EM research in the Netherlands

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Abstract

Also under Dutch conditions EM can have a positive effect on the growth of plants. In a pot-experiment with English-rye-grass EM-technology was tested in combination with 6 treatments of manure and fertilizers. In pots with EM grass production of the first as well as the second cut was higher than without EM. In the first cut this effect was significant in three out of the six treatments. Combination of first plus second cut resulted in a significant positive effect of EM in one of the six treatments. EM effect was most evident in pots with low nutrient supply. This is important because attention is focused whether EM-technology can contribute to maintain high plant production while nutrient supply is reduced EM-technology was also tested on meadows. Results are very positive: grass production was kept almost at the usual high level while chemical fertilizers were reduced to about 30 percent of the original supply. The effect of EM on the photosynthesis of grass and maize was measured on eight parcels. Photosynthesis on EM-parcels was higher than on parcels without EM. Attention was also paid to possible negative effects of EM1:

In a field experiment with 36 plots no significant effect of EM on soil organic matter was measured after one year. On farm meadows: application of EM-technology during four years resulted in an evident increase in content of soil organic matter.

Concerning effect of EM1 on microbes: 10 species were isolated from soil and water, Microbial growth was not inhibited by the presence of diluted EM-suspensions.

Key words: EM, Holland, grass production, photosynthesis, soil organic matter

Introduction

Literature concerning EM aroused hope that it could diminish the big problems in Dutch agriculture, The very high intensity of agricultural production and related high input of fertilizers and feed, as well as the intensive use of manure, pesticides, medicines etc. leads to big environmental problems, high costs of production, and decrease of the quality of the products. Dutch (and West European) agriculture is coming to a crisis: use of fertilizers, pesticides, etc. has to be reduced strongly, Can the high level of production be maintained? Can EM-technology contribute to a solution?

Several experiments are done, This contribution describes five experiments briefly.

Aim of a first experiment was to see whether also under Dutch conditions in a green-house EM- technology could improve the growth of grass. Growth of grass is also studied on farm level. Question is: can EM help to maintain the grass production on the usual high level while the input of fertilizers is decreased?

The third experiment concerns the influence of EM on plant physiological characteristics:

influence of EM1 on the photosynthesis of grass and maize is measured.

Introduction of a new technology always raises questions concerning possible negative side effects. Attention is given to the question whether EM-technology will decrease the content of organic matter in soil and the fifth section of this contribution deals with the question whether EM1 has a negative effect on microbes in soil and water?

1."Effect of EM on growth of grass: a pot experiment"
(Nelemans and van Beusichem, 1997)
Aim: to study the effect of EM1 on yield and uptake of NPK under Dutch conditions.
Methods and materials:
EM1 is applied in combination with several additions of fertilizers and cattle slurry.
This experiment shows that also under Dutch (and West European) conditions EM1 can have a significant positive effect on the growth of grass.
Further research is necessary to improve knowledge concerning these conditions.
Results :
1. Effect of EM1 on yield of dry weight.
First cut: The mean dry weight of grass in EM-pots is always higher than in similar pots without EM1. In three out of the 6 treatments this effect was statistically significant. EM1 seems to be more effective at lower additions of nutrients.
Second cut: The dry weight in EM-pots is in general lower than in pots without EM1. The effect of EM1 is not significant for all the 6 treatments.
First plus second cut: Dry weights in EM-pots is somewhat higher than without EM1. However, significance as found in the first cut disappeared, because of the second cut.

2. Effect of EM1 on uptake of Nitrogen, Phosphate and Potassium.
In the first cut uptake of nitrogen in EM-pots is somewhat higher than in pots without EM1. The opposite holds for the second cut, The effects were never significant.
Phosphate and potassium: in general no significant effect of EM1. An exception was found in the first cut: treatments without manure show a significant positive effect.

Conclusions:
It is important to improve insight in the relation between conditions (soil, plant. tillage, etc,) and optimal application of EM.

Remark: Experiment will be continued in 1999 only on one farm. The farm on sandy soil uses no fertilizers anymore (only manure), because of the positive effect of EM1.

2. EM-effect on quality and quantity of grass productions on farm research"
(Bruggenwert *et al*., 1998).
Aim: Attention is given to the influence of EM1 on quantity and quality of grass, in particular when nutrient supply is reduced. Attention is also focused on the relation between yield and the way nutrients are supplied: fertilizer or cattle manure.

Methods and materials:

Farm 1: sandy soil. A parcel is divided in 3 subparcels, each about 0.6 ha.

Farm 2: heavy clay soil. A parcel is divided in four subparcels, each about 0.5 ha.

In 1997 and 1998 subparcels are treated with fertilizers, cattle slurry and EM1 in several ways. Yield of first and second cutis determined and its quality analysed.

Results and conclusions:

Under the prevailing conditions :

- Nitrogen added as cattle slurry in combination with EM1 shows the same efficiency as N-fertilizer: Efficiency N-cattle slurry +EM1 $\geq$ Efficiency N- fertilizer.

- In combination with EM1 and usual supply of cattle slurry, the normal amount of chemical fertilizers can be reduced strongly, keeping the yield almost on the usual level. This is very important for the farmer as well as for the environment.

- The quality of grass is not influenced by EM1 and the decrease in fertilizers.

- A lot of unknown causes may influence the yield. Interpretation of results from "on farm research" must be done very carefully.

Under well defined conditions in a greenhouse. Each pot is filled with 6 kg calcareous sea clay soil. Treatments are as follows:

- Fertilizers: 1) no fertilizers; 2) NH_4NO_3, 250 kg N/ha.
- Cattle slurry: 1) no cattle slurry; 2) 30 ton slurry/ha; 3) slurry (30 ton/ha) combined with addition of crushed sea shells (6 ton/ha) and bentonite (6 ton/ha).
- EM1: 1) no EM1; 2) EM1 addition to the soil (1L/ha) and weekly sprayed 1L/ha.

Each treatment is repeated 3 times: 36 pots. Moisture content is kept constant by daily addition of demineralized water. Two cuts are earned. Fresh and dry weight and the content of N, P and K of the dry material are measured. Results are analysed statistically with ANOVA, (LSD (a = 0.01)).

3. Influence of EM1 on chlorophyl-fluorescence".

(Ketel, 1998).

Aim: Use of sunlight energy should be increased by EM1. This study is a first orientation in the Netherlands concerning effect of EM1 on photosynthetic activity of plants.

Methods and materials:

Photosynthetic activity is measured with the EARS Plant Photosynthesismeter (PPM). Measurements are made on four locations: three with grass one with maize. Eight parcels are involved. Thirty measurements are made per parcel; made within one day.

Results:

Table 1: Mean PPM-values measured on eight parcels.

Location	Plant	PPM-value	
		With EM1	Without EM1
1	Grass	78.6±1.2	59.0±1.2
2	Grass	63.4±0.6	59.0±0.6
3	Grass	71.4±0.8	57.3±1.3
4	Grass	53.8±0.8	36.2±2.1

Conclusions:

EM1-parcels show a statisically significant higher photosynthetic activity than parcels without EM1.

- Visual observable differences (quality of sod, length of maize, etc.) correspond with differences measured in PPM-values.
- More measurements are necessary to see the effect for the whole season.
- Besides the EM1 treatment, also other factors can have influenced the differences.

4.1. "Effect of EM1 on organic matter content of the soil"

(M.G.M. Bruggenwert. 1998).

Aim is to see if there is a reason to fear that EM1 could have a strong negative effect on the organic matter content of soils.

Methods and materials:

Spring 1997: 36 plots (100 m^2 each) are installed at a pasture of the Wageningen University and Research Centre. Soil samples are taken and analysed for C_{total}; CEC; N_{total} and P_{total} Various amounts of fertilizers, manure and EM1 are added. In spring 1998 soil samples are taken again and analysed.

Results:

Under the prevailing conditions this first orientation shows no significant negative effect of EM1 on CEC and total amount of C, N and P in the soil after one year.

Conclusion:

No evidence for a strong decrease in soil organic matter content.

4.2. "Effect of EM1 on organic matter content in meadow soils on farm level".

(Van den Ham *et al*, 1999).

Aim of this study is to follow the effect of the application of EM1 in combination with crushed sea shells and clay minerals (the Agriton treatment) on the organic matter content and pH of meadow soils.

Materials and methods:

The parcels (16) of Attema's dairy farm (one of the first farmers who applied EM in the Netherlands) are treated with EM1 (4 L/ha, year), crushed sea shells (500 kg/ha,3 years) and

clay minerals (300 kg/ha, year) in combination with manure and fertilizers. This treatment started in 1995. Soil samples are taken and analysed in spring 1994 and in spring 1999 by the Institute for Soil and Plant Analyses, BLGG.

In the period 1995 - 1999 the application of fertilizers was strongly reduced.

Results are given in table 2:

Table 2. Organic matter content and pH as measured by BLGG in 1994 and in 1999.

Percel no	1994		1999	
	mean org. matter %	pH	mean org. matter %	pH
4,11a,11b,12	7.4	5.3	12.7	5.8
1,7,8,9,10	12.1	5.1	18.7	5.5
2,3,5a,5b,6,13,14	26.0	5.0	29.2	5.6

Conclusion:

In almost all the parcels there is a strong increase (often a remarkable increase) in organic matter content. The treatment has also a positive effect in the pH of the soil.

5. "Effect of EM1 on growth of micro-organisms"

(van Egeraat. 1998).

Aim: To test the effect of EM1 on micro-organisms isolated from soil and sludge.

Methods and materials:

The effect is tested of

1) EM1 not diluted, pH3.70;

2) EM1 not diluted, heated up to 90 $^{\circ}$C;

3) EM1 diluted in water 1:100;

4) EM1 not diluted, pH 6.50,

on 10 micro-organisms belonging to Azotobacter, Rhizobium, Pseudomonas, Bacillus, Streptomyces, Mycobacterium, Serratia, Escherichia, Saccharomyces and Penicillium. Proper agar media are contaminated with these micro-organisms. EM1 is put into holes which are made in the agar.

Results:

Concerning EM1 not diluted, and EM1 not diluted heated up to 90 $^{\circ}$C: the growth is inhibited of all bacteria tested; growth of fungi and yeasts is not inhibited.

Concerning EM1 in water 1:100, and EM1 not diluted pH 6.50: no inhibition of all the micro-organisms tested.

Conclusions:

There is a pH effect. The low pH of EM1 not diluted causes a negative effect on growth of the bacteria tested. Fungi and yeast can stand this low pH value. EM1 heated up to 90 $^{\circ}$C shows the same effect. The negative effect disappears when EM1 is diluted (1: 100) and when the pH is increased to 6.50: low concentration of acids.

EM1 diluted (1: 100 - 1000) can have no any negative effect on the microbial live in soil,

water or on plants.

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