

THE EFFECT OF BACTERIA FERTILIZERS ON THE NITROGEN AMOUNT EXTRACTED BY THE YIELD OF PERENNIAL RYEGRASS (*LOLIUM PERENNE*) ON DIFFERENT SOIL TYPES

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Abstract

*In our comparative experiment we studied the effect of bacteria fertilizers Bactofil A10 and Biorex 1 and 2 on the nitrogen amount extracted with the yield on three soil types (a chernozem from Debrecen – Látókép, an acidic sandy soil from Nyíregyháza and a neutral sandy soil from Józsa) with perennial ryegrass (*Lolium perenne* L.) as a test plant. From our results it can be stated, that the nitrogen amount extracted by the yield is the highest in plants grown on the sandy soil from Nyíregyháza, while it is the smallest in plants grown on the sandy soil from Józsa.*

Bacteria fertilization increased the nitrogen amount extracted by ryegrass on the calcareous chernozem soil (Látókép). This effect was also proven by the statistical analysis. On this soil type the different bacteria fertilizers had similar positive effect on nitrogen mobilization.

On the sandy soil from Nyíregyháza adding Bactofil A10 resulted in a significant reduction of the extracted nitrogen amount. The bacteria fertilizer product Biorex has not any positive effect either. As our results show, on this acidic soil type with such low humus content, the bacteria that got into the soil with the fertilizer could not proliferate, therefore they couldn't fulfil their biological tasks.

On the neutral sandy soil from Józsa with low humus content, the bacteria fertilization increased significantly the nitrogen amount extracted with crop plants from soil. A statistically significant positive effect was proven in case of the application of Bactofil A10 and Biorex1-2 fertilizers as well. As our results show, on this soil type there is no need to apply a higher dosage of fertilizer for enhancing the nitrogen mobilization. In our experiment the fertilizer Biorex-2 had a higher effect on the extracted nitrogen amount, than the recommended combination of Biorex -1 and -2 fertilizers. The reason for that is

probably the application of for the nitrogen cycle important bacteria species that are applied to soil with Biorex-2.

Keywords bacteria fertilizers, extracted nitrogen amount, perennial ryegrass

INTRODUCTION

The genetic properties of our crop plants, ecological circumstances and plant nutrition determine mainly the quality and quantity of the yield. Previously the nutrient extracted from the soil with the yield were returned to the soil as chemical fertilizers – besides manure – but their inefficient application could as well be harmful for our environment (Loch and Nosticzius, 1992). Nowadays plant producers are striving to reduce the amount of chemical fertilization – in accordance to soil protection principals – and to substitute it with manure and bacteria fertilizers, that are also accepted in biological farming (Nagy P.T., 2006).

I In recent years – also in Hungary – the application of environment friendly farming methods, that reserve or even amend the soil fertility without – or with a reduced amount of – chemical fertilizers (Shen, 1997; Zsuposné, 2007; Kátai, 1995).

Regarding the environment friendly farming methods, the focus is even more on the activation of the natural ecosystem in the soil, mainly of microorganisms. Applying bacteria fertilizers, by adding from the aspect of nutrient supply important bacteria species to the soil, the microbial population of soil can be richer and more complete, therefore mobilization processes in the soil will be accelerated. So plant producers use these special bacteria fertilizers on even larger area (Makádi, 2007).

MATERIALS AND METHODS

Our experiment with perennial ryegrass (*Lolium perenne* L.) as a test plant was set up in the greenhouse of the Department of Agricultural Chemistry and Soil Sciences of the University of Debrecen, Centrum for Agricultural and Technical Sciences, Faculty of Agronomy. We set up it in the spring of 2008 with 7 treatment combinations and in 3 replications on calcareous chernozem soil from Debrecen – Látókép, and on sandy soils from Nyíregyháza and Józsa. The main physical – chemical properties of the soils are shown in Table 1.

Table 1.

The main physical – chemical properties of the soils

| | Látókép | Nyíregyháza | Józsa |
|--|---------|-------------|-------|
| pH(H ₂ O) | 6.7 | 4.4 | 7.2 |
| pH(KCl) | 5.9 | 3.8 | 6.9 |
| pH(CaCl ₂) | | | |
| Humus (%) | 2.5 | 0.7 | 0.6 |
| K _A | 42 | 31 | 27 |
| AL- K ₂ O (mg.kg ⁻¹) | 198.8 | 259.6 | 97.4 |
| AL- P ₂ O ₅ (mg.kg ⁻¹) | 77.2 | 87.7 | 129.7 |
| AL-Ca (mg.kg ⁻¹) | 3343 | 1909 | 1262 |
| AL-Mg (mg.kg ⁻¹) | 361 | 44 | 43 |

We put 1 kg air dry state soil to each pot with a volume of 1 dm³. Then we added uniformly nitrogen- and phosphorous-free nutrient solution to each pot. The content of the nutrient solution was the following: 0,006M K₂SO₄, 0,0008M MgSO₄, 0,0028M CaSO₄ 2 H₂O (Nagy and Jászberényi, 2002; Nagy P.T., 2004). (Parallel to the pot experiments we also set up incubation experiments. To be able to compare our results the application of the nutrient solution was needed.) From bacteria fertilizers the amounts in the combination plan, the originally recommended dosage and twice as much were applied to the combinations.

The composition of Bactofil A10 product is the following: Azospirillum brasilense, Azotobacter vinelandii, Bacillus megaterium, Bacillus polymyxa, Pseudomonas fluorescens variants, macro- and micronutrients, enzymes, vitamins.

In the Biorex-1 bacteria fertilizer product there are Bacillus subtilis, B. thuringiensis, B. megaterium, essential substances originating from microbial processes, micro- and macroelements.

The Biorex-2 consists of Azotobacter chroococcum, Azospirillum lipoferum, Pseudomonas putida, essential substances originating from microbial processes, micro- and mezonutrients. The used treatment combinations are shown in Table 2.

Table 2.

The used treatment combinations

| Treatment | Bacteria fertilizer | Applied amount |
|-----------|---------------------|---|
| 1. | - | - |
| 2. | Bactofil A10 | 1 l ha ⁻¹ |
| 3. | Bactofil A10 | 2 l ha ⁻¹ |
| 4. | Biorex-1+ Biorex-2 | 5 l ha ⁻¹ +10 l ha ⁻¹ - |
| 5. | Biorex-1+ Biorex-2 | 10 l ha ⁻¹ +20 l ha ⁻¹ -+ |
| 6. | Biorex-2 | 10 l ha ⁻¹ |
| 7. | Biorex-2 | 20 l ha ⁻¹ |

We ensured a water supply equal to 60% of the maximal field water capacity by daily irrigation. We cut the yield of plants twice during the vegetation period. Using the sum of the dry matter amount and the nitrogen content of the yield of the two cuts we calculated the amount of the extracted nitrogen. In this paper we elaborated these results. The total nitrogen content of plants was measured by dry combustion method (Nagy P.T. 2000).

RESULTS AND DISCUSSION

Setting up our experiment our aim was to get results about the effect of different bacteria fertilizers on the nitrogen amount extracted by the yield of perennial ryegrass, beside this if the dosage of the applied bacteria fertilizers affect the investigated parameter. We set up our experiment on – from the aspect of nitrogen supply – a well supplied chernozem soil, that has a high humus content, and regarding its pH it provide good life circumstances for the microorganisms, its pH is neutral or slightly acidic (Látókép). The other two soil types we used were sandy soils with low nitrogen and humus content and regarding their pH one was acidic (Nyíregyháza) while the other was neutral (Józsa). The experimental circumstances gave us the opportunity to compare the investigated parameter of plants grown on all three soil types.

The data of Table 3 show the nitrogen amount extracted from the three soils with the yield of ryegrass. Regarding it, it can be stated, that the extracted nitrogen content of plants was the highest ordinary on the sandy soil from Nyíregyháza, while the lowest, that means about tierce of the results of the two other soil types, on the sandy soil from Józsa.

Comparing the results from the control treatments (treatment nr. 1) we stated that plans used more nitrogen from the sandy soil from Nyíregyháza, than from the two other soils.

Table 3

The by the yield of ryegrass extracted nitrogen amount on the different soil types

| By the yield extracted N-amount (mg pot ⁻¹) | | | |
|---|---------|-------------|-------|
| Treatment | Látókép | Nyíregyháza | Józsa |
| 1 | 26.55 | 31.68 | 10.25 |
| 2 | 29.12 | 26.86 | 15.34 |
| 3 | 30.85 | 26.40 | 12.65 |
| 4 | 29.64 | 31.86 | 12.05 |
| 5 | 29.16 | 30.98 | 13.83 |
| 6 | 27.77 | 33.34 | 14.98 |
| 7 | 29.63 | 30.25 | 13.96 |
| average | 28.96 | 30.20 | 13.29 |
| SzD _{5%} | 1.15 | 1.92 | 1.34 |

From the result shown in Figure 1. – where the nitrogen content of treatments with bacteria fertilizers and of control treatments (100%) are compared – we can conclude, that bacteria fertilization increased the by the yield extracted nitrogen amount. This effect was also proven by the statistical analysis. There we no significant differences found between different treatments on this soil type. On the calcareous chernozem soil from Látókép the different bacteria fertilizers has similar positive effect on nitrogen mobilization.

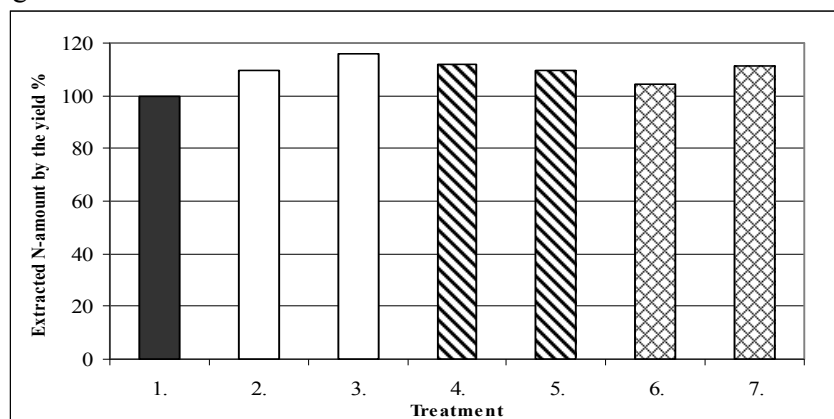


Figure 1.: The by the yield extracted N-amount (%) on the chernozem soil (Látókép)

Comparing the results on the sandy soil from Nyíregyháza (Figure 2.) it can be stated, that the application of Bacterial A10 in the recommended dosage and its twice dosage has significantly reduced the nitrogen amount extracted by the yield of ryegrass. Neither the fertilization with Biorex bacteria fertilizer had any positive effect.

As our results show, on this acidic sandy soil type with low humus content, the number of bacteria species applied with the fertilizers can't increase, so they cannot fulfil their biological tasks.

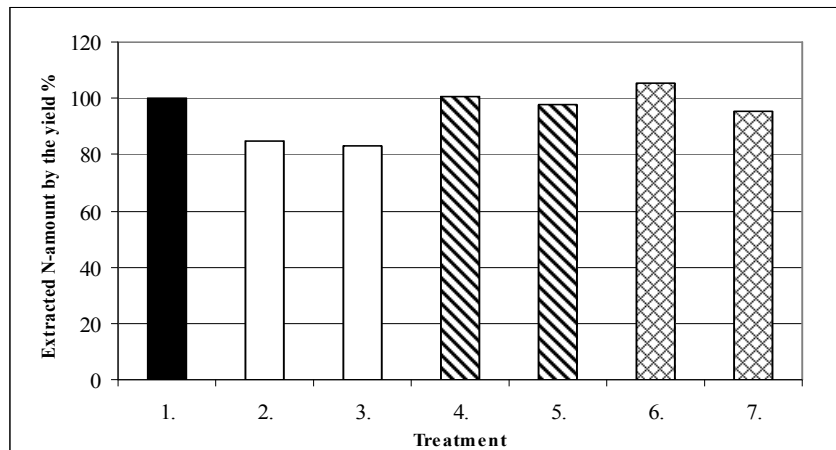


Figure 2.: The by the yield extracted N-amount (%) on the sandy soil (Nyíregyháza)

On Figure 3. the nitrogen amount extracted from soil by the yield of ryegrass on the neutral sandy soil from Józsa, with low humus content can be seen. From the figure it is evident that bacteria fertilization highly increased the by the plant from the soil extracted nitrogen amount.

Regarding the combinations with Bactofil A10 and Biorex1-2 fertilizers a significantly positive effect was also statistically proven. The extracted nitrogen amount was extreme high in combinations 2. and 6 in compartment with the control ones. As our results show, on this soil type there is no need to apply more bacteria fertilizer than the recommended dosage to enhance the nitrogen mobilization in the soil.

From our data it also became clear, that fertilization only with Biorex-2 bacteria fertilizer (6. and 7. treatment combinations) affects the amount of extracted nitrogen much more, than the recommended combination of Biorex-1 and - 2 fertilizer (4. and 5. treatment combinations). The reason for that is probably, that with the fertilizer Biorex-2 we add from the aspect of nitrogen cycle important bacteria species to the soil.

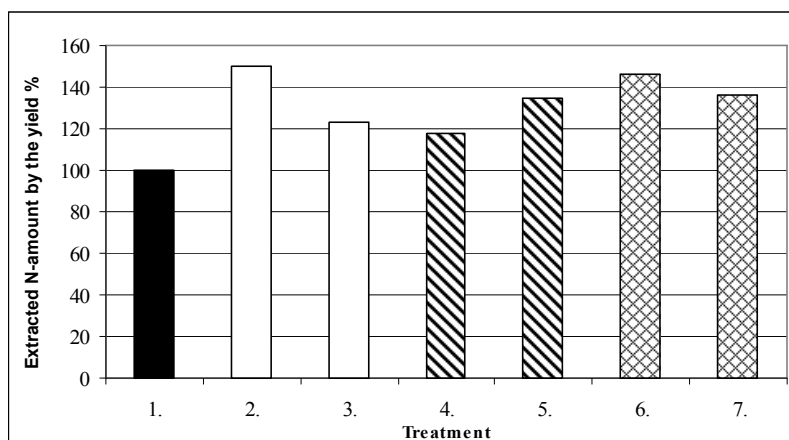


Figure 3.: The by the yield extracted N-amount (%) on the sandy soil (Józsa)

In our paper we studied the effect of bacteria fertilizers on the by the yield of perennial ryegrass extracted nitrogen amount. But our results cover also the investigation of other nutrients as well. We plan to publish our further results in accordance later.

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