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BIOTREATMENT OF ANIMAL WASTES FOR FERTIGATION OF ORGANIC FARMS

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ABSTRACT

In this study cow dung was collected with cow urine as a good source of plant nutrients. The bio-treatment and fermentation of this waste was carried out in special bioreactors. After three days of anaerobic condition molasses, fodder yeast, rock phosphate, feldspar and biococktail (Biomix) contained a mixed cultures of selected microorganisms belonged to *Bacillus*, *Micrococcus*, *Pseudomonas*, *Serratia*, *Azotobacter*, nitrifying bacteria, sulfur – oxidizing bacteria, *Trichoderma*, *Rhodotorula*) were added and vigorous aeration was started to increase the dissolved oxygen in the bioreactors reaching about 80 % of saturation. The aeration continued for seven days for each bioreactor. Results revealed that EC gradually increased from 7.1 to 19.3 dSm^{-1} at the end of fermentation period. It means that the mineralization process of organic wastes increased gradually and led to release cations and anions showing the highest peak at the end of fermentation. On the contrary, pH of the fermented solution decreased gradually from 7.1 to 4.3. The results showed that the slurry solution of (Biofert) contained a considerable amount of plant nutrients as compared with the standard solution (Holland solution) used for feeding of seedling in Mezan green houses (SEKEM).The Biofert was tested as a plant nutrient solution for fertigation of sweet pepper, tomato, and water melon seedlings and exhibited a good healthy plants as compared with standard solution. The yield of potato increased gradually with increasing the rate of biofert to reach its peak (14.2 ± 1.42Kg) at 5 L / 7 m^2 twice per week.

Keywords: Cow dung, Biotreatment, Mineralization, plant nutrients, nutritive value.

INTRODUCTION

Animal slurry is widely used as a fertilizer in organic farms. Dairy cattle typically produce between 42 kg and 64 kg (depending on body weight) of manure per day, so if they are housed for 50% of the year that corresponds to 7.6-11.6 tonnes per cow. In many developing nations, animal faeces have been composted and used to fertilize farm field (Ogbeide and Aisien, 2000; Audu *et al.*, 2003). Abou-El-Hassan *et al.*, (2002) reported that organic manures gave a high quality of cantaloupe richen with vitamin C and the fruit content of NO_3 was very low compared to that obtained with inorganic fertilizers treatment. Ichida *et al.*, (2001) observed the role of bacterial inoculum to enhance keratin degradation and biofilm formation in poultry compost. Williams *et al.*, (1999) explained the management and utilization of poultry wastes. Jingrang *et al.*, (2003) stated that total bacteria in poultry litter was found to be 10^9 cfu/g of materials. They also reported that enteric bacteria such as *Enterococcus* spp. and coliforms composed 0.1 and 0.01 % respectively of the total aerobic cultivable bacteria in poultry litters, no *Salmonella* strains were detected by culture. They stated that in order to characterize the most abundant bacterial groups, they sequenced 16S ribosomal DNA (rDNA) genes amplified by PCR with microbial community DNA isolated from poultry litter as template. Abou-Hadid *et al.*, (1989) reported that under Egyptian conditions, the use of nutrient film technique produced with organic fertilizers will be very important in the near future for reducing the cost of the nutrient solution, environment and human health, where chemical nutrient solution produce vegetable with high levels of nitrate which is hazard for human health (Hill, 1990). Smith and Hadly (1989) observed that there is a great interest of using organic N sources as fertilizers for vegetables crop production. Abdel-Aty (1997) studied the role of some organic fertilizers on the growth and yield of pepper plants cultivated in plastic houses. Keeney (1982) stated that high nitrate in the fresh vegetables has been found to be responsible for methemoglobinemia, particularly in babies. Olson and Kartz (1982) observed that there is evidence relating exposure to NO_3 and NO_2 to the incidence of cancer. Abou-El-Hassan *et al.*, (2002) demonstrated that organic manure solution led to lower percentage of total sugars and total soluble solids in the fruits due to the lower concentrations of some essential elements in organic manure solution.

The aim of this work was to apply the bio-treatment of cow dung slurry with certain microorganisms for releasing the plant nutrients and evaluate the produced fermented liquor for plant nutrition.

MATERIALS AND METHODS

In this experiment cow dung was used as an available animal wastes in Sekem farms than other animal wastes. This animal waste was collected with cow urine as a good source of plant nutrients. The bio-treatment and fermentation of this waste was carried out in special bioreactors consist of ten concrete building (2 m^3 for each) and all of these bioreactors are connected with a slurry reservoir which become ready for fertigation. All bioreactors are connected with vigorously aeration system (Figs. 1 & 2).

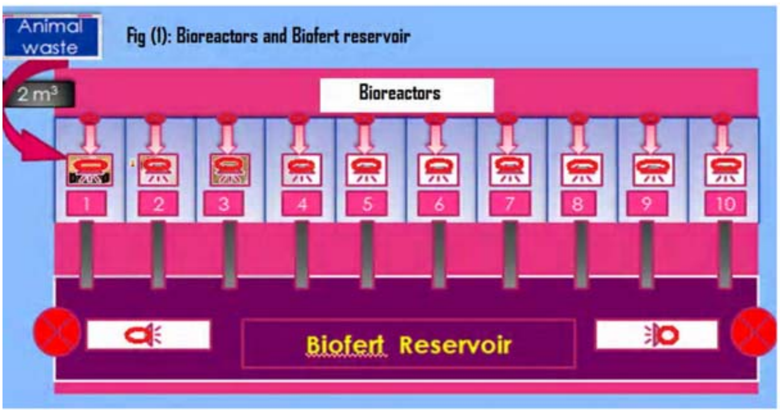


Fig (1): Bioreactors and Biofert reservoir

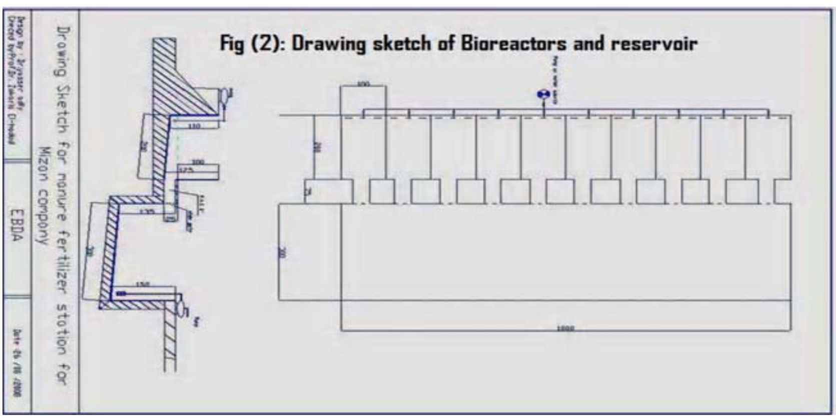


Fig (2): Drawing sketch of Bioreactors and reservoir

Anaerobic fermentation

Two cubic meters of cow dung mixed with urine (rich in urea) were added to the first bioreactor (moisture was adjusted to 80 – 85 %) and mixed thoroughly. After one day the same amount of cow dung was added to the second bioreactor and this was repeated for other bioreactors. All bioreactors were left without aeration (anaerobic conditions) for three days to perform the following biological reactions by native microflora of cow dung. Anaerobic microorganisms either strict anaerobes or facultative ones grow in the absence of oxygen to decompose organic materials producing organic acids, alcohols and gasses (Methane, mercaptans, etc…). Due to these bioreactions, energy is released leading to increase the temperature of bioreactors to about 50 – 60 ^{o} C depending on atmosphere temperature. These metabolites of microbes and high temperature lead to kill human and plant pathogens, weed seeds and parasitic nematodes. Samples taken during this period revealed that this dung waste became free from these undesirable contaminants.

Aerobic fermentation

After three days of anaerobic conditions for each bioreactor, molasses, 1 % (20 kg/2 m^3) ; fodder yeast, 1% (20 kg / 2 m^3) ; rock phosphate, 0.15 % (3 kg /2 m^3); feldspar, 0.15 % (3 kg / 2 m^3) and 1 l of biococktail (which we call it Biomix, produced by microbiology lab. in Adlia, Sekem, contained approximately 10^6 cfu of each selected microorganisms belonged to *Bacillus*, *Micrococcus*, *Pseudomonas*, *Serratia*, *Azotobacter*, nitrifying bacteria, sulfur – oxidizing bacteria, *Trichoderma*, *Rhodotorula*) were added, then vigorous aeration was started to increase the dissolved oxygen in the bioreactors reaching about 80 % of saturation (about 8 mg / l). The aeration continued for seven days for each bioreactor. During this period, the inoculated microorganisms (Biomix) grew aerobically and proliferate strongly where the environmental and nutritional requirements were ideal for this cocktail of microbes to: release macro and microelements especially NPK, produce phytohormones, antioxidants, biocontrol agents, free amino acids, osmoregulators, fix atmospheric nitrogen, oxidize ammonia and urea to nitrate, dissolve phosphorus and potassium, oxidize malodorous gasses, contain beneficial microorganisms which play an important role in the soil and rhizosphere of plants. After fermentation period under aerobic conditions (seven days in summer and 12 days in winter) to solve this problem we are planning to adjust temperature in winter to be 25 – 30^oC to reduce the fermentation period), aeration was stopped in the first bioreactor for 3 hours and the supernatant was withdrawn (outlet) to the slurry reservoir. The same technique was repeated for the second bioreactor on the second day and the third bioreactor on the third day and so on meaning that a continuous slurry was added to the reservoir every day. The slurry was analyzed for its physical and chemical properties and tested for its efficiency in plant nutrition.

Materials used

Cow dung: This waste was obtained from animal Sekem farms. The main components of this waste was: Total nitrogen (TN), 0.84 -1.37 %; Phosphorus (P), 0.62 % ; Potassium (K) , 1.08 % ; Organic carbon (OC),41.23 % ; C/N , 30-49 ; Moisture, 85 % pH, 7-8 and Electrical Conductivity (EC), 0.33 dSm^{-1}.

Molasses: Cane molasses was obtained from Alhawamdia company, Giza governorate. It contains about 50% sugar and several minerals. This product was used to support the biological activity of microorganisms. we shall try to use beet molasses(from kafr Elshiekh) due to its contents of glycine betaine (trimethylglycine) which increase the ability and plant to tolerate the high salinity *i.e.* it is working as osmoregulateres. This product also produced from the bioinoculant.(vinasse is not suitable instead of molasses)

Fodder yeast: it was obtained from Alhawmdia, Giza as a byproduct from alcohol factory. This yeast (unviable cells) is used for feeding of animals and poultry. It contains 8 % nitrogen (most of them in the form of protein, 50 %) and several vitamins special B-complex (such biotin, riboflavin, thiamin, niacin, pantothenic acid, folic acid and pyridoxine) and some minerals. This source was used to increase the biological activity of microorganisms and a good source of protein.

Rock phosphate: This rock was used as a good and cheap source of inorganic phosphorus. It contains 20 – 30 % P_2O_5 (8.8 -13.2 P) .The microbial inoculum used in the biotreatment of cow dung contains certain organisms which dissolve phosphorus from this source to be more available for plant nutrition.

K- Feldspar: The rock of feldspar was used as a good source of potassium (K) which elaborated from the rock by silicate microorganisms.

Analysis of slurry product (Biofert)

Samples of brewery solution of Biofert were collected periodically during fermentation period and at the final stage in the slurry reservoir to determine its physicochemical properties.

Soil Analysis

The collected soil samples were analyzed for physical and chemical properties according to Allen (1989).

Physicochemical analysis

Soil samples collected from different localities were subjected to some analysis including soil reaction (pH), soluble cations and anions, EC, soil texture (Olsen *et al.,* 1954 and Rhichards, 1954); dissolved oxygen was determined by oximeter. Chemical analysis of biofert were determined in Laboratory of Holland (Blgg) and central Lab of Faculty of Agric. Ain Shams Univ., Cairo, Egypt.

Effect of biofert on potato cultivated in SEKEM farm in Sinai

This experiment was conducted in SEKEM farm in Sinai. A completely randomized system was designed. The soil of this farm was treated with 50 ton compost / feddan (compost analysis was : bulk densty,1018 Kg/m^3; moisture, 21 % ; TN, 0.5 % ; P, 1.25 ; k, 33 %). The physicochemical properties of different soil samples of Sinai farm are shown in Table (6). In this experiment 49 m^2 area of Sinai soil were divided into seven treatments (seven m^2 for each) and these treatments were repeated in three plots. These plots were cultivated with potato seeds (November 2008) using local variety Nicola (1.5 ton / feddan at 25 cm deep). The irrigation with Nile water was carried out every four days using pivot system. The seven treatments (which repeated in three plots) were irrigated with different levels of biofert as shown in Table (7). The irrigation system with biofert was started after one month of planting. After 106 days (3.5 months) of planting, the plants of each treatment were gently collected from each plot and fresh weight was determined.

Statistical analysis

Statistical analysis of the data was treated by one way analysis of variance (ANOVA) as described by Snedecor and Cochran (1969), the mean values were compared by LSD at 5% using the computer program SPSS, ver. 12.

RESULTS AND DISCUSSION

Results in Table (1) revealed that electrical conductivity gradually increased from 7.1 dSm^{-1} at the start of fermentation to 19.3 dSm^{-1} at the end of fermentation period. It means that the mineralization process of organic wastes increased gradually which led to release cations and anions showing the highest peak at the end of fermentation. On the contrary pH of the fermented solution decreased gradually from 7.1 to 4.3. The gradual decrease of pH may attributed to the formation of some organic acids and sulfate anions. Dissolved oxygen during the anaerobic fermentation stage was zero due the consumption of all dissolved oxygen by facultative and anaerobic microorganisms and there was any supplementation of aeration during these period. This condition gave a good chance for anaerobic biological processes which led to inhibit and kill all undesired contaminants. Balasubramanian and Kasturi Bai (1992) Evaluated nutrient recovery after anaerobic digestion of cattle dung. Jingrang *et al.,* (2003) stated that total bacteria in poultry litter was found to be 10^9 cfu/g of materials. They also reported that enteric bacteria such as *Enterococcus* spp. and coilforms composed 0.1 and 0.01 % respectively of the total aerobic cultivable bacteria in poultry litters, no *Salmonella* strains were detected by culture Yongabi *et al.,* (2009) reported that anaerobically digested cow dung slurry does not only yield pathogen free manure, increased fertilizer and biogas but can improve the antimicrobial activity of medicinal plants. Contradictory to this, dissolved oxygen during aeration stage was ranged from 6.2 to 8.3 mg/l (ppm) *i.e.* 73.81 to 98.81 % of saturation where the oxygen saturation at 27^{o}C was 8.4 mg/l i.e. 100 % saturation. It means that the oxygen concentration during aeration stage was quite enough for microorganisms to perform the ideal aerobic biological processes. The chemical properties of the produced Biofert were observed in Table (2) according to BL99 Laboratories, Netherlands and Table (3). The results showed that the slurry solution of Biofert contained a considerable amount of plant nutrients as compared with the standard solution (Holland solution) used for feeding of seedling in Mezan green houses (SEKEM).The Biofert was tested as a plant nutrient solution for feeding of sweet pepper, tomato, and water melon seedlings and showed a good healthy plants as compared with standard solution.

The Biofert was produced in Elmizan and Aladelia (SEKEM farms) bioreactors during July, August and September 2009 as shown in Tables (4 & 5). The data in this Tables showed that the electrical conductivity widely varied from 10.0 to 34.3 dS/m , total nitrogen from 0.08 to 1.43 % and available nitrogen from 0.004 to0.105 .Whereas pH values did not show this variation (ranged from 7.1 to 8.6).This variation may be attributed to the stop of aeration during the aerated stage where the decrease of dissolved oxygen than 5 ppm lead to activate the biological activity of anaerobic microorganisms forming undesirable products and in the same time reduce the very important plant nutrients such as nitrogen and sulfate as mentioned before

It could stated that the cocktail of microorganisms (Biomix) was prepared from different selected microorganisms which showed high efficiency to decompose different organic matter such as cellulose, hemicellulose, starch, pectic substances, legnin, lipids and other carbohydrates either soluble or non soluble to finally produce carbon dioxide and water in addition to energy which part of it is used for biosynthesis of cell constituents and the other part released as heat. The mineralization of these compounds lead to elaborated the cations and anions to be more available to plants. The microbial strains used in this purposes belonged to: *Micrococcus, Pseudomonas, Bacillus, Erwinia, Arthrobacter, Pleorotus, Aspergillus, Rhizopus* and *Chaetomium*. Ammonification microorganisms decompose organic nitrogen compound such as proteins, peptides and nucleic acids to produce amino acids, urea and ammonia. The organisms involved in this reaction are: *Pseudomonas, Microococcus, Bacillus, Aspergillus Trichoderma* and *Arthrobacter*. Nitrogen fixers (Diazotrophs) can fix atmospheric nitrogen asymbiotically leading to increase its level in the brewery slurry such as Azotobacter chroococcum, Azospirillum and other free nitrogen fixers. Nitrifying Bacteria oxidize ammonia produced by proteolytic microorganisms (ammonification) to nitrite and consequently to nitrate. This bacteria include Nitroszomonas and Nitrobacter. Oxidizing bacteria oxidize sulfur and hydrogen sulfide to sulfate anions which increase the quality of slurry and also lead to decrease the pH value of fermented liquor. These bacteria incorporated different strains of *Thiobacillus.* They can also consume all H_2S produced under anaerobic condition eliminating its toxicity on soil microorganisms and plant roots. Methylotrophic microorganisms such as *Methylomonas, Methylococcus, Pichia pastoris,*and *Hansenula polymorpha* oxidize methane (toxic gas) to carbon dioxide and water. Osmoregulators–producing microorganisms produce during their metabolic activity glycine betaine which increase the osmotic potential of plant cells as osmoregulator agents leading the plants to tolerate high salinity. The osmoregulators microorganisms include: *Bacillus subtilis, Arhrobacter,* and *Pseudomonas*. Sidrophores–producing microorganisms produce special bodies outside the cells (siderophores). These bodies react with iron and other metals in the soil and rhizosphere and transfer these minerals into the plant cells through the cell wall. Siderophores also play a role in the biocontrol of soil – borne pathogens. Phytohormones–producing microorganisms have the ability to produce growth promoting substances such as indoles, gibbrillins, cytokinins, which support plant growth and give good healthy plants. These organisms (rhizobacteria) were isolated from the rhizosphere and rhizoplane of different plants such as corn, millet, tomato, *etc…*These bacteria were tested for their ability to produce phytohormones using root test and the most active organisms were selected such as *Azotobacter, Azospirillum, Painibacillus, Trichoderma, Rhizobium, Enterobacter* and *Arthrobacter*. Phosphate–dissolving microorganisms: *Bacillus megaterium* as a very active organism to transfer unavailable phosphorus to available phosphorus in the fermented liquor (slurry) was added to the biofert to increase its quality. Ichida *et al.,* (2001) observed the role of bacterial inoculum to enhance keratin degradation and biofilm formation in poultry compost. Deodorant microorganisms have the ability to absorb and utilize of malodorous gasses were selected from soil and rhizosphere of different plants. These organisms are capable to oxidize hydrogen sulfide and mercaptans gasses to eliminate the stinky smell of biofert slurry. Biocontrol agents–producing microorganisms: These organisms included *Bacillus subtilis, Trichoderma harezianum,Trichoderma viride, Pseudomonas spp, Serratia, Cl.butyricum,* and *Rhodotorula gracilis*. These organisms showed a high efficiency to biocontrol of soil – borne pathogens (Fusarium,Verticillium, Rhizoctonia and Ralostonia) and parasitic nematodes.

It is well known that some fermentation problems will happened due to the stop of aeration or reduction rate of aeration which led to depletion of oxygen and consequently change the bioreactor from aerobic (which more suitable for biomix microflora) to anaerobic conditions.

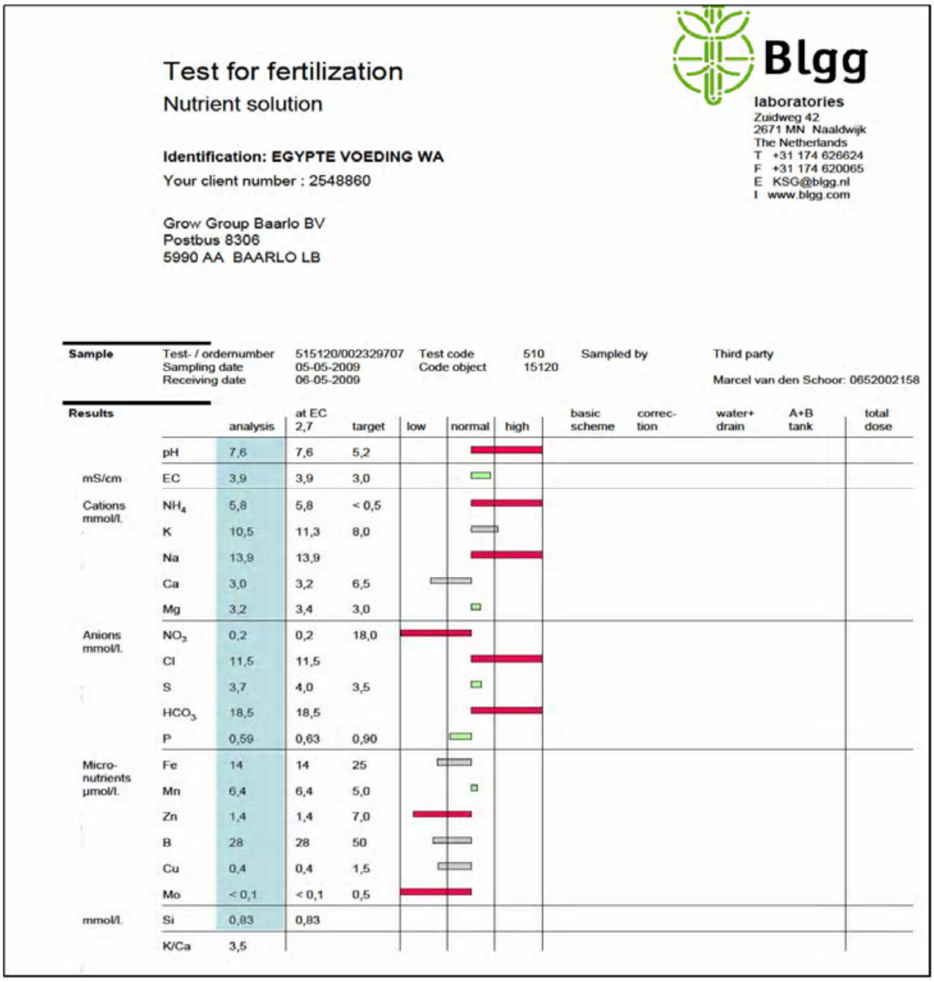
This conditions encourage the proliferation of anaerobic microorganisms and causes reduction of sulfate to hydrogen sulfite where ammonium sulfate is used as electron acceptors under anaerobic conditions. The native microflora and some organisms in the biofert cocktail can do these reactions such as *Pseudomonas* and *Desulfotomaculum nigrificans* (Fig. 3). The increase of hydrogen sulfite concentration led to form of many malodorous gasses showing a very stink smell (reaction of hydrogen sulfide with alcohols and alkyl to form mercaptans). Hydrogen sulfide also react with iron in the fermented slurry to form ferrous sulfide (FeS) which changed the slurry color to grey black (Gleying slurry). These reactions decrease the solubility of plant nutrients and increase the alkalinity of brewers. Anaerobic conditions led to anammox reaction (Fig. 4) by Plactomycetes anammoxidans in which ammonium cations react with nitrite to form nitrogen gas leading to decrease the available nitrogen in the slurry. Denitrification and nitrate –reducing bacteria activated under anaerobic conditions to reduce nitrate to nitrite which in turn transformed to dinitrogen gas. Optimum temperature for biomix cocktail is ranged from 25 – 30^{o}C. The increase or decrease the temperature than this level led to cause a deleterious effect on the beneficial biological activity of microorganisms producing less quality slurry.

Table (1): Electrical conductivity, pH and dissolved oxygen during fermentation period (September 2008, main temperature, 25^{o}C).

Time in days	Condition	EC (dSm-1)	pH	Dissolved oxygen	Dissolved oxygen of (100% air saturation)
0	Anaerobic	9.5	7.1	00	00
1		11.3	5.3	00	00
2		11.9	4.2	00	00
3		12.3	5.2	00	00
4	Aerobic	13.4	6.2	7.3	86.90
5		13.6	5.4	6.2	73.81
6		14.2	6.2	8.3	98.81
7		16.3	5.1	7.3	86.90
8		16.9	5.4	8.2	97.62
9		17.1	5.2	7.5	89.29
10		19.3	4.3	5.2	61.90

Notes Aeration rate =108 l / minute, 100 % air saturation = 8.4 mg Oxygen/l

Table (2): Physicochemical of Biofert analyzed in Holland (Blgg)



Test for fertilization
Nutrient solution

Identification: EGYPTE VOEDING WA
Your client number : 2548860

Grow Group Baarlo BV
Postbus 8306
5990 AA BAARLO LB

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Sample
Test- / ordernumber 515120/002329707 Test code 510 Sampled by Third party
Sampling date 05-05-2009 Code object 15120
Receiving date 06-05-2009 Marcel van den Schoor: 0652002158

Results

		analysis	at EC 2,7	target	low	normal	high	basic scheme	correc-tion	water+ drain	A+B tank	total dose
	pH	7,6	7,6	5,2								
mS/cm	EC	3,9	3,9	3,0								
Cations mmol/l.	NH_4	5,8	5,8	< 0,5								
	K	10,5	11,3	8,0								
	Na	13,9	13,9									
	Ca	3,0	3,2	6,5								
	Mg	3,2	3,4	3,0								
Anions mmol/l.	NO_3	0,2	0,2	18,0								
	Cl	11,5	11,5									
	S	3,7	4,0	3,5								
	HCO_3	18,5	18,5									
	P	0,59	0,63	0,90								
Micro-nutrients µmol/l.	Fe	14	14	25								
	Mn	6,4	6,4	5,0								
	Zn	1,4	1,4	7,0								
	B	28	28	50								
	Cu	0,4	0,4	1,5								
	Mo	< 0,1	< 0,1	0,5								
mmol/l.	Si	0,83	0,83									
	K/Ca	3,5										

Table (3): EC, pH and NPK of Biofert analyzed in Ain Shams university

Parameters	Sample 1	Sample 2
EC (dSm-1)	2.00	2.00
pH	7.77	7.60
TN (mg/l)	131.00	119.00
P (mg/l)	25.70	19.50
K (mg/l)	500.00	649.00

Table (4): Physicochemical properties of Biofert in different localities in SEKEM

						Biofert Analysis Sheet										
		El-Mezan									Libra					
Date:	Pool no.	Source	Quantity	Code	E.C ds/m	pH	T.N %	av.N %	Pool no.	Source	Quantity	Code	E.C ds/m	pH	T.N %	av.N %
1-Jul-2009																
2-Jul-2009																
3-Jul-2009																
4-Jul-2009									1			09/0405	12.3	8.3	0.8	****
5-Jul-2009																
6-Jul-2009									1			09/0412	12	8.5	0.08	0.004
7-Jul-2009																
8-Jul-2009		El-Mezan		09/0414	26.4	7.4	0.74	0.067								
9-Jul-2009																
10-Jul-2009																
11-Jul-2009	8	El-Mezan		09/0472	13.3	7.7	0.22	0.021								
12-Jul-2009																
13-Jul-2009									grape	El-Mezan	3 m3	09/0476	29.6	8.0	1.15	0.105
14-Jul-2009	4	El-Mezan	3 m3	09/0478	28.4	8.0	1.43	0.098	grape	El-Mezan	2 m3	09/0479	28.2	8.0	1.41	0.097
15-Jul-2009																
16-Jul-2009																
17-Jul-2009																
18-Jul-2009									1	Adleia	6 m3	09/0500	15.1	8.4	0.25	0.022
19-Jul-2009	6	El-Mezan		09/0501	34.3	7.2	0.48	0.035								
20-Jul-2009		El-Mezan	2 m3	09/0502	12.9	8.4	0.38	0.022								
21-Jul-2009	7	El-Mezan		09/0503	12.5	7.7	0.32	0.015								
" " "	8	El-Mezan		09/0504	14.1	8.2	0.36	0.029								
" " "	9	El-Mezan		09/0505	13.5	7.7	0.76	0.063								
22-Jul-2009									grape	El-Mezan		09/0507	13.2	8.6	0.26	0.015
23-Jul-2009									2	Adleia	6 m3	09/0508	12.5	8.4	0.46	0.038
24-Jul-2009																
25-Jul-2009	1	El-Mezan		09/0513	13.0	7.5	0.64	0.055	1	El-Mezan		09/0512	13.4	7.5	0.63	0.052
29-Jul-2009																
30-Jul-2009									1	Adleia	6 m3	09/0513	10.6	7.6	0.69	0.067
31-Jul-2009									1	Adleia	6 m3	09/0514	10.4	7.1	0.64	0.061
1-Aug-2009									light	Adleia	6 m3	09/0515	2.2	8.6	0.21	0.005
10-Aug-2009	4	El-Mezan		09/0521	12.0	8.1	0.11	0.008								
" " "	6	El-Mezan		09/0522	13.0	8.3	0.14	0.011								
" " "	7	El-Mezan		09/0523	10.0	8.6	0.10	0.010								
" " "	8	El-Mezan		09/0524	12.5	8.6	0.13	0.008								
" " "	9	El-Mezan		09/0525	12.7	8.5	0.10	0.010								
28-Aug-2009																
29-Aug-2009		El-Mezan			20.9	7.1	0.34	0.018								
" " "		El-Mezan			14.7	7.2	0.31	0.004								
15-Sep-2009																
16-Sep-2009									1	adlia			7.6	8.4	0.70	0.005
17-Sep-2009									2	adlia			6.8	8.4	0.63	0.008
26-Sep-2009																
27-Sep-2009									1	adlia			13.9	7.7	0.71	0.009

Table (5): Physicochemical properties of Biofert in different localities in SEKEM

Date	Source	EC dS/m	pH	TN %	Av. N /1000	Date	Source	EC dS/m	pH	TN %	Av. N /100
8.7.	Elmizan	26.4	7.4	0.74	0.67	5.7	Adlia	12.3	8.3	0.8	
11.7	Elmizan	13.3	7.7	0.22	0.21	7.7	Adlia	12	8.5	0.08	0.04
13.7	Elmizan	29.6	8	1.15	1.05	13.7	Elmizan	28.2	8	1.41	0.97
14.7	Elmizan	28.4	8	1.43	0.98	18.7	Adlia	15.1	8.4	0.25	0.22
19.7	Elmizan	34.3	7.2	0.48	0.35	22.7	Elmizan	13.2	8.6	0.26	0.5
20.7	Elmizan	12.9	8.4	0.38	2.2	23.7	Adlia	12.5	8.4	0.46	0.38
21.7	Elmizan	12.5	7.7	0.32	1.5	25.7	Elmizan	13.4	7.5	0.63	0.52
21.7	Elmizan	14.1	8.2	0.36	0.29	31.7	Adlia	10.6	7.6	0.69	0.67
21.7	Elmizan	13.5	7.7	0.76	0.63	1.8	Adlia	2.2	8.6	0.21	0.05
25.7	Elmizan	13	7.5	0.64	0.55	10.8	Elmizan	12.5	8.6	0.13	0.08
10.8	Elmizan	12	8.1	0.11	0.08	10.8	Elmizan	12.7	8.5	0.1	0.1
10.8	Elmizan	13	8.3	0.14	0.11	29.8	Elmizan	20.9	7.1	0.34	0.18
10.8	Elmizan	10	8.6	0.1	0.1	29.8	Elmizan	14.7	7.2	0.31	0.04
16.9	Adlia	7.6	8.4	0.7	0.05	17.9	Adlia	6.8	8.4	0.63	0.08
						27.9	Adlia	13.9	7.7	0.71	0.09

Table (6): Physicochemical properties of soil samples of Sinai farm

Samples	Bulk density g/cm^3	Moisture %	EC dS/m	pH	OC %	OM %	TN %	C/N	Ash %
1	1.275	7.5	0.3	8.3	3.5	6	0.07	50.1	94
2	1.29	8	0.3	8.4	3.8	6.5	0.06	60.1	93.5
3	1.25	8.5	0.5	8.1	4	6.8	0.07	56.8	93.2
4	1.3	9.5	0.1	8.4	4.1	6.9	0.08	52	93.1
5	1.29	8.5	0.5	8.3	2.7	4.6	0.07	38.4	95.4
6	1.25	7.5	0.3	8.2	2.5	4.3	0.06	40	95.7
7	1.26	8.5	0.4	8.3	2.9	5	0.06	51	95
Average	1.27	8.286	0.343	8.286	3.357	5.729	0.067	49.771	94.271
SD	0.021	0.699	0.139	0.107	0.652	1.082	0.008	8.036	1.0828
SE +/-	0.008	0.264	0.053	0.04	0.2467	0.409	0.003	30o364	0.409

Table (7): Amount of Biofert per each treatment

Treatments	Irrigation with Biofert	No of irrigation
1st Control	Without	Without
2nd treatment	2.5 l	One / week
3rd treatment	5.0 l	One / week
4th treatment	7.5 l	One / week
5th treatment	2.5 l	Twice / week
6th treatment	5.0 l	Twice / week
7th treatment	7.5 l	Twice / week

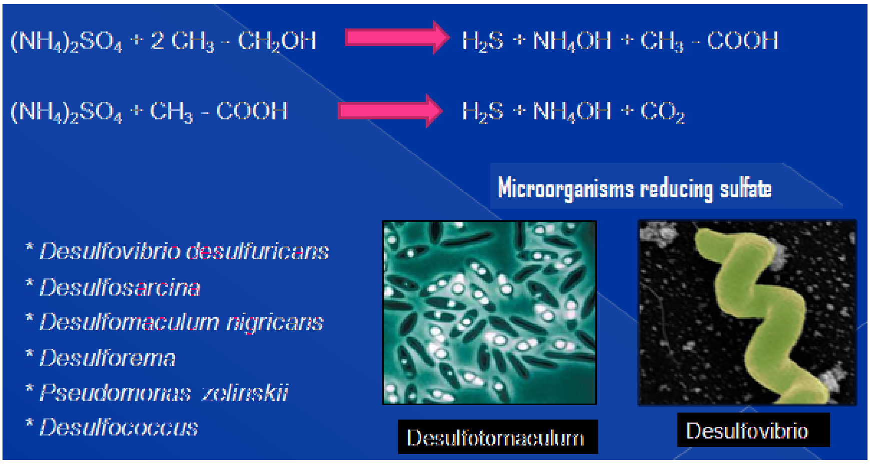

Fig (3): Sulfate reduction by anaerobic microorganisms

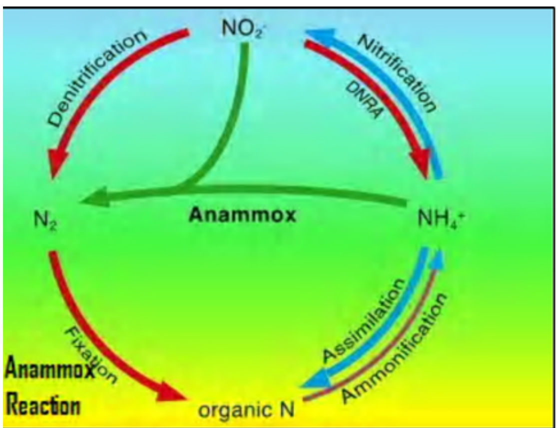

Fig (4): Anammox Reaction

Effect of biofert on potato cultivated in SEKEM farm in Sinai

The results in Table (8) and Figs. 5 (a & b) showed that the yield of potato increased gradually with increasing the rate of biofert to reach its peak (14.2 ± 1.42) at 5 l /7 m^2 twice per week. It means that this level of irrigation supported potat growth which was significantly higher than other biofert treatments and feed the plants with all nutrients required for optimal growth. The decrease of potato productivity at the highest level of fertigation may be due to the accumulation of biofert nutrients led to increase the electrical conductivity and thus effect on plant growth. So we can recommend to use biofert at 5 l / m^2 of soil. Abou-El-Hassan *et al.* (2002) studied the possibility of using the organic manure compost tea as a nutrient solution comparing with the conventional nutrient solution. They reported that organic manures gave a high quality of cantaloupe richen with vitamin C and the fruit content of NO3 was very low. Abou-Hadid *et al.,* (1989) reported that under Egyptian conditions, the use of nutrient film technique produced with organic fertilizers will be very important in the near future for reducing the cost of the nutrient solution, environment and human health

Table (8): Effect of biofert on the yield of potato in Sekem farm of Sinai.

Treatment	Biofert (L)	Irrigation No.	Fresh weigh of potato (Kg)			Average	SE ±
			Plot 1	Plot 2	Plot 3		
1	control	0	2.0	5.0	5.0	4.0	0.89
2	2.5	1	8.0	7.5	4.0	6.5	1.26
3	2.5	2	5.0	11.0	11.0	9.0	2.00
4	5.0	1	7.5	14.0	7.0	9.5	2.25
5	5.0	2	17.0	12.5	13.0	14.2	1.42
6	7.5	1	8.5	8.0	6.0	7.5	0.76
7	7.5	2	4.5	7.0	7.5	6.3	0.93

LSD at 5 % : Fertilization, 0.76 ; Irrigation, 0.72 and Interaction, 1.04

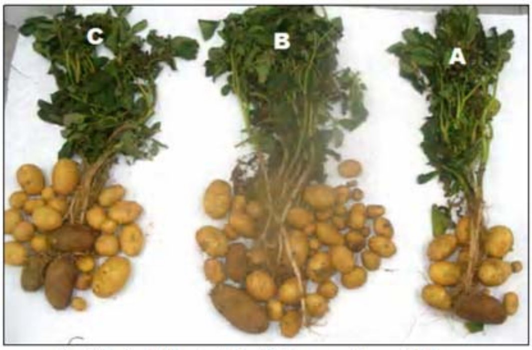

Fig (5-a): Effect of biofert on potato yield
(A = control, B = treated with 5 l twice,
C = treated with 7.5 l twice)

Fig (5-b): Effect of biofert on potato yield
(A = control, B = treated with 5 l twice)

REFERENCES

Abdel-Aty, S.A. (1997). Influence of some organic fertilizers on the growth and yield of pepper plants cultivated under plastic houses. M.Sc. Thesis, Fac. of Agric., Ain Shams Univ., Egypt.

Abou-El-Hassan, S.; U.A. El-Behairy; M.Z. El-Shinawy and A.F. Abou-Hadid (2002). Effect of using organic manure compostea as a nutrient solution on quality of cantaloupe fruits in nutrient film technique (NFT). Egypt. J. Hort. 29(3-4),461-472.

Abou-Hadid, A.F.; A.M. Zayed; U.A. El-Behairy and A.S. El-Beltagy (1989). A comparison between nutrient film technique (NFT) and soil for tomato production under protected cultivation in Egypt.Egypt.J.Hort., 16(2):111.

Allen, S. E. (1989) Chemical Analysis of Ecological Materials. 2nd Ed. Black well Sci. Pub.Osney. Oxford, London.

Audu, T.O.K.; F.A. Aisien and E.O. Eyawo (2003). Biogas from Municipal Solid Waste, NJEM, 4(1):26-30.

Balasubramanian, P.R. and R.Kasturi Bai (1992). Evaluated nutrient recovery after anaerobic digestion of cattle dung. Biomass and Bioenergy 3(5): 377-380.

Hill, M.J. (1990). Nitrate and nitrites in food and water. In Ellis Horwood, Food Science and Technology. 193 P.

Ichida, J. M., L. Krizova, C. A. LeFevre, H. M. Keener, D. L. Elwell, and E. H. Burtt (2001). Bacterial inoculum enhances keratin degradation and biofilm formation in poultry compost. J. Microbiol. Methods, 47:199-208.

Jingrang, Lu.; Susan Sanchez; C. Hofacre; J.J.Maurer; B.G.Harmon and M.D. Lee (2003). Evaluation of broiler litter with reference to the microbial composition as assessed by using 16S rRNA and functional gene marker. Appl. Environ. Microbiol., 69(2):901-908.

Keeney, D.R. (1982).Nitrogen management for maximum efficiency and minimum pollution. In: F.J. Stevenson (Ed). Nitrogen in Agriculture Soils. No. 22 in the series Agronomy. Madison, WL. USA. pp. 605-649.

Ogbeide SE, Aisien FA (2000). Biogas from Cassava peelings, Afr. J. Environ. Stud., (1-12): 42-47.

Olsen, S.R.; Cole, C.V.; Watanabe, F.S. and Dean, L.A. (1954).Estimation of available phosphorus in soils by extraction with sodium bicarbonate. US Dept. Agric., Circular No. 939, 19 p.

Olson, A.A. and L.T. Kartz (1982). Crop nitrogen requirement, utilization and fertilization. In: F.J. Stevenson (Ed). Nitrogen in Agriculture Soils. No.22 in the series Agronomy. Madison, WL. USA. pp 567-604.

Richards,L.A. (1954). Diagnosis and improvement of saline and alkaline soil. Dept. Agric.,Agric. Handbook No. 60: 17-337. USA.

Smith, S.R. and P. Hadly(1989). A comparison of organic and inorganic fertilizers: Their nitrate-N and ammonium-N release characteristics and effects on the growth of lettuce *(lettuce sativa* L.cr. Fortune). Plant and Soil, 115,135.

Snedecor, G. M. and W. C. Cochran (1969)."Statistical Methods" 6^{th} Ed. Iowa State Univ. Press, USA.

Williams, C. M.; J. C. Barker, and J. T. Sims(1999). Management and utilization of poultry wastes. Rev. Environ. Contam. Toxicol. 162:105-157.

Yongabi, K.L.; P.L. Harris; D. M. Lewis and M. O. Agho (2009). Preliminary study on the effect of anaerobically digested cow dung slurry on the antimicrobial activity of three medicinal plants. African Journal of Microbiology Research, 3 (4): 168-174

المعاملة الحيوية للمخلفات الحيوانية لإستخدامها في تسميد المزارع العضوية بالري

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** المركز الإقليمي للأغذية والأعلاف – مركز البحوث الزراعية – الجيزة – مصر.

تم في هذه الدراسة تجميع روث وبول البقر لإستخدامها كمصدر جيد من المغذيات النباتية ، و قد أجريت المعاملة الحيوية وعملية التخمير لهذه المخلفات في مخمر (مفاعل حيوي) خاص.

أظهرت النتائج أنه بعد ثلاثة أيام من المعاملة اللاهوائية فإن إضافة المولاس وخميرة العلف والفوسفات الصخري والفلسبار وخليط من المزارع الميكروبية (BIOMIX) يحتوي علي (*Bacillus*, *icrococcus*, *Pesudomonas*, *Serratia*, *Azotobacter*, nitrifying Bacteria, Sulfur–oxidizing bacteria, *Trichoderma*, *Rhodotorula*) مع التهوية الشديدة أدى إلى زيادة إذابة الأكسجين في المخمرات حتي وصلت درجة تشبعها الي 80% وأستمرت التهوية لمدة 7 أيام في كل المخمرات.

دلت النتائج أن تركيز الملوحة ازداد تدريجياً من 7.1 الي 19.3 ديسمتر/م2 في نهاية فترة التخمير، كذلك فقد زادت عملية معدنة المخلفات العضوية تدريجياً مما أدي الي إرتباط الكاتيونات والأنيونات ووصلت الي ذروتها في نهاية عملية التخمير، و نقصت درجة الحموضة تدريجياً من 7.1 الي 4.3.

من ناحية اخرى اكدت النتائج أن المحلول المتخمر (Biofert) يحتوي علي مقدار كبير من المغذيات النباتية مقارنة بالمحلول القياسي (Holland Solution) والمستخدم في تغذية البادرات بالبيوت المحمية بشركة الميزان (سيكم).

و قد أدى أضافه المحلول المتخمر (Biofert) بمعدل 5لتر/7م2 مرتان أسبوعياً الى زيادة حجم ثمار البطاطس حتى وصل الى 1.42 كجم.