STUDY OF LIVESTOCK WASTE PROCESSING INTO MICROBIAL FERTILIZERS TO SOLVE ENVIRONMENTAL PROBLEMS

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ABSTRACT

Peculiarities of microbial fertilizers with polyfunctional properties produced by the fermentation of livestock farm waste are being discussed. Wide possibilities in the beneficial application of the fertilizers both for the environment and agricultural sector are shown. Livestock organic waste processing by aerobic microorganisms makes it possible not only utilize the waste, but to produce microbial fertilizers, which can be efficiently used to treat oil-contaminated soils, intensify biological decomposing of municipal waste, remedy soil fertility and to serve as an alternative to pesticides.

INTRODUCTION

At present time, livestock waste is still a hazardous environmental pollutant. In Russia only more than 400 million ton of livestock and poultry waste is produced annually, 80% of which are not used, but pollute the environment (Arkhipchenko, 2000). At the same time, there is research data, which demonstrate that an additional product can be produced on farms: microbial fertilizers. They have a wide spectrum of application, both in agriculture and environment improvement.

MATERIAL AND METHODS

Three types of microbial fertilizers were studied: Bamil: pelleted fertilizer produced from aerotank active sludge of pig farms (108 thousand heads); Omug: fertilizer produced during aerobic fermentation of litter poultry dung and Ecud: fertilizer after anaerobic fermentation of litter-free poultry dung.

Experiments were carried out in 10-liter pots and in the field on 100 m^2 plots. Amount of microorganisms, their activity and soil agro-chemical parameters were evaluated by traditional methods (Alef and Nannipieri, 1998).

RESULTS AND DISCUSSION

This research is considering the results obtained in 1998-2003 in industrial experiments.

Treatment of oil-contaminated soils by microbial fertilizers.

Saturation of microbial fertilizers with active microorganisms among which there are a lot of plant growth promoters and oil destructors is a peculiarity of microbial fertilizers as we have found out earlier (Arkhipchenko and Zolnikova, 2001). These fertilizers are able to decompose oil by 45-51% (table 1) at the level of oil contamination 47-98 g/kg soil. Additional introduction

of microorganisms-alkanotrophes by immobilization onto microbial fertilizers makes it possible to increase oil decomposition level up to 88-94% (table 2). Due to industrial reclamation of oil-contaminated soils in Timano-Pecherskyi Region in the northern Russia, oil carbon decomposition by microbial fertilizer Omug was 30-71% for 2 months at the level of oil contamination 136-991 g/kg peat soil.

Hence, on the basis of microbial fertilizers Bamil and Omug new biopreparations were produced for oil decomposition. Immobilization of alkanotrophic microorganisms of g. *Bacillus* and g. *Rhodococcus* promotes the activity of the preparations and ensures reclamation of agrochemical properties of soils and plant growth increase.

Table 1. *Physical, chemical and biological description of microbial preparations.*

Biofertilizer	Moisture capacity, %	Adsorption capacity, 10^6 cells/g	Content of alkanotrophes, CFU/g	Oil destruction, %
Bamil	121	5.3	4000	51
Omug	550	4.8	8000	45

Table 2. *Dependence of Bamil ability to decompose oil on the type of microorganism.*

Type of microorganism	Oil decomposition, %	
	Without Bamil	With Bamil
Bacteria in association No. 15	75.3	88.6
Bacteria in association No. 17	74.2	94.3
Micromycetes strain 12	84.6	94.7
Micromycetes strain 14	76.1	86.5
Micromycetes strain 21	80.1	94.3
Control *	8.0	67.5
* Medium without inoculated cultures		

Optimization of composting of municipal waste by microbial fertilizers

The most promising method of municipal waste treatment is their fermentation to produce compost. It is economically profitable to reduce fermentation period, but it is possible to achieve by activating microflora. Introduction of microbial fertilizers to enrich organic waste with specific microflora, which predominates in the fertilizers: *Bacillus*, *Micrococcus* and *Arthrobacter* enables us to accelerate the process of bio-oxidation, increase exothermal reaction temperature by 10-20% and reduce fermentation period by 25%. The latter can be explained by the enrichment of organic mass with thermophilic microorganisms, which are present in biofertilizers. Simultaneously, we observed increase in the amount of humus substances by 35.5% in the variant with Bamil added into fermentation mass. Municipal waste without Bamil served as Control. Compost saturation with nitrogen was also observed: 2.2% N_{tot} in comparison with 1.7% N_{tot} in Control. Composts produced with biofertilizers increase ryegrass yield by 21-33% if compared with composts produced according to traditional technology.

Application of microbial fertilizers in organic farmers.

Microbial fertilizers in relatively small doses are able to promote plant growth and development (table 3). Stimulating plant growth they reduce physiological stages of plant development, which prevents insect pests to damage crops. According to the data presented in the table plant damage is reduced by 2-4 times in comparison with Control. Green mass yield also increases 1.5-3 times depending on the fertilizer type. Considerable role in the efficiency of fertilizers is played by the content of tryptophan: precursor of indole-3-acetic acid, plant growth promoter. In Bamil tryptophan content is higher than in Omug, hence, its efficiency is higher (table 3).

***Table 3**. Effect of microbial fertilizers on the green mass yield, growth and development of Galega orientalis Lam.*

Biofertilizer		Tryptophan content, μg/g	Green mass yield, kg/m^2	Number of leaves on the plant	Height of plant after 60 days, cm	Plants damaged by insects, %
Type	Load, g/m^3					
Control	-	-	0.51	22	17.5	11.4
Ecud	242	18	0.59	28	21	5.5
Omug	134	24	0.86	38	28.2	4.9
Bamil	100	388	1.55	52.4	35.9	2.9

CONCLUSIONS

Expediency to process livestock waste into microbial fertilizers is proved scientifically. Practical examples demonstrated the prospects for successful application of the fertilizers:

- To remedy oil-contaminated soils, which provides for oil carbon decomposition and reclamation of soil biological activity.
- To optimize composting process of municipal wastes, which makes it possible to improve compost quality considerably and reduce fermentation period by 25%.
- In organic farming to produce ecologically safe crops free from chemicals and pesticides.

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