

# DIFFERENCE OF MACROELEMENTS CONTENT BETWEEN VARIANTS WITH APPLICATION OF DIGESTATE AND CALCIUM AMMONIUM NITRATE DURING VEGETATION SEASON - PERMANENT GRASSLAND

SIMECKOVA JANA, JANDAK JIRI

Department of Agrochemistry, Soil Science, Microbiology and Plant Nutrition  
Mendel University in Brno  
Zemedelska 1, 613 00 Brno  
CZECH REPUBLIC

jana.simeckova.uapmv@mendelu.cz

*Abstract:* Nutrients are very important for crop production. Our agriculture would not exist without external inputs of nutrients. The external inputs of nutrients are provided fertilizers. We have the opportunity to choose from a large number of fertilizers. With the expanding amount of biogas production is increasingly applied by-product of their activities (digestate) to the soil as fertilizer. This article describes the differences content of macroelements and pH/KCl between variant with digestate and calcium ammonium nitrate by vegetation cover permanent grassland. These results were taken from a field trial. It can state that it was found statistical significant differences between contents of macroelements and pH/KCl too.

*Key Words:* digestate, calcium ammonium nitrate, macroelements, permanent grassland

## INTRODUCTION

Our modern lifestyle is reliant on the electric energy. Currently, it is the shift from fossil fuels to renewable biomass resources. And the interest in using renewable energy sources is constantly increasing (Galvez et al. 2012). Ragauskas et al. (2006) wrote it is the development of a sustainable society and an effective management of greenhouse gas emission. Moreover, majority of European countries are component of EU. The recent EU policies regarded renewable energy. It resulted in the increase of the number of operating biogas plants (Concil directive 2009/28/EC 2009).

But, it is likely that the intensification of production bio-energy will produce considerable amounts of by-products and will pose the problem of their disposal (Galvez et al. 2012).

It exists the idea: we can apply by-products in soil. Van Camp et al. (2004) justifies it, that it may represent an effective strategy to tackle the widespread loss of soil organic matter acknowledged in the last decades.

The proper plant nutrition is very important for crop yield. In the shortage of particular nutrients the plant suffers and reflects it to a lower yield. The shortage of relevant element is reflected on plant. (Vaněk 2007)

The literature contains many studies focusing on the fate of N in soil, the fertilizing capacity of N for plants after the distribution of digestate or the fertilizing capacity of P (Bachmann et al. 2014, Grigatti et al. 2015, Grigatti et al. 2011, Gunnarsson et al. 2010, Vanden Nest et al. 2014). While the fertilizing capacity of macroelements have been less studied (Galvez et al. 2011, Garcia-Sánchez et al. 2014)

In our investigation, a field trial was used to obtain the results the changes of macroelements content – phosphor, potassium, calcium and magnesium and the changes of pH/KCl. The applied fertilizers were digestate and calcium ammonium nitrate. The differences were observed during the growing season 2014, vegetation cover was permanent grassland.

## MATERIAL AND METHODS

### Characterization of growing locality

The soil samples were taken from a field trial. The field trial was established on the place of Research grassland station Vatín – Faculty of Agronomy, Mendel University in Brno, Czech Republic in the spring of 2014. Vatín is located 49° 31' N and 15° 58' E, around 60 km NW of Brno, 5 km S of Žďár nad Sázavou. The elevation of the research station is 540 m above the sea level.

The soil type is Dystric Cambisol Loamic; parent material is gneiss (Bugnerová 2013, IUSS Working Group WRB 2014). Cambisol is the most widespread soil type in the Czech Republic (Tomášek 2007). These soils are developed in humid environments. Chemical and physical properties are varied. This is affected by soil organic matter content and soil texture. (Němeček et al. 2011)

### Experimental design

It was applied two fertilizers on the vegetation cover permanent grassland (meadow mixture + clover grass mixture with the ration 2:1). One plot had 10 m<sup>2</sup>. The fertilizer managements are: mineral fertilizer – calcium ammonium nitrate (CAN) and digestate (D).

The fertilizers were applied in a dose 150 kg · ha<sup>-1</sup> of N. The dose was divided into two – the first dose was in the spring and it was 60% of total delivered N. The second dose was in the June and it was 40% of total delivered N. The element phosphor and potassium were added to variant of CAN based on chemical analysis of the digestate. In this it should provide single input elements – nitrogen, phosphor and potassium. It is important for evaluation further results of field trial.

The soil samples were taken by probing rod to the depth 0.30 m in May (one month after first application of fertilizers), July (about one month after first application of fertilizers) and September 2014.

*Table 1 Properties of applied digestate*

Properties	Digestate 1	Digestate 2
N total	0.44	0.56
P	0.08	0.08
K	0.50	0.56
Ca	0.13	0.13
Mg	0.09	0.07
pH	7.84	8.21

*Legend: Digestate 1 – digestate applied in spring; Digestate 2 – digestate applied at July*

### Laboratory

The soil samples were processed standardized procedure on the fine earth (Zbiral et al. 2010). Using of Mehlich III we got the results about content of macroelements: phosphor, potassium, calcium and magnesium (Mehlich 1984). Part of assay is the measurement of pH. It was determined in potassium chloride (KCl) (Zbiral 2002).

### Statistic

The data obtained were subjected to Shapiro-Wilkův W test for the identification of normal distribution of data. Subsequently, t-test was used at significance level  $\alpha = 0.05$  using the Statistica 12 program (StatSoft, USA).

## RESULTS AND DISCUSSION

The changes during the growing season are observed by individual macroelements. It is natural change as a result of the growth of vegetation. On the one hand, the variants had the same dose of nitrogen, phosphor and potassium. But on the other hand, the differences by content of these macroelements were found for same lab results. May be due to various accessibility elements for plants used fertilizers (Vaněk 2007).

The content of individual macroelements and pH/KCl are showed on the Figure 1.

Both, digestate and calcium ammonium nitrate, had similar the progress content of potassium and calcium. But in all cases, it had a higher content at fertilizer management with D. The differences were statistically significant.

On the other hand, fertilizer management with CAN had higher content of phosphor (the dose of this element was the same for both fertilizers). The reason why this situation arises because of the element phosphor can be more releasing from digestate. Following, it is very risk for natural. The surplus of phosphor can lead to eutrophication of water. Chiew et al. (2015) draw attention to the danger.

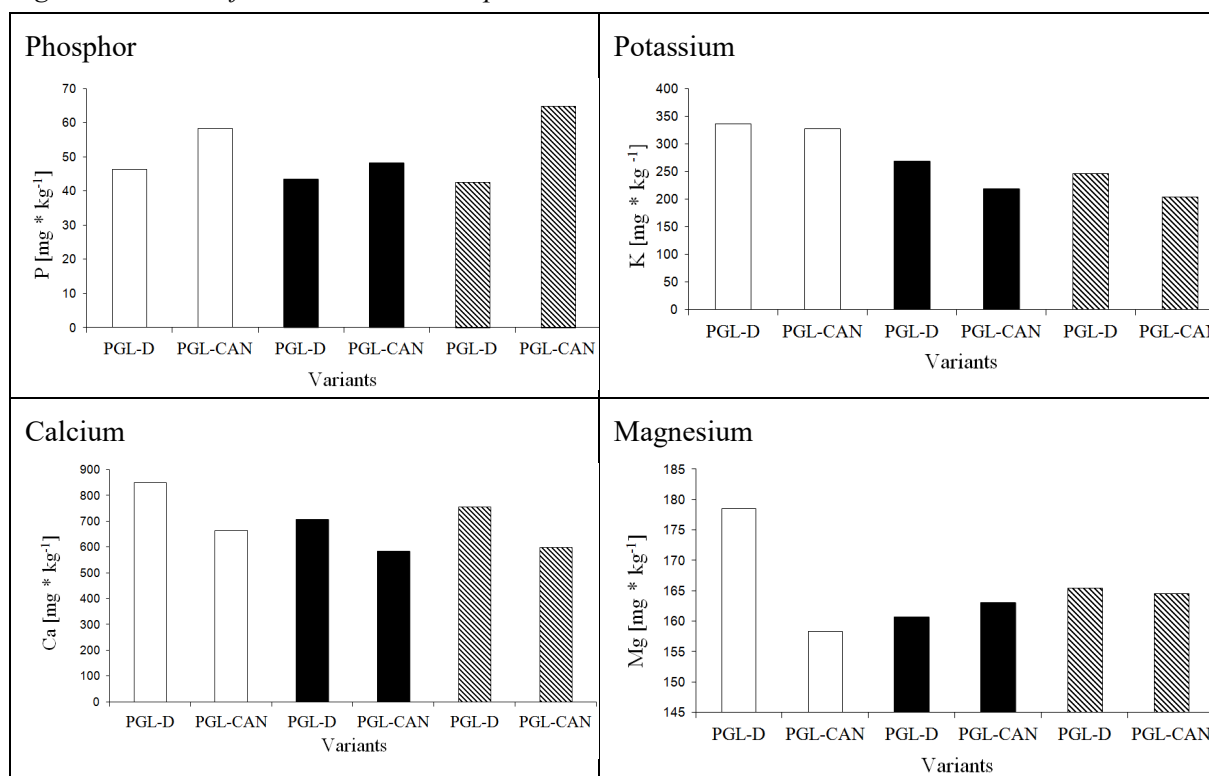
At higher Mg content was found after application of the fertilizer D in May. In the following two samplings the content was levelled.

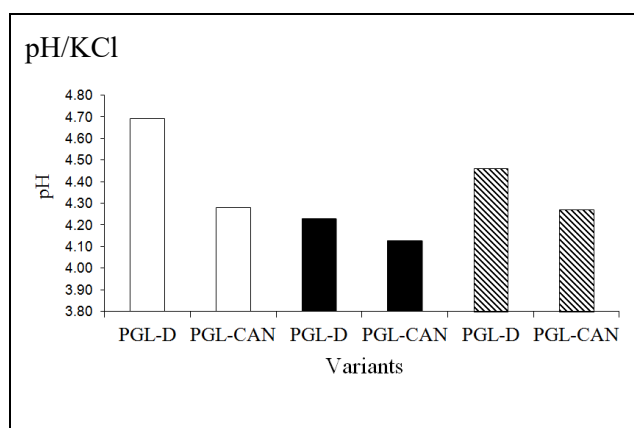
The pH is very important for plants. From the Figure 1 it is seen that the variant with D had higher value of pH during all vegetation season. The differences were statistically significant. Therefore, the digestate may be recommended for acid soil. On the other hand, in the classification of the soil stayed in the group strongly acid to acidic. But, Chiew et al. (2015) went to a different conclusion – they assert that chemical fertilizers proved to make less acidification than digestion of the food waste and use of the digestate as fertilizer. One possible solution is, how Grigatti et al. (2015) say, digestate application is not so easy because every digestate type shows different features. Of course, every soil type reacts differently.

But, the digestate application is not so easy because every digestate type shows different features (Grigatti et al. 2015). So, long-term monitoring and in-depth analysis of the fertility of soils that are amended with digested slurries are required (Bachmann et al. 2014).

According to applicable laws of the Czech Republic for agrochemical soil testing for permanent grassland the content of phosphor by D is satisfactory, but CAN even good. The content of potassium was high for both fertilizer management and throughout the growing season. The content declined during year and was in category good. The content of magnesium was during vegetation season 2014 in category good. (Regulation no. 275/1998 Coll.)

Figure 1 Content of macroelements and pH/KCl





Legend: PGL – permanent grassland, D – digestate, CAN – calcium ammonium nitrate

□ May 2014      ■ July 2014      ▨ September 2014

## CONCLUSION

Contemporary agriculture depends on external inputs. The yield without them was unsatisfactory. Thanks to a new understanding of nature, there are also new opportunities of fertilization.

As a result, both fertilizer managements can be used for nutrition of permanent grassland. Both managements provide sufficient nutrition of permanent grassland.

It can be very interesting to observe changes of pH. The digestate analysis and our results suggest that digestate could move higher soil reaction.

Although both variants of fertilizer management got the same dose of phosphor and potassium, but were statistically significant differences at some sampling terms. It suggests a difference at availability and possibly escapes the elements in the soil depending on various fertilizers.

## ACKNOWLEDGEMENT

The research was financially supported by the IGA – Internal Agency Faculty of Agronomy MENDELU No. IP 28/2015.

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