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NEW APPROACH TO FERTILIZER RECOMMENDATIONS CONCERNING POTASSIUM CASE STUDY FOR POLAND

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Abstract

The first part of the paper presents results of laboratory research including 27 thousands soil samples from all over Poland on the content of water soluble K_{H_2O} and available Egner DL, K_{DL} soil potassium. The derivative soil parameters, i.e. potassium buffer capacity Q/I (as K_{DL}/K_{H_2O}) and simulated concentration of potassium in soil water at full water capacity, FWC is analyzed as well. The second part presents the new calibration figures for K_{DL} , based on water soluble potassium. These figures are lower than the officially used ones which make possible more economical potassium management. The new, preliminary approach to potassium fertilizer recommendation is described. The novelty of this system relies on splitting the system of recommendation into two stages. In the first stage plant potassium demands are established, and in the second one potassium fertilizer rates in relation to crop potassium uptake are given.

Key words: soil potassium, exchangeable potassium, potassium in soil water, potassium fertilizer recommendations

METHODS OF SOIL TESTING FOR AVAILABLE POTASSIUM CONTENT IN CENTRAL-EASTERN EUROPEAN COUNTRIES

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Abstract

Paper presents the preliminary results of the investigation on the usefulness of soils tests for available potassium, being in use in the Central-Eastern European CEE countries. The material for this evaluation consists of 132 soil samples originating from long-term field experiments carried on in 9 CEE countries. The samples were collected in each of 33 experiments from two soil layers and treatments with and without potassium fertilization. All tests of available potassium, i.e. exchangeable potassium, Mehlich, DL and CAL proved to be equally efficient for distinguishing the difference in potassium content between the experimental treatments. However, Mehlich test extracted the highest amount of potassium and showed the strongest correlation with exchangeable potassium, considered as a reference soil test. All tests in comparison have been strongly interrelated, and high correlation coefficients justify elaboration of recalculation coefficients from one test to another.

Key words: soil tests, available potassium, recalculation coefficients, long-term field experiments

INFLUENCE OF FERTILIZER USE ON THE CONTENT OF SOIL ORGANIC MATTER

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Abstract

Soil organic matter (SOM) is an important component of soil fertility. Its positive effects are long considered and universally accepted. Fertilisation is one of the most important factors influencing organic matter content in soils. The paper reviews the aspects of mineral and organic fertilisation management related to SOM, using data from long-term field experiments. In the Broadbalk Winter Wheat Experiment at Rothamsted (Great Britain) with continuous applications of mineral fertilizers

and farmyard manure (FYM), the content of SOM in FYM treated soils increased relative to that in mineral fertilizer treated soils. In the Market Garden Experiment, Woburn (Great Britain) four different types of organic manures have been applied. The content of soil organic carbon increased linearly with the increasing amount of organic matter added in manures. Results of the Continuous Rye Experiment in Halle (Germany) indicate an increase of soil organic matter through manure application and a very low increase through NPK application. Similar results are reported from the long-term fertilisation experiment in Martonvásár (Hungary). Manure application influenced strongly and mineral fertilization to a much smaller extent the content of soil organic matter. In the treatments without any fertilizer application, the content of SOM decreased. However, results of the long-term fertilization experiment in Gödöllő showed an increase of soil organic matter content under the influence of mineral fertilization. In another long term fertilization experiment in Keszthely (Hungary) the highest SOM content has been found for manure application, independently of the level of mineral nitrogen fertilization.

Keywords: soil, organic matter, carbon, organic fertilizer, mineral fertilizer

POSSIBILITIES OF THE DETERMINATION OF PLANT AVAILABLE SOIL POTASSIUM CONTENT

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Abstract

Paper presents the relation between amounts of potassium extracted from soils using 0.01 M CaCl₂ solution and ammonium lactate acetic acid AL. The last method is officially used in Hungary. Soil samples in the number 633 originate from the Hungarian Soil Information Monitoring System TIM and a long-term field experiment. Soils originating from TIM show very different properties and the correlation between both method of potassium extraction was moderate ($r=0,76$). Therefore, no general conversion coefficients from one method to another could be established for all soils. The amount of potassium extracted by AL solution was on average three times higher than extracted by CaCl₂ solution and this proportion increased with increasing clay content in soil. In more homogenous soils originating from field experiment the correlation between both method was much closer ($r=0,95$). Therefore, the CaCl₂ method reflects well the long term effect of potassium application.

Key words: soil potassium, 0,01 M CaCl₂, AL solution

EFFECT OF NITROGEN AND POTASSIUM FERTILIZING SYSTEMS ON MAIZE GRAIN YIELD

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Abstract

Potential productivity of maize is high, providing that supply of basic nutrients at critical stages of yield development is not limiting for its growth. In Poland potassium supply to maize plants is limited due to low K soil fertility level and/or unbalanced nitrogen application. In years 2001-2003 three series of field experiments were conducted on naturally K fertile soil to evaluate the effect of four potassium fertilizing systems on fertilizer nitrogen productivity. The highest nitrogen partial productivity factor has been obtained for crop grown on the K medium fertile plots but regularly fertilized with K. Under these K supply conditions, maize achieved a good state of balance between vegetative (mainly stems) and reproductive (cobs) plant parts, which, in turn allowed producing maximal yield of grain. Excessive supply of both potassium and nitrogen resulted in domination of vegetative plant

parts and in consequence, decreased grain yield.

Key words: potassium management systems, nitrogen fertilization, maize grain yield

EFFECT OF POTASSIUM FERTILIZING SYSTEM ON DYNAMICS OF DRY MATTER ACCUMULATION BY MAIZE

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Abstract

Rate of dry matter accumulation by maize at critical stages of plant development is highly sensitive to external growth factors and finally affects grain yield. In the years 2001-2003 field experiments were carried on two soils differing in content of available potassium (high H and medium M) with two levels of freshly applied potassium, 0 and 160 kg K₂O·ha⁻¹ with the aim to evaluate the effect of potassium supply on maize dry matter accumulation rate. The total, stems and cob biomass has been examined during the whole maize growing season. The analysis of the data, though showing high seasonal variability revealed three main critical phases of maize canopy growth. The progressive phase, up to the tasseling in which plants are developing the highest growth rate of total and stem biomass, plateau, which length is subjected to external factors and regressive one, in which cobs only are showing growth rate response. The second phase, deciding upon the structure of grain yield was significantly affected by potassium supply. Insufficient potassium supply accelerates or delays the occurrence of plateau phase and reduces the rate of dry matter accumulation by whole plant biomass or its particular part.

Key words: dry matter accumulation rate, potassium supply, critical stages of maize growth

EFFECT OF POTASSIUM FERTILIZING SYSTEMS ON MAIZE CROP NITROGEN MANAGEMENT DURING GRAIN FILLING

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Abstract

Grain yield of maize significantly depends of nitrogen management by the canopy during the whole growing season, both in the vegetative and reproductive period of growth. So far, the ripening part of maize vegetation is weakly recognized in the stay-green group of varieties. In order to evaluate maize crop nitrogen economy this particular period three series of annual field experiments was conducted in 2001, 2002 and 2003 years. Effect of increasing nitrogen rates on the background of interacted four systems of potassium management on total and plant part specific nitrogen accumulation at anthesis (stems, leaves, cobs) and at maturity (grain, stems, leaves, cob covering leaves, cob core) were evaluated. Total uptake of nitrogen at anthesis was slightly above 50% of total uptake at harvest, which amounted on average to 250 kg N ha⁻¹. Contribution of pre-anthesis N to grain N yield was low, as indicated by nitrogen translocation indices, in addition without any significant effect on final grain yield. Effect of the studied potassium management systems on N economy during ripening period of maize growth was treatment specific. Based on the obtained data it was possible to indicate the best treatment, i.e. the medium fertile soil currently fertilized with K as effective in grain yield production. Both lack of long term fertilizer potassium application and excessive application of both nutrients, i.e. nitrogen and potassium lead to excessive nitrogen uptake by a maize canopy as indicated by analysis of the unit nitrogen uptake index, which any increase resulted in lower N accumulation in grain, in turn negatively affecting yield of grain.

Key words: maize canopy, nitrogen economy, reproductive growth, yielding response

PRODUCTIVITY OF FODDER BARLEY AFFECTED BY NITROGEN FERTILIZATION AND WEATHER CONDITIONS.

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Abstract

The purpose of the study was to determine the effect of weather conditions under different nitrogen fertilization on spring barley (*Hordeum sativum ssp. distichon* L.) grain yield, yield components and quality. Moisture conditions were described by Sielianinow's index, called also conventional moisture balance or water provision index. The base of the study was the trial carried at the Grabów Experimental Station of the Institute of Soil Science and Plant Cultivation – National Research Institute in Puławy, Poland over the years 2005-2007. The results proved close relationships between the schedule of moisture balance during the vegetation period and grain yield and protein content. Profitable moisture conditions support the nitrogen effect and proper development of the components influencing final yield. Grain yield was determined by different components depending on the moisture conditions during the vegetation period. The highest grain yields in 2005 (4.4 t·ha⁻¹) was possible due to moisture conditions, which enabled the highest number of grains per spike and weight of 1000 grains. Grain yield in 2007 (4.1 t·ha⁻¹) was decided by the high number of spikes per area unit. The smallest yield in 2006 (3.5 t·ha⁻¹) resulted from dry conditions, which reduced number of spikes per area unit and weight of 1000 grains. In the wet 2005 year nitrogen efficiency calculated for one kg N ·ha⁻¹ was the highest and equaled to 26.6 kg grain, in 2007 year to 18.2 kg grain and in the dry 2006 year, of the poor barley productivity to 17.8 kg grain only. The optimal nitrogen rates, calculated as a rate securing 95% of maximal grain yield were 105, 55 and 82 kg N · ha⁻¹ in 2005, 2006 and 2007, respectively.

Key words: spring barley, moisture conditions pattern, nitrogen efficiency, grain yield, yield components, grain quality

PRODUCTIVITY OF TRITICALE AFFECTED BY NITROGEN FERTILIZATION AND WEATHER CONDITIONS

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Abstract

The purpose of the study was to determine the role of nitrogen under different weather conditions in yield formation of winter triticale. The main emphasis was put on the effect of interaction between nitrogen rate and moisture conditions in the vegetation period on the development of the grain yield components. The base of the study was an experiment carried on in the years 2004-2007 at Grabów Experimental Station of the Institute of Soil Science and Plant Cultivation – National Research Institute in Puławy, Poland. Moisture conditions were characterized by Sielianinow's index, called also conventional moisture balance or water provision index. The results confirmed close relationships between the moisture conditions in the vegetation period and grain yield. These conditions modify nitrogen availability for plants and its effect on development of the yield components, influencing final grain yield. Grain yield, due to the differentiated pattern of moisture conditions between study years was determined by individual yield components. The highest

grain yields in 2004 (9.1 t·ha⁻¹) was possible due to profitable moisture conditions in the whole vegetation period and good development of all yield components. Positive effect of nitrogen fertilization depended on limitation of the competition between the yield components. Smaller productivity in 2005 (6.8 t·ha⁻¹) resulted from worse moisture conditions, which reduced number of spikes per unit area and weight of thousand grains. The smallest yield (4.5 t·ha⁻¹) in dry 2006 occurred pursuant to the low productivity of a spike due to the limited number of grains per spike. Increase of yield in 2007 comparing to 2006 resulted from higher weight of thousand grains and number of grains per spike. The highest nitrogen efficiency, 50.3 kg grain·kg⁻¹N was recorded in wet 2004, while the moisture deficit in 2006 reduced nitrogen efficiency to 19.8 kg grain·kg⁻¹N. The optimal nitrogen rates, calculated as rates securing 95% of maximal grain yield amounted to 158 and 156 kg N·ha⁻¹ in wet 2007 and 2004 years, respectively and to 83 kg N·ha⁻¹ in dry 2006. In the 2006 year, the lowest nitrogen rates (30 and 60 kg N·ha⁻¹) proved to be efficient only.

Key words: winter triticale, moisture conditions, nitrogen efficiency, grain yield, yield components

EFFICIENCY OF MAIZE FERTILIZATION WITH NITROGEN AND POTASSIUM

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Abstract

In the field experiment carried on in the years 2004-2005 on sandy loam soil, response of maize to increasing rates of nitrogen 0, 100, 150 and 200 kg ha⁻¹ and two rates of potassium 0, 160 kg K₂O·ha⁻¹ has been studied. Grain yield of maize as well as other plant parts depended significantly on N rates but not on potassium fertilization. Optimum nitrogen rate calculated from 2nd order regression equation, securing 95 % of maximal yield (8,5 t grain ·ha⁻¹) was 100 kg N·ha⁻¹. It was corroborated by several post harvest N indices, i.e. agronomical and physiological N efficiency, N utilization coefficient and N harvest index.

Key words: soil K fertility, maize, harvest index, post-harvest N indices, optimal N

RESPONSE OF MAIZE VARIETIES TO INCREASING NUTRIENT INPUT ON THE BACKGROUND OF NATURAL SOIL FERTILITY

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Abstract

Grain yields of maize in Poland are much below yielding potentials of currently cultivated varieties. Main reasons of low yields and also their high year-to-year grain instability are poor soil fertility level and imbalanced fertilizing practices. In order to verify the formulated hypothesis, two soil agronomic complexes were used to test sensitivity of maize varieties to soil types: light and medium. Both tested soils presented the same current fertility level as, i.e. amounts of available nutrients (P, K, Mg). The basic set of two factorial experiment consisted of i) three varieties: 210, 240 and 260 FAO number, ii) four fertilizing treatments with increasing inputs of cations: NP, NPK, NPKMg and NPKMgNa. Variable weather courses in 2005, 2006 and 2007 years were another stressful factor for maize growth and yielding. Grain yields of maize cropped on medium soil were both higher and showed lower year-to-year variability as compared to those harvested on light soil. Plants grown on naturally poor soil responded significantly to fertilizers' input in years with mild (2005), but not with deep-water stress (2006), which totally depressed plant growth and yield. Plants grown on rich soil could overcome even severe water stress, but only under well supply of nutrients. The studied fertilizing strategies affected grain yields through

significant impact on the kernel number per cob. This plant characteristic showed a linear relation with grain yield on light soil and curvilinear, for maize grown on medium one. The latter response pattern allows defining maximum achievable yield in this particular site.

Key words: maize, fertilizer input, yield, elements of yield structure