

**39. Monograph Effect of fertilizing systems supporting nitrogen use efficiency on maize yield development** . Jarosław Potarzycki . < [jarekpo@up.poznan.pl](mailto:jarekpo@up.poznan.pl) > Department of Agricultural Chemistry, University of Life Science, Wojska Polskiego 71F, 60-625 Poznań

IMPROVING NITROGEN USE EFFICIENCY OF MAIZE BY BETTER FERTILIZING PRACTICES . Review .Jarosław Potarzycki.2010.39: 5-24

#### **Abstract**

Nitrogen use efficiency (NUE) in maize production in Poland is unsatisfactory, achieving for the period 1992-2008 level of 75 kg grain· kg N<sup>-1</sup>, whereas its maximum is much higher, amounting to 105 kg grain· kg N<sup>-1</sup>. Nitrogen use efficiency, NUE, is an index relating the harvested yield (biomass, grain) to a unit of nitrogen supply and/or assimilated in the harvested yield. Taking into consideration the whole course of plant growth this index can be split into three sub-units: nitrogen uptake efficiency, N<sub>UPE</sub>, nitrogen utilization efficiency, N<sub>UTE</sub>, nitrogen remobilization efficiency, N<sub>REE</sub>. There are two main ways for NUE improvement, breeding new, more efficient varieties and introducing better fertilizing practices. The first strategy requires full understanding the genetic backgrounds of nitrogen uptake by roots and nitrogen functions in increasing radiation use efficiency. The second strategy of NUE improvement relies on maize crop growth environment modification (soil pH, overall fertility level improvement) and on optimizing N rates and on balancing N with other nutrients supply. Band phosphorus application and soil or foliar application of magnesium, sulfur and zinc create fertilizing bases for substantially increase of nitrogen use efficiency.

**Key words:** maize, nitrogen use efficiency (NUE), stripe phosphorous application, foliar/soil magnesium application, foliar zinc application

YIELD FORMING EFFECT OF ZINC AND MAGNESIUM APPLIED AS SUPPLEMENTS OF THE NPK FERTILIZER TO MAIZE CULTIVATED IN MONOCULTURE .Jarosław Potarzycki 2010.39:25- 43

#### **Abstract**

Field trials with maize (var. FAO 240) cultivated in monoculture were carried out in five consecutive growth seasons from 2003 to 2007. The aim of the work was to evaluate the yielding response of maize fertilized with zinc (NPKZn) or magnesium (NPKMg) at the background of two nitrogen rates: 80 and 140 kg N·ha<sup>-1</sup>. The average maize grain yield (GY) over years amounted to 9.82 and 10.49 t·ha<sup>-1</sup>, for nitrogen rates 80 and 140 kg N·ha<sup>-1</sup> respectively. Zinc or magnesium supply significantly influenced GY, however in treatments with 80 kg N·ha<sup>-1</sup> [NPKZn (10.20 t·ha<sup>-1</sup>) ≥ NPKMg (9.89) > NPK (9.49)] only. In the treatment with 140 kg N·ha<sup>-1</sup>, yield increment due to zinc supply amounted to 0.36 t·ha<sup>-1</sup>. The multiple regression analysis with the choice of the best subset of independent variables (yield components) versus dependent variable (yield) revealed, that GY depended mainly on the thousand kernels weight (TKW), but in the NPK treatment, GY was a resultant of the interaction of all main yield components. TKW generally responded to N rate and Zn supply, but magnesium external supply is important to increase the seasonal yield stability. The results outline a possibility of significant nitrogen rate reduction provided external zinc and/or magnesium supply.

**Key words:** maize, fertilization, nitrogen efficiency, magnesium, zinc

YIELD FORMING EFFECT OF COMBINED APPLICATION OF MAGNESIUM, SULPHUR AND ZINC IN MAIZE FERTILIZATION .Jarosław Potarzycki. 2010.39: 44-59

#### **Abstract**

Intensive maize cropping requires including in the fertilization system the secondary nutrients and microelements as factors controlling nitrogen yield forming effect. The aim of the paper was to assess the yield forming effect of combined application of magnesium, sulphur and zinc in the background of different nitrogen rates in maize fertilization. Maize variety Eurostar (FAO 240) was cropped during years 2006-2008 after winter wheat. The following experimental factors have been studied: (i)

nitrogen rate [115 and 175 kg N·ha<sup>-1</sup>], (ii) fertilizer type, control (NPK), NPK +MgS (NPK + kieserite), MPK+MgS+Zn ( NPK + kieserite + zinc sulphate). A positive response of fertilizers on maize grain was detected as follows: NPK + MgS + Zn (9.83 t·ha<sup>-1</sup>) ≥ NPK + MgS (9.49) > NPK (8.86). The yield forming effect of fertilizers was more pronounced in treatments with the lower nitrogen rate. From the analysis of path coefficients established for the pairs grain yield (GY) and yield structure components (number of kernels on the cob – NKC) and 1000 kernels weight (TKW) it appeared, that the main determinant of GY was the NKC in the treatment NPK + MgS and NPK + MgS + Zn. In the control treatment (NPK), GY was shaped similarly by NKC and TKW. The yield forming effect of zinc resulted in the creation of efficient mechanisms of biomass translocation from developing leaves to kernels. Magnesium, sulphur and zinc increased not only nitrogen agronomical efficiency, but significantly reduced seasonal fluctuations of the efficiency of applied nitrogen fertilizers.

**Key words:** maize fertilization, magnesium, sulphur, zinc, nitrogen agronomical efficiency

#### **EFFECT OF INCREASED INPUT OF FERTILIZERS BALANCING NITROGEN ON NUTRIENTS ACCUMULATION BY MAIZE AT MATURITY** Jarosław Potarzycki. 2010.39:60-77

##### **Abstract**

Amount of nutrients in maize plant and their redistribution among plant parts at maturity are important, mainly for silage and grain quality assessment and also for post-harvest plant nutritional status assessment, describing ex-post growth conditions in the season. In order to evaluate the second main objective in the years 2007 and 2008 series of field experiments including two factors: i) N rates of 115 and 175 kg N ha<sup>-1</sup> and ii) increased input of fertilizers aimed at balancing N fertilizer: NPK, NPK+MgS, NPK+MgS+Zn were carried on. The study revealed that N balance can be achieved providing that N fertilizer rate is sub-optimal. Under these conditions phosphorus supplies to maize plants was the main limiting growth factor. Its efficiency was affected by supply of magnesium and zinc. Under a condition of excessive supply of nitrogen, nitrogen imbalance can be however partly controlled by sufficiently high supply of potassium and magnesium. Nutrient relationships in maize leaves at harvest can be used as a useful indicator of nitrogen balance.

**Key words:** maize, nutrients accumulation, nitrogen balance, yields diagnosis

#### **THE IMPACT OF FERTILIZATION SYSTEMS ON ZINC MANAGEMENT BY GRAIN MAIZE.** Jarosław Potarzycki. 2010.39: 78-89

##### **Abstract**

Maize is one of the most sensitive crops to zinc supply. The hypothesis has been formulated that this micronutrient exerts a strong effect on maize at the critical stage of kernels set up, in turn affecting final grain yield. This hypothesis was verified in two factorial field experiment including following factors: 1<sup>st</sup> two N rates: 115 and 175 kg N·ha<sup>-1</sup>, 2<sup>ed</sup>. three forms of basic fertilization: NPK, NPK+MgS, NPK+MgS+Zn. Zinc concentration in cob core was much higher than in other maize parts. Slightly more than 50% of accumulated zinc was found in grain, which showed a significant response to increasing input of basic fertilization. Under sub-optimal rate of nitrogen application total accumulated zinc in maize crop affected grain yield in accordance to linear model, whereas under supra-optimal N supply followed the quadratic model, thus indicating lower N efficiency. The linear response of maize to the total amount of accumulated zinc was related to increasing physiological sink capacity of maize cob, as indicated by significant effect of zinc content in stem on the kernel number per cob.

**Key words:** maize parts, zinc accumulation, yield response, kernel number per cob

#### **INFLUENCE OF BALANCED FERTILIZATION ON NUTRITIONAL STATUS OF MAIZE AT ANTHESIS** Jarosław Potarzycki. 2010.39: 90-109

##### **Abstract**

In the two-factorial experiment carried out in 2007 and 2008 the first factor was nitrogen fertilization levels, 115 and 175 kg N· ha<sup>-1</sup> and the second one balancing fertilizing treatments, NPK, NPK+MgS, NPK+MgS+Zn. At the BBCH 65 stadium (anthesis) samples of ear leaves were collected and analyzed for the concentration of N, P, K, Ca, Mg, Zn, Cu and Mn. Plant nutritional status was estimated by the DRIS indices and N/nutrients ratio. The only elements, whose concentrations in the

ear leaf were affected by both fertilizing factors, was nitrogen and zinc. In spite of the high concentration of nitrogen in the maize leaves the influence of this element on the maize grain yield was limited if the remaining nutrients have not been properly balanced. It was concluded that in spite of the high concentration of nitrogen in the maize leaves during anthesis, the yield generating influence of nitrogen can be disrupted if the remaining mineral nutrients are not properly balanced. The concentration of nutrients (N, Zn and Mn) in the ear leaf proved to be the best universal indicator for yield forecasting. It was followed by the ratios of nitrogen to other nutrients (N/K, N/Mg and N/Zn). In the conditions of imbalanced fertilization resulting from the exclusive use of nitrogen, phosphorus and potassium (NPK), too divergent values of nitrogen to the zinc (N/Zn) ratio in the maize ear leaf results in grain yield decrease due to the lower number of kernels per cob. In the context of the grain yield forecasting, the DRIS indices proved to be least useful. The only exception is the values of indices for nitrogen, which can characterize the grain yield at the significance level of  $P < 0.001$ .

**Key words:** maize, balancing fertilization, DRIS indices, N/nutrient ratio, ear Leaf

**YIELD FORMING FUNCTIONS OF ZINC IN MAIZE CROP .REVIEW PAPER .Jarosław Potarzycki. 2010.39: 109-128.**

**Abstract**

The paper assesses the state of knowledge in the field of physiological and yields forming role of zinc in maize fertilization. Two critical stages of plant zinc uptake in maize are singled out, prior to 9-leaf stage BBCH 19 and at the blister stage of the kernel development BBCH 70-71. The role of zinc was analysed in the context of affecting the yield structure of maize determined by the number of kernels in the cob and the weight of 1000 kernels. On the base of the literature data as well as own studies, it has been concluded that zinc fertilizers in maize should be applied quite early i.e. before sowing or up to the 3-4-leaf stages BBCH at the latest. The possibility of control the structure of maize yield has also been discussed. The effective control depends on time of zinc application and the choice of proper zinc fertilizer in a given application time. The later concerns both chemicals as well as a physical form of the zinc fertilizer. Yield forming role of zinc should be analyzed in terms of nitrogen management because if maize is well provided with zinc, the rates of nitrogen fertilizers can be reduced. The last part of the paper indicates the need for further detailed studies on maize fertilization. These studies should be targeted at the role of zinc in maize plant nitrogen metabolism, role of zinc in the formation of maize root system and possibilities of using zinc fertilizers in combination with herbicides.

**Key words:** maize, zinc fertilization, interaction of zinc and nitrogen