SUITABLE NUTRIENT SUPPLY-GOOD FERTILITY

Géza László NAGY – László NAGY – Karina BODNÁR – Szilvia VERES – Brigitta TÓTH

Department of Agricultural Botany and Crop Physiology, Institute of Crop Sciences, Faculty of Agricultural and Food Sciences and Environmental Management, 4032 Debrecen, 138 Böszörményi str. Hungary. e-mail: btoth@agr.unideb.hu

Abstract: The intensive land use, including the artificial N-fertilizers in agriculture causes the acidification of soils due to the harvest or leaching of cations.
Soil microbes are of great importance in cycling nutrients such as carbon, nitrogen, phosphorus and sulfur. Beside their effects on the availability of nutrients the bacterial soil life prevents the uptake of several harmful ions. The most important limiting factor for microbial growth in soil is the abundance of available organic carbon sources. To increase microbial activity in a soil one must make the environment optimal, or at least more favorable, in terms of aeration, moisture and pH, and above all provide the organic substrates needed to fuel the population. The main object of our study was to examine the impact of two living bacteria containing bio-fertilizer as the potential tool to improve the agricultural production. The different effect of LBCF also was examined on 3 types of fodder corn (*Zea mays* L. DKC 4014, DKC 4608, DKC 5190) and two types of sweet corn (*Zea mays* L. GH 2042, Spirit). The dry matter accumulation, relative chlorophyll, chlorophyll *a* and *b*, chlorophyll a/b ratio and carotenes were measured.
The selected corn types had different reactions on the two LBCF, which can be explained by the suitable use of LBCF depends on types.

Keywords: biofertilizer, nutrients, maize

Introduction

During the past four decades we have witnessed the doubling of the human population and a concurrent doubling of food production. Plant nutrition has played role in this dramatic increase in demand and supply of food. Increases in crop production have been made possible through the use of commercial man-made fertilizers. The use of nitrogen fertilizer has increased almost nine-fold and phosphorous more than four-fold (Vance, 2001). The tremendous increase of N and P fertilization, in addition to the introduction of highly productive and intensive agricultural systems, has allowed these developments to occur at relatively low costs (Schultz et al., 1995). The increasing use of fertilizers and highly productive systems have also created environmental problems such as deterioration of soil quality, surface water and groundwater, as well as air pollution, reduced biodiversity, and suppressed ecosystem function (Socolow, 1999).
In this paper we aim to provide a brief overview of potential use of various biological agents.

Materials and methods

Maize seeds (*Zea mays* L. DKC 4014, DKC 4608, DKC 5190, GH 2042, Spirit) were used in the experiments. The seeds were sterilized with 18% hydrogen peroxide, and then washed in distilled water. The maize seeds were then replaced to 10 mM $CaSO_4$ for 4 hours. After that, they were germinated on moistened filter paper at 25°C.
The seedlings were transferred to a continuously aerated nutrient solution of the following composition: 2.0 mM $Ca(NO_3)_2$, 0.7 mM K_2SO_4, 0.5 mM $MgSO_4$, 0.1 mM KH_2PO_4, 0.1 mM KCl, 1µM H_3BO_3, 1µM $MnSO_4$, 10 µM $ZnSO_4$, 0.25 µM $CuSO_4$,

0.01 μM $(NH_4)_6Mo_7O_{24}$. Iron was added to the nutrient solution as Fe(III)-EDTA at a concentration of 100 μM.
The seedlings, 12 for each treatment, were grown under controlled environmental conditions (light/dark regime 10/14 h at 24/20 ^oC, relative humidity of 65–70% and a photosynthetic photon flux of 300 μmol m^{-2} s^{-1}) in controlled environmental room.
The relative chlorophyll contents of the 2nd and 3rd leaves of the sunflower were measured by Chlorophyll Meter, SPAD - 502 (Minolta). The number of repetitions was 60. The chlorophyll content was measured by spectrophotometycal method using N, N-dimethylformamide (DMF) as described by Moran and Porath (1982).
The dry matter of shoots and roots were measured at the end of experiments with the use of thermal gravimetric analysis, after drying at 85 C^o for 48 h.
The applied biofertilizer "A" contains *Azotobacter chrococcum* (1-2x10^9 db cm^{-3}) and *Bacillus megaterium* (1-2x10^8 db cm^{-3}). The biofertilizer „B" contains the following bacteria: *Azospirillum brasielnse, Azotobacter vinerólandii, Bacillus megaterium, Bacillus polymyxa, Pseudomonas fluorescens, Sterptomyces albus*.

Results and discussion

The applied biofertilizers have different effect on different maize varieties. The Table 1. contains the result of dry matter of roots and shoots.

Table 1. Dry matter accumulation of shoots and roots of different maize varieties treated by biofertilizers (g $plant^{-1}$) n= 9± S.E. (C: control; A, B: biofertilizers)

Treatments	DM of shoots		DM of roots	
	Mean	SD.	Mean	SD.
DKC 4014 C.	0.214	0.09	0.046	0.01
DKC 4014 „A"	0.159	0.11	0.054	0.01
DKC 4014 „B"	0.306	0.09	0.052	0.01
DKC 4608 C.	0.321	0.08	0.062	0.01
DKC 4608 „A"	0.249	0.01	0.055	0.01
DKC 4608 „B"	0.275	0.06	0.061	0.01
DKC 5109 C.	0.243	0.05	0.052	0.01
DKC 5109 „A"	0.201	0.05	0.040	0.01
DKC 5109 „B"	0.291	0.06	0.063	0.01
GH 2042 C.	0.171	0.05	0.033	0.01
GH 2042 „A"	0.105	0.04	0.022	0.01
GH 2042 „B"	0.205	0.08	0.043	0.02
SPIRIT C.	0.218	0.08	0.042	0.01
SPIRIT „A"	0.145	0.05	0.027	0.01
SPIRIT „B"	0.119	0.02	0.025	0.01

The dry matter of shoot was higher at the DKC 4014, DKC 4608, DKC 5109 and GH 2042 when biofertilizer "B" applied than at the "A" biofertilizer. The biofertilizers have negative effect on dry matter accumulation of SPIRIT.
Leaf relative chlorophyll content can be rapidly estimated in situ by SPAD (Soil Analysis Development) readings. The results are shown in Table 2.

Table 2. The relative chlorophyll content of second and third leaves of maize treated by biofertilizers (SPAD-index) n=60± S.E.

Treatments	2nd leaves		3rd leaves	
	Mean	SD.	Mean	SD.
DKC 4014 C.	41.48	1.82	37.88	2.92
DKC 4014 "A"	40.36	2.81	38.25	2.86
DKC 4014 "B"	43.09	2.52	41.76	3.08
DKC 4608 C.	43.28	2.37	39.45	2.78
DKC 4608 "A"	44.55	1.93	38.92	2.56
DKC 4608 "B"	43.80	2.82	36.08	2.82
DKC 5109 C.	46.48	3.06	34.29	4.68
DKC 5109 "A"	48.00	1.81	39.42	2.45
DKC 5109 "B"	47.73	3.95	43.86	3.60
GH 2042 C.	37.33	4.70	33.15	2.12
GH 2042 "A"	36.12	4.64	30.58	2.90
GH 2042 "B"	36.84	3.07	34.37	4.38
SPIRIT C.	40.33	1.18	39.02	1.98
SPIRIT "A"	39.04	2.53	38.03	1.59
SPIRIT "B"	38.54	2.42	36.62	2.70

The relative chlorophyll content increased in the 2nd and 3rd leaves of DKC 4014, DKC 4608, DKC 5109 when were treated by biofertilizers.
The relative chlorophyll content increased with 3 SPAD-index when DKC 4014 was treated with "B" biofertilizer compared to the "A" biofertilizer.
The relative chlorophyll of GH 2042 and SPIRIT decreased when were treated with biofertilizers.
Total chlorophyll concentration is a unifying parameter for indicating the effect of specific interventions. However, it is important to record changes in the two components of chlorophyll-*a*, chlorophyll-*b* and especially their ratio. The amount of photosynthetic pigments is given in Table 3.
The chlorophyll-*a*, chlorophyll-*b* and carotenoids contents increased in the cases of DKC 4014 and DKC 5109 when were treated by "B" biofertilizer.
The chlorophyll-*a* decreased by 2 mg g^{-1} when was treated with "B" biofertilizer. Moreover, the content of carotenoids increased with 1 mg g^{-1}.

Table 3. The content of chlorophyll *a*, *b*, carotenoids (mg g^{-1}) and a/b chlorophyll ration

Treatments	chlorophyll-*a*		chlorophyll-*b*		carotenoids		a/b ratio
	Mean	SD.	Mean	SD.	Mean	SD.	
DKC 4014 C.	15.44	0.75	5.67	0.95	10.13	0.74	2.72
DKC 4014 "A"	14.83	0.16	5.46	0.49	9.93	0.58	2.72
DKC 4014 "B"	16.35	0.12	5.68	0.48	10.13	0.58	2.88
DKC 4608 C.	14.95	0.05	5.35	0.67	9.66	0.69	2.79
DKC 4608 "A"	14.59	0.03	5.06	0.09	9.18	0.14	3.33
DKC 4608 "B"	14.21	0.82	5.66	0.57	10.11	0.66	2.51
DKC 5109 C.	12.41	0.55	3.86	0.39	8.14	0.36	3.21
DKC 5109 "A"	14.63	1.46	3.58	0.74	8.19	0.98	3.67
DKC 5109 "B"	15.54	1.01	5.79	0.83	10.13	0.95	2.68
GH 2042 C.	14.19	0.14	4.57	0.39	9.29	0.21	3.11
GH 2042 "A"	14.17	0.36	4.82	0.20	9.35	0.38	2.94
GH 2042 "B"	12.17	0.89	4.63	0.87	10.34	0.29	2.62
SPIRIT C.	12.48	0.80	4.53	0.77	7.79	0.85	2.75
SPIRIT "A"	12.93	0.89	4.48	0.67	8.00	0.67	2.88
SPIRIT "B"	13.49	0.47	4.26	0.35	8.31	0.55	3.16

Conclusions

The applied bacteria containing biofertilizers have different effect on the measured plant physiological parameters.

When we use biofertilizer, we have to know the requirement of hybrid, too.

On the basis of our results, we came to the conclusion, that the biofertilizers is an alternative for replacing partly the chemical fertilizer with a biologically active, environmentally protective agent, and at lower cost.

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