

EVALUATION OF THE OPTIMUM NITROGEN FERTILIZER DEPENDING ON THE NITRATE CONTENT OF THE SOIL IN SWEET CORN PLANTATION

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Introduction

The soil nutrient-analysis results only gain physical meaning by being calibrated. We can get results directly utilizable in practice if the calibration is carried out in small plots. The field has to be chosen in a way that its nutrient supply, which calibration is targeted on, be low. We have to form plots where the nutrient supply to be calibrated varies from very poor to the exaggerated, whereas the supply of all the other nutrients is the same, abundant on all the plots. Using calibrating method for the soil-analysis, calibration is achieved with regard to the given plant grown on the experimental plot, if soil-analysis values are represented on the horizontal axis, whereas the production goal are represented on the vertical axis. Calibration trials enable us to separately study the effect of soil supply and fertilization on the yield. The nutrient delivered by fertilization acts differently than the soil supply prior to fertilization. There exist several 'good' supplies, i.e. such where it is not necessary or even forbidden to fertilize; the corresponding yield, however, can be very different (Buzás, I. 2002).

Methods

Our research was carried out in 2004. and 2005. at the Kiszfai Research Farm of Kecskemét College in calcareous sandy soil with humus, in sweet-corn plantation.

The arranging of the trial is a two-factor stripped split-plot with four repetitions. The nitrogen supply (factor a) of the main plot's soil was set for various levels with the help of the ammonium-nitrate fertilizer given in the autumn prior to the sowing. The amount of nitrogen per hectare delivered for these purposes was in 2003. 0, 50, 100, 150 kg, in 2004. 0, 150, 300, 450 kg. Within the main plots 5-5 small plots were formed, which – in both test years, in spring before sowing – received 0, 50, 100, 150, 200 kg nitrogen amount (factor b) per hectare in the form of ammonium-nitrate.

The harvest was carried out by hand, the corn ear was measured, and 40 ears were picked per plot. The percentage rate of the corn husks and grains, the grains and corn cob, the grain moisture and composition of grains were defined based on the sample. The sweet-corn samples were processed by us with the help of the equipment of the Kecskemét Cannery Ltd.; the moisture of the grains was defined by the laboratory of the Kecskemét Cannery Ltd.

Results and discussion

The sweet corn yield per plot based on the average amount of fertilizer was represented in order to determine with the nitrate content of which soil layer the corn yield correlates. The figure 1. obviously presents that the nitrate content of the upper layer and the corn yield shows correlation. No correlation was found between the nitrate content of the lower layers and the yield. This finding is surprising and leads to the conclusion that the yield of the sweet-corn is determined even before its roots would take up nitrogen nutrient from the layer beyond 34 centimetres.

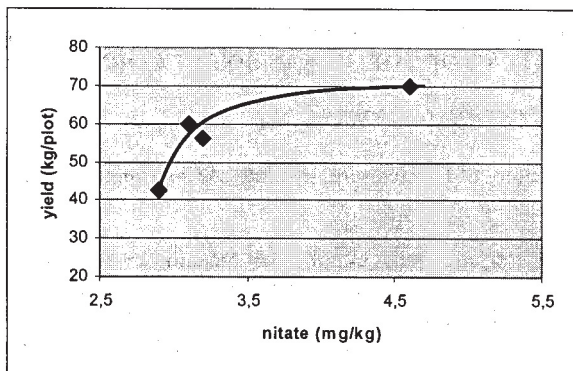


Fig. 1. Connection between yield and nitrate content of the soil in 0-34 cm

The yield results show that on soil poorly supplied with nitrogen even with the highest amount of N-fertilizer (200 kg N ha^{-1}) we could not achieve the same yield as the soil well-supplied with nitrogen ($4.6 \text{ mg NO}_3\text{-N kg}^{-1}$ soil) produced without N-fertilizer or with the smallest amount of fertilizer (50 kg N ha^{-1}). The same was found with the husked cob per hectare.

The grain percentage, i.e. the rate of the grain weight expressed in the husked corn ear's weight percentage, changes due to the nitrogen supply as is represented in figure 2. The figure clearly shows that on soil poorly supplied with N, the increasing amount of N-fertilizer after a while reduces the grain rate, however, starting off from good N-supply, the good grain percentage can further be increased with N-fertilization.

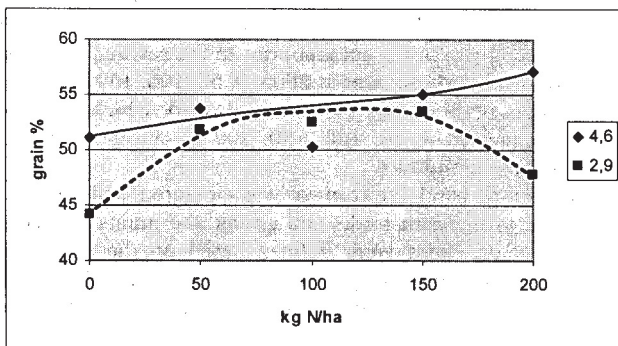


Fig. 2. Changes of grain % depending on the fertilizer with 2,9 and 4,6 mg kg^{-1} nitrate content of the soil

Depending on the $\text{NO}_3\text{-N}$ content of the soil before fertilization, it is also true for the grain-dry matter rate that the maximal yield achieved with nitrogen fertilization can vary. At $2.9 \text{ mg NO}_3\text{-N kg}^{-1}$ soil nitrogen concentration, using the biggest amount of fertilizer (200 kg N ha^{-1}) the same yield was achieved as when no fertilizer was applied at $4.6 \text{ mg NO}_3\text{-N kg}^{-1}$ starting nitrogen concentration. Consequently it is not enough to give only one calibration curve. The calibration curve in figure 3. shows how much grain-dry matter yield is expected on $2.9 - 4.6 \text{ mg NO}_3\text{-N kg}^{-1}$ soil range, on soils of various nitrogen supply, using 0-200 kg nitrogen fertilizer in spring.

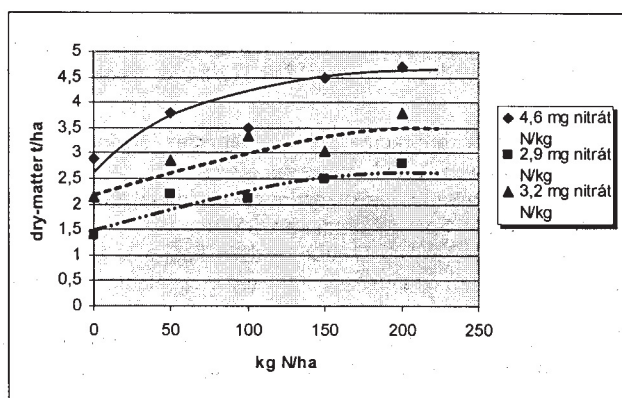


Fig. 3. Calibration curves with different N-supply show the expectable grain-dry matter produce

Conclusions

We stated that quantitative and qualitative indices of the sweet-corn yield correlate with the nitrate-nitrogen content of the upper layer of the soil, up to 0-34 cm. Since we did not find correlation between the nitrate-nitrogen content of the lower layers and the sweet-corn, we came to the conclusion that the success of the sweet corn yield is determined before its roots would reach beyond the depth of 34 cm and the nitrogen content of the lower layers could have had an effect on the sweet-corn.

We also found that – depending on the $\text{NO}_3\text{-N}$ content of the soil before fertilization – the maximal corn ear achievable with fertilization can vary. At the smallest analyzed soil nitrogen concentration ($2.9 \text{ mg NO}_3\text{-N kg}^{-1}$), using the highest amount of fertilizer (200 kg N ha^{-1}) – but also probably with any amount of fertilizer – we cannot achieve the same yield as on soil of $4.6 \text{ mg NO}_3\text{-N kg}^{-1}$. This phenomenon, i.e. in case of various soils, on soils with better production features the maximal yield achievable through fertilization is bigger than in case of worse features, is well-known. The fact that in the case of same soils (i.e. those that only differ from each other in calibrating soil test values) it is also possible was expected after the calibrating experiments carried out by T. Németh and I. Buzás on winter oilseed rape, later on by L. Kulcsár on beet root in Sopronhorpács (Kulcsár, L. – Buzás, I. 1996, 1997; Kulcsár, L. 1998, and Buzás, I. 2002); and it has not been proved on sweet-corn yet.

We found that the sweet-corn's grain-dry matter production per hectare can still be enhanced with the increase of the soil's nitrogen supply even if the corn ear does not grow.

We produced such calibrating curves that – in the $2.9 - 4.6 \text{ mg NO}_3\text{-N kg}^{-1}$ soil range – show how much corn ear and grain-dry matter produce are expected on soils of various nitrogen supply, delivering 0-200 kg nitrogen fertilizer in spring.

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