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NEW DEVELOPMENTS IN SOIL TESTING AND PLANT ANALYSIS REVIEW

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Abstract

In the review paper, based mainly on the researches carried on at the Department of Plant Nutrition and Fertilization of the Institute in Pulawy, the contemporary approach to plant and soil tests have been presented and discussed. Plant tests are classified as direct, destructive using plant sampling and chemical analysis and indirect, non destructive, using spectral analysis of plants or crop canopy. As the best and most reliable, but cumbersome and destructive, plant test for nitrogen the nitrogen nutrition index NNI is recommended. Soil tests are most commonly based on soil sampling, extraction of samples with different solution and estimation of so called available forms of nutrients. The main and still not fully solved problem lies in the calibration of soil tests, i.e. establishing their threshold values, by which crops show no positive reaction to fertilizer application. The new calibration figures for nitrate nitrogen and available potassium soil test have been proposed.

Key words: soil test, plant test, calibration of soil and plant tests

THE EFFECT OF LONG-TERM FERTILIZATION ON THE SOIL STRUCTURE

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Abstract

In the paper, the results concerning the influence of different fertilization systems on the soil structure, based on two long-term experiments, carried on in the years 1990 and 1993 at Experimental Station Łyczyn are presented. The fertilization systems significantly influenced soil structure. Manure and lime application increased index of soil structure, the mean weight diameter of crumb and water aggregate stability.

High rate of mineral fertilizers decreased the index of soil structure and the water resistance of soil aggregates in comparison to control treatment. The most favourable effect on soil structure exerted farmyard manure supplemented by limestone and mineral fertilizers.

Key words: long-term experiment, fertilization systems, soil structure, water resistance of soil aggregates.

THE FATE OF PHOSPHORUS IN THE SOIL AND THE BALANCE OF THIS ELEMENT IN LONG-TERM FIELD EXPERIMENTS

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Abstract

The phosphorus balance sheet for the years 1996–2009 was calculated, based on the results obtained in permanent field experiments carried on at the Experimental Station Skierniewice belonging to Life University. Field A with free crop rotation without manure and without leguminous crops, field D with rye monoculture without manure, and field E with a five-course crop rotation and manure application have been selected for these investigations. In

each field two treatments, without phosphorus and with phosphorus was taken into consideration. Balance sheet included the input of phosphorus in fertilizers, output in harvested plant products and changes in the total and/or available phosphorus in the soils.

In the fertilized treatment, the phosphorus surplus was recorded, which has been reflected in changes of the total and to a smaller extent in available phosphorus content. In the light soils showing low sorption capacity, about half of the phosphorus surplus migrated down the soil profile. In the control treatment, crops have taken up significant amounts of phosphorus from the not-readily-available forms, depleting both the topsoil and the deeper layers of the soil profile. Anyhow, the rates of total and available forms of phosphorus increases in the fertilized treatments were higher than the rates of its depletion in the control treatment. The migration of phosphorus surplus down the soil profile was the greatest in the rye monoculture, smaller in free crop rotation and the smallest in five-course crop rotation.

Key words: phosphorus balance sheet, total phosphorus, available phosphorus, long term experiments

CROP YIELDS AND NITROGEN BALANCE IN LONG-TERM FERTILIZATION EXPERIMENTS

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Abstract

The permanent field experiments have been carried on since 1923 at Experimental Station Skierniewice, belonging to Warsaw University of Life Sciences. In these fertilization experiments, the crop response to the withdrawal of nitrogen and/or phosphorus and potassium in relation to complete mineral fertilization (CaNPK, NPK) is investigated. Crops are grown in three rotations: arbitrary rotation without a leguminous plant and without manure, five-course rotation with a leguminous plant and with manure, and rye, or potato monoculture. Crop yields and changes in the soil chemical properties are published every 10-15 years. The paper concerns crop yields and nitrogen balance, in the last 15 years.

Key words: long –term field experiments, crop rotation, nitrogen balance

EVALUATION OF PLANT NUTRITIONAL STATUS BY THE CND METHOD: CASE OF SUGAR BEET

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Abstract

The CND-clr (Compositional Nutrient Diagnosis into centered log ratios) diagnostic norms were evaluated by analyzing nutritional status of sugar beet cultivated under different field conditions. Experiments were carried out in years 2001-2003 at commercial farms located in Czempin (Wielkopolska, Poland). The following factors were investigated: manure application (-FYM, +FYM), sodium rate (0, 12,5, 25 and 50 kg Na ha⁻¹) and type of the sodium fertilizer (NaCl, Na₂SO₄ and NaNO₃). For diagnostic purposes, leaf blades at the stage of 7th leaf (BBCH 17) and at the well-developed rosette stage (BBCH 43) has been analyzed. It has been shown that CND indices depended on the prevailing external conditions during the growing season and plant's growth stage. Experimental factors have exerted only a secondary effect on sugar beet nutritional status. Plants fertilized with sodium were characterized by best and lowest nutrient imbalance indices CND_{r2}, which resulted mainly from the highest share of sodium and low shares of calcium in the CND-clr complex. Relationships between nutrient concentration and whitesugar yields were affected by plant growth stage and weather conditions. The transformation of „pure” nutrient contents into CND-clr indices have

increased R_2 values for tested relationships. The best fit was obtained in the growth period, when the nutrient composition of leaves differed considerably from standard values. The positive role of sodium in sugar beet yielding, was pronounced mainly at BBCH 17, as compared to potassium, which revealed at BBCH 43. No significant interaction has been found for the pair „manure and Na treatments”. Furthermore, the obtained data have shown that on the treatment without manure, the application of sodium exerted a significantly more pronounced effect on $CND I_{Na}$ indices as compared to the treatment with manure.

Key words: sugar beet, sugar yield, CND method, sodium fertilization

YIELD FORMING EFFECTS OF CULTIVATION MEASURES IN LONG-TERM FERTILIZER EXPERIMENT ON GRASS SWARD

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Abstract

In over 40-year experiment localized in Czarny Potok near Krynica (20°54'53" E; 49°24'35" N) at an altitude of about 720 m a.s.l., the effect of diversified mineral fertilization on sward yield was investigated against the background of cultivation measures. The vegetation period in the area of the experiment lasts from April until September (150-190 days), and the weather conditions reveal a considerable rainfall variability. In order to present the results, the whole 42-year period of the investigations was divided into twelve stages according to conducted cultivation measures. The stage comprises the year in which the measure was initiated and the subsequent years, i.e. it's direct or residual effect. The level of fertilization had a marked effect on the crop yield but caused a slight shift in the time at which the highest yields were obtained. Among the cultivation measures the greatest diversification of yield, especially from the second cut was caused by two-year breaks in fertilization. Restoring the yield forming potential was associated with a high variability in the subsequent years. Liming or micro elements application stabilized or increased the yields in the long run but the restoration of the yield forming potential of the hay meadow based on mineral fertilization is difficult, particularly in conditions of intensive nitrogen fertilization.

Key words: long-term fertilizer experiment, mountain meadow.

DIAGNOSTICS OF FERTILIZATION REQUIREMENTS IN A SITE-SPECIFIC FERTILIZER MANAGEMENT

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Abstract

The paper presents selected results of the investigations carried out since 1997 in the Baborówko Experimental Station (near Poznań) belonging to the Institute of Soil Science and Plant Cultivation – State Research Institute in Puławy, Poland. The experiment has been conducted with the method of scientific observations. The experimental field of 50 ha area has been split into three plots on which winter rape, winter wheat and spring barley were grown in succession. On the area of the whole field, 403 observation points have been permanently marked using GPS device. In these points, every third year, the soil samples were collected from the plow layer. These samples were analyzed for pH, soil organic matter SOM and the content of available phosphorus, potassium and magnesium. Soil map has been drawn in the scale 1:500 and granulometric soil composition was estimated in the samples with laser method. Crop yields have been harvested by combine harvester provided with continuous yield meter and GPS device. The yield map prepared by the combine computer was

approximated to the yield in the observation points. In the paper, the results concerning soil analysis performed in 2008 years and the average yields of crops for the years 2000-2002 are presented. The main aim of the research was to calculate the relation between soil properties and the relation between soil properties and the crop yields, and to develop the maps of fertilizer rates with recognition of variation of soil properties within the experimental field. The doses of phosphorous, potassium and magnesium fertilizers were calculated based on spatial variability of nutrients content in soil and changeability of crop yields. Quantity of fertilizers used in compliance to the precision agriculture and according to a traditional system was compared. It was stated that the consumption of fertilizers in both systems has been very similar. However, differentiation of fertilizer's consumption in conditions of ES Baborówko was quite meaningful.

Key words: soil variability, scientific observation, site specific fertilization, variability of fertilizer rate, fertilizer utilization

USEFULNESS OF COMPOST FROM MUSHROOMS SUBSTRATE FOR FERTILIZATION OF MISCANTUS PLANTATION

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Abstract

At the Experimental Station in Skierniewice belonging to the University, three types of compost have been produced based on the mushroom substrate, remaining after the mushroom growing cycle. The first type is compost made exclusively from the mushroom substrate. The second type is the substrate mixed with sewage sludge, and the third one from the substrate mixed with cereal straw. The content of nutrients in composts was evaluated against nutrient requirements of one-year Miscantus crop. Application of composts in accordance with the guidelines of the Nitrate Directive would satisfy the nutrient demand of Miscantus for N, P, Ca and Mg at a yield of 20 t dry mass. ha⁻¹. However, the composts were poor in potassium what suggests supplementing them with this nutrient.

Key words: mushroom substrate, compost, Miscantus, sewage sludge

DIVERSITY OF MINERAL NITROGEN CONTENT IN SOIL IN THE REGION CLOSE TO NITROGEN PLANT IN PULAWY

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Abstract

The paper presents studies on the impact of environmental degradation caused by the emission and immission of gaseous and dust pollutants from the Nitrogen Plant in Pulawy on the content and dynamics of mineral nitrogen compounds in the soils of the surrounding area. Studies showed that in the transect SW ↔ NE the content of N-NH₄ and N-NO₃ in the soil varied depending on the distance from the emitter, soil depth layer, plant cover, the period during the growing season, and year of study. Along the distance from the emitter to 2500 m in the north-east (NE), content of mineral forms of nitrogen significantly decreased in the soil layer 0–5cm and to a lesser extent, in soil layer 5–20 cm.

Key words: N-NH₄⁺ and N-NO₃ - in soil, Nitrogen Plant in Pulawy, gaseous and dust Contaminations

METHODOLOGICAL PARADIGMS IN RESEARCH ON AGRICULTURAL CHEMISTRY FROM THE CREATION OF SCIENCE TO THE PRESENT DAY

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Abstract

In the paper paradigms of agricultural chemistry which occurred in the past, and after some time to a greater or lesser extent became obsolete, were presented. It was concluded that the achievements of the agricultural chemistry in the last 60 years, have been in close correlation with Polish socio-economic development. Today, the main paradigm of research and application in the field of agricultural chemistry as applied science is to conduct sustainable agriculture and sustainable nutrient management, which allow maintaining and even improving the quality and productivity of soils and crops.

Key words: agricultural chemistry, paradigms, science