temperature and increase in its relative humidity, which generates a number of fungal diseases of rice. Also in wetter years, there is an additional risk of severe torrential rains during the growing season as a result of the rice stem gaining extra weight, which leads to lodging culture and a sharp decline in rice yield.

To predict the level of productivity and the value of gross fees necessarily must be considered agrometeorological factors is a major factor in significant changes in rice yield.

Keywords: rice, yield, climate, temperature, precipitation.

THE CONCENTRATION OF SOME METALS IN SOIL ON ONE SERPENTINE LOCALITY (SERBIA)

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ABSTRACT

Ultramafic (serpentine) soils, developed upon ultramafic rocks, are widely distributed in different parts of the world and also cover quite large areas in the Balkans, more than in other parts of Europe. The aim of presented research was to assess the content of eleven metals (Ca, Mg, Fe, Mn, Cu, Zn, Ni, Pb, Cd, Co, Cr) in serpentine soil near the village of Kamenica in Central part of Serbia. The metal concentration in the soil was: Mg>Fe>Ni>Ca>Cr>Mn>Co>Pb>Zn>Cu>Cd. Our study exhibited different metal concentration in serpentine soils, depending on kinds of metal, and confirm the fact that serpentine soils content high concentration of some heavy metals (Fe, Ni, Cr, Co).

Keywords: serpentine soils, concentration of metals.

**ESTIMATION OF SOIL EROSION INTENSITY AND RUNOFF IN THE RIVER BASIN
OF BIJELI POTOK, NORTHEAST OF MONTENEGRO**

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ABSTRACT

The area of Polimlje in Montenegro covers an area of around 2,200 km² and consists of 57 river basins. For one of the tributaries of the river Lim, the river basin of Bijeli potok, the authors of this paper studied soil erosion processes. It was concluded that many factors have influenced the development of erosion processes in the territory of the subject river basin. The most significant factors are the area's climate, relief, geological substrate and pedological composition, as well as the land use. The intensity of soil erosion and runoff for the river basin of Bijeli potok was calculated using the IntErO model, with the Erosion Potential Method embedded in the algorithm of this computer-graphic method. The research foresees that the maximal outflow from the river basin, Q_{max}, is 62 m³s⁻¹ (incidence for the next 100 years). The river basin belongs in „Destruction Category IV”, according to the classification system of Professor Gavrilovic. The strength of the erosion process is weak, and the type is mixed erosion. The real soil losses are 612 m³/year (211 m³/km²/year).

Keywords: Soil erosion, runoff, river basin, land use, modelling, IntErO model

RECLAMATION OF SALINE PADDY SOIL IN KAZAKHSTAN

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ABSTRACT

In this paper an improvement techniques to existing and new methods for reclamation of saline soils, TMS and LMS (without washing) to provide the designed and planned harvest in the first year are presented. This method has no analogues in the near and far abroad, from both an environmental and an economic feasibility.

Keywords: reclamation; multifunctional ameliorant PFM; high valence chemical-HVC; bentonitic clay–BC

DYNAMIC OF SOLUBLE NI, CD AND AS IN A PERIODICALLY FLOODED ARABLE SOIL: BIOGEOCHEMICAL MICROCOSM INCUBATION FROM REDUCING TO OXIDIZING CONDITIONS

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ABSTRACT

The aim of the research was to estimate the temporal dynamics of nickel (Ni), cadmium (Cd) and arsenic (As) in a slightly acid, periodically flooded arable soil, located in the river Velika Morava valley, when soil redox status (EH) evolves from anaerobic to aerobic conditions after inundation. We have flooded the fine soil fraction (< 63 µm) in an automated biogeochemical microcosm system (soil:water ratio 1:8), which allows control and continuous measurements of EH and pH at 10 minutes intervals. Three microcosms were used as replicates. Flooding of the soil caused a decline of EH to the values between -184 and -261 mV, confirming the development of anaerobic conditions in the slurry. From then on, EH was increased in the steps of approximately 100 mV by adding O₂. The highest EH values reached were between 583 and 609 mV. During the experiment, pH fluctuated in the range 6.21 – 8.02. The solution was sampled approximately 24 h after reaching each new EH-window and analyzed for: soluble Ni, Cd, As, Fe, and Mn, dissolved organic carbon (DOC), and sulfates (SO₄²⁻). Pseudo total metal concentrations were determined in the bulk soil. Pseudo-total Ni concentration in the soil was about 3.5 fold higher than the proposed maximum allowable concentration in agricultural soils, while pseudo-total Cd and As concentrations were below the maximum allowable concentrations. Concentrations of Ni, Cd and As in the solution during the experiment ranged: 67-249 µg L⁻¹, 0.06-2.01 µg L⁻¹ and 9.2-105.0 µg L⁻¹, respectively. Soluble nickel and arsenic concentrations were above the guideline values for drinking water quality proposed by the World Health Organization (WHO) and above the groundwater threshold values proposed by the European Communities regulations.

Soil redox status (EH) was found to be an important factor controlling the solubility of the metals. Significant positive correlations were found between EH and soluble Cd, sulfates and pH. Redox potential correlated negative with the soluble Ni, As, Fe, Mn, and DOC.

The Cd concentrations in the solution were low at low EH. Increasing redox potential facilitated mobilization of Cd, what coincided with increasing concentrations of sulphates. Thus, oxidation of sulphides and subsequent release of metals might be one reason for the increasing solubility of Cd with increasing EH. In contrast, concentrations of Ni and As in the solution were high at low EH and declined with increasing EH, what coincided with decreasing concentrations of soluble Fe and Mn. Accordingly, Fe/Mn (hydr)oxides precipitation might control Ni and As solubility at high EH, which was confirmed by the positive correlation between soluble Fe and Ni, then between soluble Mn and Ni, and between both Fe and Mn with soluble As. On the other hand, Cd did not adsorb to or co-precipitate with Fe/Mn (hydr)oxides.

The results suggest that the mobility of Ni and As will increase when the studied soil is flooded while the mobility of Cd will decrease under the same conditions. A verification of the detected dynamics and an evaluation of potential environmental risk at various scales, including field conditions, are recommended for the future research.

Key words: soil, redox potential, heavy metals, solubility, mobility

MODELING OF GROUNDWATER LEVELS IN THE DANUBE AREA

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ABSTRACT

The aim of this paper is to show possibilities of MA and ARMA type regression models for modeling of groundwater water level dependence on the river water level in the case of hydrological type groundwater. The area of study is located on the left bank of the Danube, near town of Kovina. Groundwater levels modelling is very important in agricultural areas affected by superfluous water, because the appropriate protective measures may be based on the process prediction.

Physical models for numerical modeling of groundwater levels have been successfully developed over decades. The lack of these models is that require precise characterization and quantification of the physical properties and mutual dependence in a system that is of interest for analysis. This approach also requires a large number of input data that are usually not covered by precise measurements. Statistical models are much simpler for implementation, because these models do not require physical parametrization of measured sequences. In the case reported in this paper long time series of data on the water level measured in the monitoring wells in the area Kovin Dubovac and data on water levels of the Danube were used. Statistical tests of mean error, mean absolute error, root mean square error, coefficient of correlation and coefficient of efficiency are used for checking of compatibility between the obtained models and available measurements. Statistical models of MA and ARMA type can be used successfully to model the dependence of the Danube water levels and groundwater levels.

Keywords: model, MA, ARMA, groundwater level, Danube

**THE QUALITY OF WATER USED FOR IRRIGATION OF AGRICULTURAL SOIL IN
THE BASIN OF RIVER TIMOK**

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ABSTRACT

This paper presents the results of testing the quality of water for irrigation during the growing seasons 2012/2013, in the basin of the river Timok, from Knjaževac to Visočnog brda (Mokranja), in three monitoring cycles on 17 selected sites belonging to agricultural area under irrigation.

Since the older classifications (Nejgebauer and Stebler) unlike contemporary (FAO, U.S. Salinity Laboratory, RSC Residual Sodium Carbonate) are providing a rough assessment of the usability of water for irrigation without assessing the impact of the water used on the plant and equipment, their comparative analysis were performed.

According to the FAO classification, tested water samples are belonging to the class of water for drinking and irrigation, and to the class of irrigation water, and according to the classification of U.S. Salinity Laboratory samples are belonging to C2-S1 class. By classification of Nejgebauer, tested water samples belongs to the Class I water with a small concentration of salt and a very favorable ratio of divalent cations to the sum of Na^+ and K^+ , and only Na^+ .

In the second cycle of testing individual samples belonged to class III according Nejgebauer classification, which is characterized as the waters that are unsuitable for irrigation. In relation to the classification Stebler and RSC Residual Sodium Carbonate all of the samples belonged to the class of good water.

Variations in the class of suitability of water for irrigation in relation to the following classifications in the second monitoring cycle were primarily caused by low water, and the dry season, which was present at the time of study.

Based on results of analysis of water quality of river Timok it can be concluded that it is usable for irrigation of crops and soil with restrictions and frequent quality checking during the summer months.

Keywords: quality of irrigation water, soil, irrigation

**THE CONTENT OF HARMFUL TRACE ELEMENTS Cr, Ni, Pb, Cd, Hg, S, As i
B IN SOILS AND GROUND WATERS IN THE AREA OF COAL POWER-PLANT
„NIKOLA TESLA“ D.O.O. OBRENOVAC**

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ABSTRACT

Soil surrounding power-plants, such as coal power-plants, is often contaminated by some harmful substances, which migrated from the ash and slash after the combustion of coal and hydraulic transportation by water of ash in the special constructed boxes for ash. Among the contaminants we pointed out some harmful microelements as are Cr, Ni, Pb, Cd, Hg, S, As i B. The results obtained exhibit the higher content of harmful substances such as Pb, B and SO₄ in the nearby ground waters above the MAC (Decree for the classification of waters and water bodies (Sl. gl. R. Srpske 3/97, 3/99 i 29/00) -values for the fifth class of waters. At the other side the content of harmful microelements in the nearby soils is not above MAC (Regulation of maximum allowed content of harmful materials in soils and irrigation waters (Sl. gl. RS br.23/1994)

Keywords: harmful, trace elements, contamination, power plant

SECTION 3

SOIL IN SPACE AND TIME

- Pedology, soil genetic and classification
- Soil chemical, physical and mineralogical properties
- GIS in soil science

CHEMICAL PROPERTIES OF CALCAREOUS VERTISOLS OF PCINJA DISTRICT

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ABSTRACT

This paper presents the results of the chemical properties analyses of calcareous Vertisols. The samples were taken in Pcinja district, on four locations (Vranje – Neradovac, Bustranje, Cukovac, Vladicin Han – Rid) between 345 and 489 m.a.s.l. Chemical properties analysed are: CaCO₃ content (by Scheibler calcimeter), active acidity (pH in soil-water suspension, 1:2.5), exchangeable acidity (pH in soil-1M KCl suspension, 1:2.5), humus (Tjurin method) and nitrogen content (Kjeldahl method), available phosphorus (P₂O₅) and potassium (K₂O), (by Egner-Rhiem method) and available micronutrients : Fe, Mn, Cu, Zn (DTPA extraction) and B. Formation of calcareous Vertisols is related to calcareous clay parent rock, and average CaCO₃ content is 9.1% (ranging from 1.8 to 23.7%). Depending on climate conditions and the process of decarbonization, CaCO₃ content increases with depth. These Vertisols, due to CaCO₃ present, have higher values of pH in water suspension - 7.84 at the depth to 20 cm. According to the humus content these soils are classified as weak to medium supplied. The value of available potassium is high, and the content of the available phosphorus is low. Content of available Fe, Mn and B is directly correlated to the CaCO₃ content. These soils have medium to high amount of available micronutrients.

Keywords: calcareous Vertisols, chemical properties, macro and micro nutrients (K, P, Fe, Mn, Cu, Zn, B).

**CATION EXCHANGE CAPACITY OF HYDROMORPHIC BLACK SOILS IN
PELAGONIJA**

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ABSTRACT

During the field examinations of hydromorphic black soils in Pelagonia valley a 25 soil profiles were excavated and examined. The main scope of these investigations was to examine the cation exchange capacity and the content of exchangeable cations of hydromorphic black soils.

Cation exchange capacity (CEC) is high and its average values ranges from 46,618 cmol (+) kg⁻¹ soil in the hor. A of vertic subtypes, to only 15,97 cmol (+) kg⁻¹ of soil in a hor. A of typical subtype of hydromorphic black soils. This difference is result of several factors: clay content, character of clay minerals and organic matter content.

Base saturation (BS) have the highest values of 37,19 cmol (+) kg⁻¹ of soil in the halomorphc and alkaline subtypes of hydromorphic black soils.

The base saturation percent (V %) is high in all subtypes of the hidromorphic black soils (>70 %).

Exchangeable calcium (Ca⁺⁺) dominate between the other cations in CEC, while the content of exchangeable Mg⁼⁼, K⁼, Na⁼ follows in the same order as indicated.

The average content of exchangeable Ca⁺⁺ has the highest values in the vertic non-carbonate hydrogenic black soils, 31.34 cmol (+) kg⁻¹ of soil and the lowest in the typical non-carbonate subtype with 8,03 cmol (+) kg⁻¹ of soil. In almost all horizons the content of exchangeable Ca⁺⁺ is over 50 %. Its content increases with the depth of the profile. The content of the other exchangeable cations vary in a very broad ranges: exchangeable Mg⁺⁺ in the ranges of 2-25 %, K⁺ from 0,62-6,34 %, exchangeable Na⁺ in the ranges of 0,08-23,7 %., while the content of the acid cations H⁺+Al³⁺ vary from 1,38-29,8 % of CEC.

Keywords: hydromorphic black soils, cation exchange capacity, base saturation, base saturation percent, exchangeable cations

MINERAL COMPOSITION OF PSEUDOGLEY OF SOUTH MACVA AND POCERINA

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ABSTRACT

This paper presents result of mineral composition of pseudogley subtypes from south Macva and Pocerina. The research was conducted on nine locations, out of which two locations have been chosen as representative (Lipolist – pseudogley of plains and Slatina- pseudogley of slopes). All genetic horizons of pseudogley have been sampled (10 samples). Mineral composition of the whole sample and of the clay-size fraction was determined by XRD method.

Results of the analyses of the whole soil sample have shown that mineral composition of the two soil profiles are qualitatively similar but they differ quantitatively, consequent to different formation conditions.

Whole soil sample consists of quartz, feldspars, plagioclase, micas, amphibole, smectite, chlorite, illite and goethite.

Analyses of both soil profiles have revealed that quartz is the most abundant, with content ranging from 46.5 to 55.5%. Following quartz, there are Na-plagioclase (albite) – 16.9%, micas (9%), smectites and chlorites (8.6%), feldspars (6.8%), illite (5.6%). There are traces of amphiboles and goethite.

It is of high importance to point out high quartz/ plagioclase ratio (Q/Pl) in pseudogley of slopes, that varies between 2.70 and 3.58, which is indicative of acid soil reaction of this pseudogley subtype. This fact is verified by $14 / 10\text{\AA}$ mineral ratio, being 0.49 and 0.55 in Ahp and Eg horizon of pseudogley of slopes.

Analyses of clay size fraction, showed that illite is the most abundant in both soil profiles (in all horizons, ranging from 43.2% to 56.2%). Following quartz, there are mix layer minerals (MLM, 15.3%), kaolinite (9.79%), smectite (8.99%), chlorite (6.17%), vermiculite (4.96%) and halloysite (4.43%).

Distribution of clay minerals along the soil profile is important for genesis and characteristics of pseudogleys. Concentration of smectite, MLM, chlorite and vermiculite is significantly higher in Btg and BtgC horizon, and concentration of illite, kaolinite and halloysite is lower.

Keywords: pseudogley, south Macva and Pocerina, pseudogley subtype, mineral composition

**THE INFLUENCE OF MECHANICAL COMPOSITION AND ORGANIC MATTER ON
THE RETENTION CURVES AT SOIL MOISTURE IN THE HUMIC CALCARIC
REGOSOL**

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ABSTRACT

The mechanical and organic matter content of the soil affects the water- physical relations. Soil water retention in different tension is in tight correlation with humus, clay, and silt content and mineralogical composition of the clay.

The paper presents the results of the research on the influence of the mechanical composition and organic matter on the soil in retention curves on moisture soils in diver's pressures.

Therefore different physical and chemical soil characteristics are in a constant interaction, while a good insight into these characteristics and their mutual influence is being applied in the modern agricultural production.

Keywords: mechanical composition, chemical properties, retention curves, humic calcaric regosol

**THE SOILS OF THE STUDY AREA NATIONAL PARK BISTRA-MAVROVO IN THE
REPUBLIC OF MACEDONIA**

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ABSTRACT

The soil cover was researched in the national park Bistra-Mavrovo. The soil of the study area is characterized by numerous soil systematic units. Eight different soil types were studied: in the classes of undeveloped soils: colluvial soil (colluvium) and litosols, in the class of humus-accumulation soils: humus-siliceous soil (ranker), rendzina and calcomelanosol (Lithic leptosol), and in the class of cambic soils: brown soil on limestone (calcocambisol), dystric brown (dystric cambisol) and eutric soil (eutric cambisol), cinnamonic forest soils.

Keywords: soil types, site conditions, production potential, Bistra

**CHEMICAL PROPERTIES OF AGRICULTURAL LAND IN THE EASTERN PART OF
THE REPUBLIC OF SRPSKA**

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ABSTRACT

In this paper are presents the results of basic analysis of chemical properties of the soil of the eastern part of the Republic of Srpska. Investigations have included analysis of soil acidity, humus, carbonates, total nitrogen, available phosphorus and potassium. Soil samples were collected during the 2011 and 2012 years, with areas that mostly belong to plow land areas. The objective of this paper was to getting initial picture of the soil fertility for specified region and their potential for crop production, the application of appropriate soil ameliorative interventions. The results showed that most of soil samples had a low acid reaction in aqueous solution and an acid reaction in salt solution (pH H₂O 6.50 KCl and pH 5.20), low-carbonate (CaCO₃% 2.56) and belong to the group of low lime soil, well provided with humus (3.94%) and total nitrogen (0.26%). Available phosphorus content is very low and averaged 5.54% P₂O₅ mg/100g soil until the readily available potassium content in most samples is at the optimum level and the average value was 23.98 K₂O mg/100g soil.

Keywords: chemical characteristics, control, fertility, soil

**PRESENTATION OF SOIL ERODIBILITY IN OSEČINA MUNICIPALITY:
ONE EQUATION - TWO APPROACHES**

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ABSTRACT

Soil water erosion is the most widespread form of land degradation in Serbia. The problem of soil erosion rose in the past with the intensification of agricultural activity and deforestation, and it is still very present with the potential to rise in the near future. Although a plenty of erosion combat measures were developed, they were not frequently used in agricultural systems in Serbia. The susceptibility of soils to water erosion could be estimated using soil erodibility factor (K) which is a part of USLE. The estimation of soil erodibility factor is obtained on a basis of soil water permeability, soil structure, particle size distribution and organic matter content. Osečina municipality is located in the western part of Central Serbia, in Kolubara district. The results of soil survey in the municipality were used in order to estimate K factor. Two maps of soil erodibility were made by two different approaches using same equation. The first approach is related to interpolation techniques between K values at sampling sites. The second approach is related to assignment of K-factor values to the soil types on soil map of Serbia in a scale 1:50 000. The advantages and disadvantages are present in both approaches and the most accurate map of soil erodibility could be obtained combining them.

Keywords: soil erosion, USLE, erodibility factor

THE PROPERTIES OF PLANOSOILS ON SERPENTINE ROCKS ON MALJEN MT.

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ABSTRACT

Results of Morphology, and physical and chemical properties research of planosoils on serpentine parent material, investigated on Maljen Mt. in various plant communities (beech forests with admixed fir, scotch pine forests and wet meadow communities) were presented in this paper. Planosoils forming process occurs as a consequence of heavy textural composition and weak water permeability of soils on serpentine. Planosoil stadium on serpentinites of Maljen Mt. develops after the illimerized or humus-accumulation soil stadia. Planosoils in researched area are characterized by short wet phase during soil forming process. They occur on flat terrains and on milder inclinations in foothills.

Keywords: Planosoil, Soil properties, Serpentine rock, Mountain Maljen

**AGGREGATE STABILITY AND AGGREGATE-ASSOCIATED ORGANIC CARBON
IN FIVE SOIL TYPES UNDER DIFFERENT VEGETATION**

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ABSTRACT

Soil aggregate stability plays a major role in soil sustainability and agricultural production. As an important cementing agent in the aggregation process soil organic carbon (SOC) strongly affects soil structure. This study deals with the impact of different soil types and land uses on aggregate stability and aggregate associated SOC. According to the structure indices (mean weight diameter (MWD) and geometric mean diameter (GMD)) results showed higher aggregate stability under meadow and forest compared to the cropland. Aggregate stability in different soil types decreases in the following order: Vertisols < Solonetz < Chernozems < Fluvisols < Arenosols. All land uses and soil types have higher SOC concentration in small macroaggregates (2000-250 μm) followed by large macroaggregates (>2000 μm), microaggregates (250-53 μm) and silt and clay (<53 μm). This is not in accordance with the well known conceptual model of aggregate hierarchy which is subjected to change when SOC is not the main cementing and stabilizing agent in the soil. Soil types and land uses that contain higher concentrations of cementing agents that prevent structure deterioration have more favorable structure.

Keywords: soil structure, aggregate stability, soil organic carbon, soil type, land use

**PROPERTIES OF THE SOILS FOR OLIVE PLANTATION IN THE SELEMLI
LOCALITY, GEVGELIJA**

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ABSTRACT

The soils researched in the Selemlj locality, Gevgelija belong to the soil type known as primary pseudogley. The conditions for formation of soils and their properties are described in detail in the complete material. These soils are noncarbonate and have slightly acid to neutral reaction. They contain very little amount of humus, nitrogen and are poorly supplied with available phosphates and medium to well supplied with available potassium. We have emphasized some negative processes as well as soil properties such as unfavorable water, air and thermic regimes well as water presence in all profiles (depth 80-100cm).

Special accentuate is given on the reclamation measurement for better fertility of the soils as an essential part of successful olive planting.

Keywords: pseudogley (primary), mechanical composition, chemical properties, measures for reclamation

BASIC PROPERTIES OF THE SOIL FORMED ON A PYROCLASTIC ROCK

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ABSTRACT

This study aimed to analyze properties of the soil formed on amorphous material. Pyroclastic rocks were recognized and mapped on the Geological Map of SFR Yugoslavia in the scale 1:100 000. Investigated soil profile is located northeast from Vujan mountain (43° 58' 21.8'' N, 20° 29' 58.4'' E, 667 m a.s.l.) on a hilly forest terrain with mild slope.

Soil profile depth was 61 cm and it was differentiated into O - horizon (0-3 cm), A – horizon (3-17 cm), AC – intermediate horizon (17-23 cm) and C - horizon (23-61cm) horizon. Parent material was recognized as a weathered tuff.

Active and exchangeable acidity were measured by pH meter. Presence of amorphous material was tested using method of Fieldes of Perrott (pH in NaF). Organic matter content was determined by Tjurin method, and particle size analysis by sedimentation and pipette method. Bulk density was determined using cylinders and specific gravity by picnometer while phosphate retention was determined by New Zealand method.

Mineral composition was determined by XRD analysis on Philips PW1051 diffractometer, under following conditions: U = 36 kV; I = 18 mA; velocity 1⁰/ min; Rc = 4/2. XRD analysis was performed on air-dry; ethylene-glycol saturated and heated (550°C) samples of surface horizon (A horizon) and of parent material (C horizon).

Reaction in water suspension (1:2.5) was extremely acid (3.8 to 4.1). Test with 1M NaF gave values from 8.2 to 8.8. A NaF pH of 8.4 or more indicates a significant component of short-range-order minerals in the exchange complex. Organic matter content was 5.1% in A horizon and 1.4% in AC horizon. Phosphate retention decreased with depth, from 51% to 38%.

Specific gravity of soil particles ranged from 2.26 gcm⁻³, in surface horizon, to 2.38 gcm⁻³ in parent material, while the bulk density of surface horizon was 0.88 gcm⁻³. Particle size analysis showed indicated uniform texture along the soil profile. Silt size fraction prevailed in soil, and it slightly increased with depth, from 80.1% to 84.4%. The studied soil had silt loam texture.

Mineral analysis of the surface horizon revealed presence of quartz, biotite, vermiculite, feldspars, etc. Diffractograms of the parent material indicated presence of quartz, lepidomelane, vermiculite, biotite, etc. Diffractograms of samples from surface horizon and parent material showed background from 2 to 6 Å, which is indicative of amorphous material.

The analyses have revealed some andic properties of this soil.

Keywords: amorphous parent rock, pH in NaF, mineral composition

**SOIL CHARACTERISTICS AND MINERAL COMPOSITION OF SMONICA
(VERTISOL) IN PIROTS VALLEY**

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ABSTRACT

Three subtypes of smonica: smonica (Vertisol) calcareous, smonica (Vertisol) non-calcareous, and brownised Vertisol were sampled and analyzed for chemical, mineralogical and water-physical characteristics in the Pirot area, Serbia.

The results showed that the parent material and relief played a crucial role in the first earlier genesis of smonica, and in the second phases of pedogenetic factors as: climate, hydrography, vegetation, and man intensify further genesis of the subtypes of smonica.

Physico-chemical properties in the soil were significantly intensified by the increased percolation of water from the slopes, carrying particles of colloidal fraction of clay in the lower parts of the valley of Pirot. Increased affluence of colloidal fraction is adding increasing amounts of colloids and intensifies the process of argillogenesis.

The common characteristic of subtypes of smonica Pirot valley is very heavy texture. The percentage composition of the colloidal clay fraction (<0.002 mm) is very high, and in some sections and > 60.0%. Silt and clay together (<0.02 mm) is roughly 80.0% of mechanical composition. Fractions of fine and coarse sand together (> 0.02 mm) are <20.0% of the total mechanical composition, which is very small, so that smonica in textural composition is belong to the land with heavier textural type, of heavy clay.

The analysis of the mineral composition of the carbonate and brownised subtypes of vertisol were observed mineral: quartz, calcite, muscovite, alkali feldspar, plagioclases and small amounts of amphibole. The difference in mineral composition between these subtypes of smonica reflected in the content of calcite, which is absent in brownised smonica, as well as the quantitative one between the presence of certain minerals.

In the mineral composition of the colloidal clay fraction of the subtypes of vertisol prevail mineral three-layer type lattice of montmorillonite group or swelling and frequently isomorphically substituted in the crystal lattice. Three-layer mineral illite is the second most abundant of the clay minerals.

Keywords: smonica, mineral composition, Pirot, clay

**PHOSPHORUS REGIME OF DARK-CHESTNUT SOILS OF ASHESAI RURAL AREA
OF WEST-KAZAKHSTAN REGION**

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ABSTRACT

Chestnut soils are formed in dry-steppe zone of West-Kazakhstan in the conditions of water deficiency. The calcium carbonate present in this soils sometimes from the surface, immobilizes the plant-available phosphorus. In Chestnut soils of dry-steppe there are not significant amount of total phosphorus and very low amount of available phosphorus.

Application of phosphor mineral fertilizer the calcium carbonates results in transformation of mono-substituted forms of phosphorus into double- and triple-substituted forms of phosphates.

Keywords: soluble phosphorus, total phosphorus, fractional composition of phosphorus, phosphorus pool, phosphorus supply.

APPLICATION OF GIS IN CREATING INFORMATION BASIS FOR MANAGEMENT OF FOREST ECOSYSTEMS OF BELGRADE

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ABSTRACT

Forest management integrates various activities of planning and management of forest resources and the related ecosystems. Given its contemporary level of development and complexity, forest management cannot be imagined without the application of GIS. The need of forestry profession for quicker, more reliable and more economic method of collection and processing of spatial data for the purpose of higher quality and easier management of forest resources imposes a need to create a uniform methodology for the application of Geographic Information System (GIS). Intense industrialization, urbanisation, transportation development and the resulting changes to the lifestyle of modern humans which, inter alia, imply higher and increasingly complex requests imposed on forests, face traditional forestry with a need for changes, particularly in urban areas. According to the UN estimations of 1977, it is expected that more than 60% of the world's population will live in towns by 2030. Consequently, this paper presents the procedures and methods for GIS application in creating information basis for management of forest ecosystems in the region of the city of Belgrade. Out of the total territory of Belgrade, 15.7% is covered by forests. The development of plans and the management is very complex due to the complexity of the requirements imposed on these forests and due to the need for their adjustment, avoidance of conflicts and functional durability. Preparation of planning documents is performed in three phases: preparatory works (control and updating of cadastral data, preparation of working maps, etc.), field work (spatial division of areas under forests, collection of qualitative and quantitative information on the site and the forest within units resulting from such division) and office work (computer data processing, analysis, preparation of management plans and preparation of thematic maps). In contemporary conditions, it is impossible to imagine a successful implementation of these phases without an adequate and proven application of the GIS technology.

Keywords: forest ecosystems, Belgrade, planning, management, GIS

THE IMPORTANCE OF REMOTE SENSING IN THE ANALYSIS OF SOIL COVER

– The implementation of supervised and unsupervised classification –

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ABSTRACT

The aim of this paper is to highlight the importance of remote sensing in the study of soil cover, which will be a special emphasis on the use of supervised and unsupervised classification. The paper will explain the possibilities of application of remote sensing in determining the type of soil base, as well as changes in soil formed by the action of harmful substances. The tasks is the substantive and formal presentation of the difference between supervised and unsupervised classification on the basis of which will be detected by a variety of soil types and changes in them. The result of the application of supervised and unsupervised classification is through the creation of digital thematic maps performed on the basis of satellite images (LANDSAT) in the software Idrisi, which contributes to good governance, promotion and protection of soil.

Also, the authors will provide guidance for research of soil cover through modern technologies and methods of remote sensing.

Keywords: remote sensing, soil, supervised classification, unsupervised classification.

PEDOGENESIS OF SOLONCHAK SOILS IN NORTHERN VOJVODINA

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ABSTRACT

Soil testing in Northern Vojvodina, as part of the project conducted by the Ministry of Education and Science of the Republic of Serbia, resulted in lower values of soil salinity indicators, in soils classified as Solonchak type in previous research. Desalinization trend was also observed in recent research. Desalinization is the results of hydromeliorative work on the territory of Vojvodina during the 20th century. After the removal of salinization agents, the process of pedogenesis focuses on the development of alkaline and hydromorphic soil types. Field and laboratory testing on these locations need to be expanded due to the methodological limitations.

Keywords: solonchak, soil classification, pedogenesis

**SLOVAK LAND PARCEL IDENTIFICATION SYSTEM -LPIS–BASIC
REQUIREMENT FOR OBTAINING EU AREA BASED SUBSIDIES AND
EVALUATION OF EFFECTIVENESS OF SOIL PROTECTION MEASURES OF THE
RURAL DEVELOPMENT PROGRAM IN SLOVAKIA**

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ABSTRACT

Rural development Program -RDP represents the second pillar of Common agricultural Policy - CAP of European Union. The SAPS – Single area payment scheme, direct payments represents the first pillar of CAP. Both pillars are based on Land Parcel Identification System –LPIS, which was created and is regularly updated in Slovakia on Soil Science and Conservation research institute. This system is compulsory for each EU members state and its purpose is to enable assign to each reference parcel of LPIS exact agriculture area, exact geographical location, unique code and several attributes concerning cross compliance and Rural development program. The LPIS was created and is regularly updated on the background of actual digital orthophotomaps which have to meet EK technical requirements. In Slovakia is LPIS based on reference parcel – physical blocks which represent agriculture land with stable boundaries. One of the most significant problems of degradation of agricultural land in Slovakia is accelerated water erosion. The system of agri-environmental subsidies to farmers of the Rural Development Program -RDP aspires to contribute to reducing the negative impacts of agricultural production on land and other basic environmental components, as well as strengthening greening of agriculture in Slovakia. A group of Soil protection measures, whose main purpose is reducing the extent of accelerated water erosion, is aimed at protecting agricultural land use in the frame of RDP. This contribution evaluates the application of Soil protection measures on agricultural land in Slovakia during the second programming period of the Rural Development Program 2007–2013 by the Slovak regions for the individual regions. The analysis of ten agro-environment measures as well as their geographic location and cartographic interpretation were performed using geographic information system instruments. Its results form the basis for an important input for the development and evaluation of the effectiveness of state environmental measures with regard to the formulation of proposals and recommendations for action to the next programming period 2014 – 2020.

Keywords: Soil protection measures, Agro-environmental measures, Protection against erosion, LPIS, GIS, agricultural soil, Rural Development Program

LEGAL PROTECTION OF AGRICULTURAL LAND IN THE SLOVAK REPUBLIC

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ABSTRACT

The quality of soil and land-use management is the basis for good conditions of life inhabitants. For this reason this issue should be at the core of any soil policy. Soil is the main natural resource, and the economic and social potential of each country. The way of farmland use must be adequate to natural conditions in given landscape and at the practical level of farming and must not threaten an ecological stability of the territory.

The soil is a multifunctional phenomenon, which is part of the environment, allows the production of foodstuffs and raw materials filters and holds water, and ecologically compensated balance of substances found in nature. The limitations of the availability of soil resources are a critical issue when considering global food security.

The soil quality issue is significant to policy makers because some aspects of soil degradation are only slowly reversible (decline organic matter) or irreversible (erosion) ones. Everybody who uses farmland for agricultural production is doing duty to utilize farmland in such a way, which conserves its natural fertility. The new law about agricultural soil protection has been approved in the year 2004 and amended in the year 2013. This law determinates protection properties and function of agricultural soil and protection environmental function of agricultural soil, which are production of biomass, filtration, and neutralization and transformation substance in nature.

Keywords: Soil, agricultural soil, soil conservation, soil conservation service, soils function, laws of the soil protection, environmental function, water and wind erosion, compaction, degradation

**WEBGIS APPLICATION IN SOIL SCIENCE USING GOOGLE FUSION TABLES AND
GOOGLE MAPS TECHNOLOGIES**

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ABSTRACT

Application of WebGIS allows designing, implementing, generating, delivering and analyzing interactive maps on the World Wide Web. Bearing in mind that the latest trend in databases and data warehouses is "floating in the cloud", the Google and other database service providers are applying cloud computing principles to database technologies. The Google developed a new online database called Fusion Tables that takes a new approach to database management, fusion Tables stores data on Google servers, which allows users from multiple locations convenient access to the data and powerful tools for data manipulation. The Google Maps is a web mapping service application and technology provided by Google, that powers many map-based services; also Google Maps API allows external developers to write applications that use Fusion Tables as a database.

In this paper will be presented the advantage of using soil pH (KCl) and pedology layers of Cadastral municipalities Kostolac and Kostolac Village stored at Google Fusion Tables and soil pH (KCl) data interpolated by kriging method stored as KMZ layer at server side, as the end product all layers are displayed on the World Wide Web by employing Google Maps API.

Keywords: WebGIS, Google Maps, Google Fusion Tables, Cloud Computing, soil pH (KCl), pedology

**THE SATELLITE PHOTOS OF THE HIGH RESOLUTION IN THE DEFINION OF
THE CHANGES IN THE ECOSYSTEMS USING**

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ABSTRACT

The adequate biodiversity protection at the species and genetic level is not possible without the adequate site protection. The climate change causes the increase in the air temperature (increased evapotranspiration), decrease in the quantity of precipitation, as well as the deterioration of the soil physical characteristics. The deterioration of the water-air soil characteristics will lead to the deterioration of the structure caused by the decrease of the nutrient content. The protective role of the vegetation will be reduced, the soil erodibility will increase, as well as the number of the wildfires, whereas the site conditions will deteriorate drastically. The global changes also affect the smaller regions, owing to which the monitoring of them is of a particular importance for the changes in the ecosystems. For this purpose we use the satellite photos of the high resolution, and by the use of GIS technology the method of the monitoring of the periodical changes in the ecosystems was developed. The collected data will enable the creation of the model which contain the dynamics of changes in the natural ecosystems. This paper analyzes cadastral municipality Đurašići. The classification based on EUNIS sistem of the site classification was applied. By the use of the satellite photos of the high resolution (pixel size 1m) for Đurašići area the spacial distribution of the sites was defined. By the periodical recording of the characteristic areas in Serbia the spacial distribution of the ecosystems, as well as the changes in their composition and structure, will be monitored.

Keywords: ecosystem, biodiversity, climate change, site, GIS

**ACIDIFICATION OF SOIL AS A LIMITING FACTOR OF AGRICULTURAL
PRODUCTION IN LUBOVIJA MUNICIPALITY**

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Soil acidification implies, above all, the reducing its pH. It may be the result of many years of slow, purely natural processes or significantly accelerated as a result of a combination of natural processes and anthropogenic impacts (due to excessive emissions of S and N, uncontrolled deforestation and intensive agriculture). Acidification is a very important factor in permanent degradation of soil fertility, as the most difficult and renewable natural resources.

In order to facilitate the monitoring and reduction of the intensity of acidification, the distribution of land to the municipality Ljubovija according to different levels of susceptibility to acidification was done using geostatic GIS module. In the research areas, we applied two models of evaluation of possible acidification. As the main characteristics of the land in the process of neutralization, in the first model the CEC and pH were taken, and in second model the CEC and V. In order to obtain more accurate values of soil susceptibility to acidification, the two models are particularly isolated and sensitivity to acidification of areas was compared with each other. Received different levels of acidification of inspected surfaces allow timely to act toward reduction the overall acidity of the soil.

Management of agricultural land area in isolated areas, should focus on a balanced nutrition and cultural practices and the selection of those crops which contribute to the optimization of land use and sustainable productivity.

Keywords: acidification, soil fertility, GIS module

EFFECT OF CONVENTIONAL TILLAGE AND DIRECT SOWING ON THE SOIL STRUCTURE

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ABSTRACT

Maintaining favourable soil structure represents main aim to achieve high and stable crop yields. Soils with good structure provide less resistance during tillage retains a larger amount of available water for plants, reduces water loss and sealing risk. The highest share of aggregates 0.25-7 mm, and in some cases up to 10 mm ensures the most suitable air-water properties of soils. Unstable structure of soil reduces its infiltration rate and permeability, increases evaporation and sealing risk, decrease aeration and intensifies erosion in specific conditions.

The aim of this study was to examine the impact of conventional tillage and direct sowing - no till on the aggregate size distribution and macro-aggregate stability of chernozem as well as effects of humus content on macro-aggregate stability.

The soil samples were collected from 0 to 30 cm depth and analyzed in the laboratory for water-physical and chemical properties at the Faculty of Agriculture, University of Novi Sad. The higher amount of macro-structural aggregates >5 mm was determined in the treatment with direct sowing (no till) compared to conventional tillage. The relationship between mega-, macro- and micro-structural aggregates shown that structural coefficient was higher in conventional tillage ($K = 5.68$) compared to a direct sowing ($K = 3.16$). The higher amount of stable aggregates >2000 μm was determined in the treatment with direct sowing while in conventional tillage stable aggregates <2000 μm were dominated. Based on the mean weight diameter of stable aggregates - MWD it can be observed significantly higher values of this index in the treatment with direct sowing (MWD = 2417 μm) compared to conventional tillage (MWD = 1512 μm). This parameter indicates higher distribution of stable aggregates in the treatment with direct sowing.

In our soil and climatic conditions direct sowing should be combined with conventional tillage to ensure favourable structure of soil.

Keywords: soil structure, tillage, direct sowing

PERSPECTIVE OF AGRICULTURAL PRODUCTION IN THE AREA OF RASKA, CONCERNING SOIL FERTILITY AND CONTAMINATION BY SOME HARMFUL SUBSTANCES

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ABSTRACT

Area of Raska is situated in the south-west part of Serbia on the 3918 km². There are two main towns Kraljevo and Novi Pazar and three municipalities: Raska, Vrnjacka Banja and Tutin. In the year 2005 the research of soil fertility, 315 soil samples were collected from that area. Samples were collected by grid system, on each 1000 ha from the depth of 0-25cm. The mostly of samples were collected from the woods, pastures and meadows as the whole area is situated on the slopes. The analyses of samples exhibit low content of lime (0-1%) and pH reaction acid to slow – acid (63 %). The content of organic matter (humus) is mainly on the high level. The content of easily –available K₂O is average to high, while easily-available P₂O₅ is low. There were not some serious contamination of the area by harmful substances as heavy metals. The content of Ni (38% of samples) and Cr(36 % of samples) was higher than MAC but it is originated from the parent rocks from the valley of Ibar which are mainly ultrabasic serpentines. In some soil samples higher content of As, Pb, Cd, Cu and Hg were observed.

Keywords: Area of Raska, soil fertility, heavy metals.

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