EXAMINATION OF AN ALTERNATIVE WAY TO PREVENT NITRATE LEACHING IN SOIL BY USING GLYCEROL AS A BIODIESEL BY-PRODUCT

László Tolner, Gabriella Rétháti, Attila Kovács

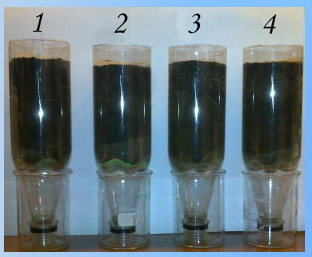
Department for Soil Science and Agricultural Chemistry, Szent István University, Gödöllő, Hungary

Abstract: Using nitrogen fertilizer can be a potential contamination to ground water. In general, disposal of an industrial by-product is a potential pollution. There are such cases, when two potential pollutants can extinguish each other harmful effect. Contaminated glycerol as a by-product from biodiesel production is available in increasing amounts. The conventional utilization of glycerol can not be substantially increased, therefore investigation of alternative ways of usage should be searched for. The contamination content of the glycerol by-product mainly consist of useful materials from plant seeds and potassium hydroxide catalyst. Glycerol such as sugars represents an easily accessible source of energy for microorganisms in soil. It is well known that if nitrogen poor organic matter (e.g. straw) added into the soil, it can cause, through assistance of microbes, temporary reduction of the nitrogen supply. Our experiment was performed in small scaled soil columns. Different treatments were applied on a sandy soil. Nitrate leaching can be significantly decreased by using glycerol treatment.

Materials and methods

The experiments were carried out using two types of soil columns. The first type of columns (diameter: 6 cm, length: 10 cm) contained 400 g soil (C1) (Figure 1.), the second type of the columns (diameter: 4 cm, length: 3 cm) contained 80 g soil (C 2).

Figure 1. The columns (C1)



A sandy soil from Fót was applied for treatments. The main properties of this soil: saturation percentage, K_A = 28.33, lime content, $CaCO_3$% = 8%, pH(H_2O) = 8.2, humus content, H% = 1.4%., AL-P_2O_5 = 95 ppm, AL-K_2O = 120 ppm.
The solution were: 1000 mg N dm-1 KNO_3 (7.221 g of KNO_3 were dissolved in 1000 cm^3 solution) and glycerol 5% C content (128.6 g 95% glycerol in 1000 cm^3 solution). Four types of treatment were used (Table 1.).

Table 1. The treatments of the first type of soil columns (C1)

Treatment	N ppm	N-sol. cm^3	C %	G-sol. cm^3	DV cm^3
1. Control	0	0	0	0	100
2. N	100	40	0	0	60
3. Glycerol	0	0	0,5	40	60
4. N+glycerol	100	40	0,5	40	20

The treatments of the second type soil columns (C2) were similar to first type soil columns (C1).
The columns were leached with 100-100 cm^3 distilled water (C1) and 40-40 cm^3 distilled water (C2) for 3 days. The nitrate and glycerol contents were measured in the effluent solutions. After 3 days this method was repeated using half dose of distilled water.
The nitrate content was determined by diphenylamine test. The glycerol content was determinate with refractometer (CARL ZEISS F1). We used a program for ANOVA which made by Tolner in Microsoft Office Excel.

Results and discussion

The experimental dates of two types of soil columns (C1 and C2) were evaluated using two ways ANOVA. The nitrate-N concentrations are in ppm ($mg.dm^{-3}$) unit (Figure 2.).

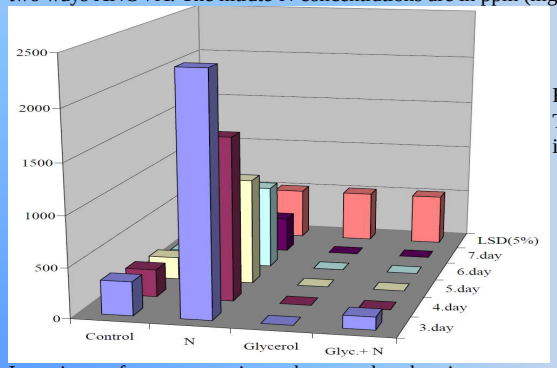


Figure 2. The nitrate content in the effluent solutions

Investigate of treat means it can be seen that the nitrate content in the effluent solutions decreased using glycerol treatment. The effect of the N treatment was reduced significantly (5% probability) by glycerol (Glyc.+N). The glycerol treatment reduced the effect of the control treatment significantly (10% probability). The time means show decreasing tendency (5% probability).
The glycerol was not measured in effluent dilution of soil columns which did not get glycerol treatment. The glycerol-C contents in effluent solutions are in Figure 3.

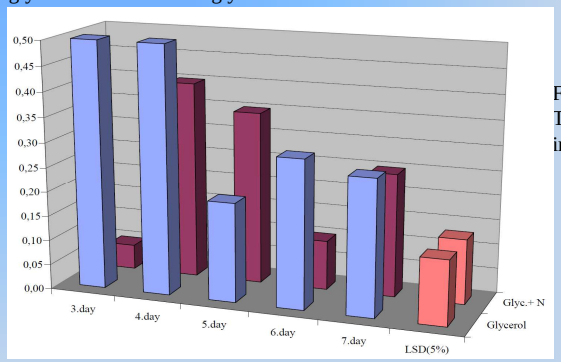


Figure 3. The glycerol-C contents in effluent solutions

The leaching of glycerol was blocked by the soil . The slow effect significantly forced by the effect of nitrogen treatment. Because of nitrogen treatment the mean concentration of leached glycerol were reduced from 0.36% to 0.23% (LSD5%=0.06%) and the glycerol content appeared in the effluent solution one day later (LSD5%=0.13%).

Conclusions

In summary, the glycerol treatment significantly reduced the flow of nitrate through the soil column. Nitrate treatment reduced the effluent glycerol content. Both effects suggest that the treatments provided favourable conditions for microbial activity, so the nitrogen immobilized totally and the glycerol immobilized partially.

Acknowledgements This work was supported by Hungarian Development Agency (NFÜ) TECH-09-A4-2009-0133, BDREVAM2