Research article

Use of BioClean and Liquid Biofertilizers in the Temples for Enhancing a Natural Environment

SITTISAK UPARIVONG*

Faculty of Technology, Khon Kaen University, Khon Kaen, Thailand Email: sittisak@kku.ac.th

Received 14 December 2011 Accepted 18 April 2012 (*: Corresponding Author)

Abstract BioClean is the brand name of a liquid bioproduct, which had been produced by using various types of flowers. Liquid biofertilizers had been produced by using local available materials such as vegetables, fruits, herbaceous crops, etc. and molasses as substrate, especially added with 18 species of zymogenic synthetic microorganisms. This generation of bioclean products and liquid biofertilizers are aimed to serve to the environmental cleaning sector and the liquid biofertilizers sector for planting trees in the temples and green areas near the region of Khon Kaen University. The board of 18 zymogenic synthetic microorganisms was transferred from the original microorganisms seeding of previous research products of liquid biofertilizer, such as kku-1 and/or liquid biofertilizer biotech-1. The product composition of bioclean and liquid biofertilizers were investigated by standard methods for standard products, and the quality of products was determined by field testing with crops such as water convolvulus; flowers, and water quality treatment for fish living before servicing products to the temples for natural environment. The services project of both products were designed to treat the two temples of Wat Adulkaewmordee and Wat Nonmuang near the region of Khon Kaen University on the event of "Temples big cleaning day 2011" for natural environment treatments by utilizing bioclean products at 1:2000 (0.05%) for cleaning and wastewater treatment, and utilizing liquid biofertilizer products at 1:500 for planted trees and green areas. Furthermore, liquid biofertilizer products had been utilized to plant trees along the main road at Khon Kaen University. The evaluation results of satisfactory services rating of projects of bioclean and liquid biofertilizers to the both temples and green areas had satisfactory results as 4.26 average score value or 85.3%, evaluated by the expert board of ten committees's considerations.

Keywords BioClean, liquid biofertilizers, 18 zymogenic synthetic microorganisms (18 ZSMs), temples, environment

INTRODUCTION

BioClean is an original brand product that plays an important role as a liquid bioproduct of various flowers. Liquid biofertilizers are liquid bioproducts of various local available materials such as vegetables; fruits; some herbaceous crops; etc. Bioclean and liquid biofertilizers are produced under a similar process but only from different raw materials. The name of bioclean was used in order to solve an odour problem of liquid biofertilizers that responded the interested users. The original bioclean had been produced by using 14 diversities of odoriferous flowers since 2003 (Uparivong, 2009). The original liquid biofertilizer kku-1 had been produced since 2002 (Uparivong, 2002). For this generation products, bioclean was produced by using various flowers donated during the graduated ceremony of Khon Kaen university in 2010, meanwhile liquid biofertilizer biotech-1 and liquid biofertilizer biotech-1 and biotech-2 since 2003-2004 (Uparivong, 2004). The targets of this project were aimed to serve for environmental and healthy living places to the two temples of "Wat Adulkaewmordee" and "Wat Nonmuang" near the region of Khon Kaen university, in order to utilize bioclean services for reducing odours such as floor;

sewerage; bathroom/lavatory; wastewater treatment; water quality treatment; etc., and utilizing liquid biofertilizers services for encouraging the plantation of trees and creation of green areas. Moreover, project services had supported the promotion of green areas and plant trees along the main road at Khon Kaen University. Furthermore, bioclean could be applied for agricultural sectors as liquid biofertilizers. Thus, the utilization of liquid biofertilizers may solve the problem of degradated soil by increasing organic biofertilizers applied into soil land, and to increase the quality of organic agriculture products (Pairintra, 1991), and to improve the quality of life and health safety, and to respond the policy for agricultural products safety to kitchen of the world (Uparivong, 2004). The board of 18 zymogenic synthetic microorganisms (18 ZSMs) was selected and invented by Prof. Dr. Chaitat Pairintra, former professor at Khon Kaen University to our research project of "Improvement of the theparuge's liquid biofertilizer product" since 2002. The 18 ZSMs consisted of 9 bacteria, 6 fungi and 3 yeast species (Uparivong, 2002).

METHODOLOGY

Materials

The originality of raw materials to produce "BioClean" was obtained by selecting 14 types of odoriferous flowers such as rose; marigold ; orchid; lotus; etc. since 2003 (Uparivong, 2009), and using organic biomaterials such as vegetables; fruits; herbaceous crops; etc. to produce "liquid biofertilizers biotech-1" and "liquid biofertilizer biotech-2" since 2003-2004 (Uparivong, 2004). For this study, raw materials to produce this generation of "BioClean (v.2010)" were various flowers donated during the graduated ceremony at Khon Kaen University in 2010, and by using the previous research stocks of original microorganism seeding of liquid biofertilizer biotech-1 and liquid biofertilizer biotech-2 to produce "liquid biofertilizers biotech-1 (v.2010)" and "liquid biofertilizer biotech-2 (v.2010)". Thus, the original microorganism seeding of liquid biofertilizer biotech-1 and liquid biofertilizer biotech-2 were produced by utilizing the group of 18 zymogenic synthetic microorganisms (18 ZSMs) which consisted of 9 bacteria, 6 fungi and 3 yeast species, and transferred from the original microorganism seeding of liquid biofertilizer kku-1 (Uparivong, 2002). Molasses were supplied from sugar cane factories at the local areas of Udon Thani and Khon Kaen provinces.

Biofermentors and liquid biofermentors

Biofermentors and liquid biofermentors to produced this generation products of bioclean and liquid biofertilizers had been supplied by using the previous research equipments of biofermentors and liquid biofermentors such as a 500-L liquid biofermentor model BT-1 equipped with a motor 1 hp and with/or without a compressor air supply (Uparivong, 2004); a 500-L liquid biofermentor model BT-2 equipped with a stirrer motor 1 hp and with/or without an air pump supply (Uparivong, 2006) and a 500-L biofermentor or liquid biofermentor model BT-3 equipped with a stirrer motor 1 hp and with/or without an air pump supply (Uparivong, 2007), as shown in Fig. 1.



Fig. 1 Liquid biofermentors BT-1, 2, 3

Process methods

Methods to produce bioclean and liquid biofertilizers were the same excepting only for the different raw materials (Uparivong, 2009; 2010). For these generation productions, bioclean (2011) used the diversities of donated odoriferous flowers as mention above, meanwhile liquid biofertilizer biotech-1 (2011) and liquid biofertilizer biotech-2 (2011) utilized the previous research stocks of original fermented liquid bioproducts of liquid biofertilizers biotech-1 and biotech-2 that had been produced by using vegetables; fruits; some herbaceous crops; etc. (Uparivong, 2004; 2005; 2006; 2007). The 3 steps of this processing method are explained below.

First step, preparation: All available materials were cleaned and cut into small pieces for fermenting as the ratio as "Materials : Molasses : Microorganism seeding of liquid biofertilizer kku-1 or liquid biofertilizer biotech-1 or liquid biofertilizer biotech-2" = 3 : 1 : 1 or 3 : 1 : 2 (w/w/v), and filling clean water within biofermentors such as 20; 30; 40 gallons (75.7; 113.55; 151.4 liters) or more etc., during the retention time more than 2 weeks.

Second step, fermentation: The original liquid bio-extracted product of the first step process was separated from residues (to become solid biofertilizers), and then fermented with molasses and clean water as the ratio as "Liquid bio-extracted product : Molasses : Clean water" = 1 : 1 : 40 or 2 : 1 : 40 (v/v/v) within liquid biofermentors such as 500; 1000; 1500 liters or more etc., equipped with/or without a stirrer motor to produce the fermented liquid bioproduct during the retention time of 1-2 weeks.

Third step, filtration: the fermented liquid bioproduct of the second step process was filtered to obtain the final products as so called "BioClean" or "Liquid Biofertilizers" depending on the differential types of raw materials.

Methods to utilize bioclean and liquid biofertilizer kku-1 and liquid biofertilizers biotech-1; biotech-2; biotech-3 were utilized for environmental and agricultural sectors as follows.

For agricultural utilization: Using the dilution ratio of liquid biofertilizer products at 1:2000 by spraying or pouring to the growth crops every 5-7 days, and the dilution ratio of 1:500 to the plant trees and green areas for living places.

For environmental utilization: Using the dilution ratio of bioclean product at 0.05% (1:2000) for floor cleaning, the concentration ratio of 70-80% for reducing odour treatment of bathroom/ lavatory/ toilet/ w.c./ sewerage etc., and the concentration ratio of 0.05% for wastewater treatment and water quality treatment or water flood treatment.

Methods to quality test bioclean and liquid biofertilizers were determined before servicing to the temples and the green area at the regions of Khon Kaen University as follows:

For agricultural test: Both products were tested by cultivating for various crops to evaluate the growth rate of crops by pots and/or fields testing such as water convolvulus; flowers, etc.

For environmental and healthy test: Both products were tested by treating for sanitary systems such as reducing odour treatment for bathroom/ lavatory/toilet/wc.; sewerage; wastewater treatment and especially water quality treatment for goldfish and nile tilapiafish living, etc.

Analysis methods to investigate the composition products of bioclean and liquid biofertilizers were investigated as the same analysis methods as previous research (Uparivong, 2002; 2004; 2005; 2006; 2007) as follows:

Investigation of optimized microorganism populations: Both products were investigated by the method of standard plate count (using agar powder, peptone, bacteriological *HIMEDIA RM001*) at a laboratory of the Faculty of Technology, Khon Kaen University.

Investigation of composition of the products: Both products characteristics were analyzed, such as pH; EC (electrical conductivity, ds/m); %OM (organic matter); Total N; P; K; Na; Ca; Mg; etc. by the standard methods at a laboratory of Faculty of Agriculture, Khon Kaen University.

Methods to evaluate the satisfactory services rating of bioclean and liquid biofertilizers on the event of "Temples big cleaning day 2011" at both temples of Wat Adulkaewmordee and Wat Nonmuang, including project services to green areas and along the main road at the region of Khon Kaen University were designed by using the applied forms of the Academic Service Center of Khon Kaen University as follows:

- First, evaluation by temple's persons and monks at both temples

- Second, evaluation by general persons/home/shop owner or members/ etc. around the regions of both temples
- Third, evaluation by inviting the expert board of ten committees's considerations

RESULTS AND DISCUSSION

Properties of bioclean and liquid biofertilizers

This generation of bioclean (2011), liquid biofertilizers biotech-1 and biotech-2 (2011) were contained into bottom and tank containers such as 1-L; 10-L; 20-L; etc., as examples shown in Fig. 2. The results of effective microorganism populations of bioclean, liquid biofertilizers biotech-1 and biotech-2 obtained $1.0 \ge 10^8 - 3.4 \ge 10^{13}$ cfu/ml, $1.0 \ge 10^8 - 3.8 \ge 10^{13}$ cfu/ml and $1.0 \ge 10^8 - 4.0 \ge 10^{12}$ cfu/ml respectively, after the retention time more than 7-8 day, as in Table 1, which optimized biomass populations were more than the standard products (10^7-10^8 cfu/ml). The composition properties of bioclean products obtained were pH=3.76, EC=4.31 ds/m, N=0.018 ppm, P=25 ppm, K=561 ppm, Na=73 ppm, Ca=254 ppm and Mg=200 ppm, and liquid biofertilizers biotech-1 and biotech-2 obtained were pH=3.45-4.19, EC=3.00-5.43 ds/m, N=0.025-14 ppm, P=28-38 ppm, K=881-1023 ppm, Na=108-225 ppm, Ca=175-271 ppm and Mg=0.50-142 ppm, as in Table 1. These results obtained were similar as the previous research products of bioclean and liquid biofertilizers (Uparivong, 2002; 2004; 2005; 2006; 2007; 2009; 2010).



Fig. 2 BioClean and liquid biofertilizer biotech-2 (2011)

Product Sample	Optimize	pH_{w}	EC	OM	Ν	Р	K	Na	Ca	Mg
$(2011)^{a}$	cfu/ml		(ds/m	(%)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
)							
BioClean (original)	6.0×10^{12}	4.32 ^b	2.50	-	10	26	598	82	205	131
BioClean	3.4×10^{13}	3.76	4.31	-	0.018	25	561	73	254	200
Liquid biofertilizer	3.8×10^{13}	4.19 ^b	3.00	-	14	28	811	108	271	142
Biotech-1										
Liquid biofertilizer	4.0×10^{12}	3.45	5.43	1.43	0.025	38	1023	225	175	0.50
Biotech-2										

 Table 1 Properties of bioclean and liquid biofeftilizers biotech-1, 2

^{*a*}The generational products had produced since 2011, ^{*b*}The pH_w (1:5)

Quality testing of bioclean and liquid biofertilizers

Quality of bioclean and liquid biofertilizers biotech-1, 2 were tested for quality standard products before distributing to general users by the pots and/or fields testing. For agricultural testing, both products of bioclean and liquid biofertilizers were tested by the growth rate of various crops such as water convolvulus; flowers, etc. during 45 days (data not shown). For environmental and healthy testing, both products were satisfactorily evaluated by testing for sanitary systems such as reducing odour treatment for the bathroom/ lavatory/ toilet/ wc./ sewerage of distributed general households by responding feedback of users. For wastewater treatment, the efficiency of chemical oxygen

demand (COD) of pond treatment was 61.90% and 89.80% by using the dilution ratio of 0.05% bioclean product during the retention time of 7 days and 14 days respectively, at a pond treatment of Wat Nonmuang near Khon Kaen University, including water quality treatment for goldfish and nilefish, as shown in Fig.3.



Fig. 3 BioClean and liquid biofertilizers testing (2011)

Compositions	Biotech-1	Biotech-2	Biotech-3	
pH	4.28	4.73	4.64	
EC (mS)	13.23	8.72	7.30	
N (%)	0.24	0.075	0.376	
P (%)	0.083	0.070	0.037	
K (%)	0.20	0.193	0.135	
Ca (% or mg/L)	1629 mg/L	0.023	0.071	
Mg (% or mg/L)	570 mg/L	0.042	0.026	
Na (% or mg/L)	303 mg/L	0.003	-	
SO ⁻⁴ (%)	-	-	0.024	
OC (%, g/100mL) C/N	-	1.16	0.97	
	5.33	15.47	2.78	

Fable 2 Properti	es of original	liquid biofertilize	ers1
1		1	

¹ Source reference: the development of biofermentor BT-3 (sittisak, 2007)

Evaluation rating by temples on the big cleaning day

Project products of bioclean and liquid biofertilizers were supplied to the two temples of "Wat Adul kaew mordee" and "Wat non muang" near the regions of Khon Kaen University on the event of "Temples big cleaning day 2011". The results of evaluation services rating after used for floor cleaning; sewerage; toilet/wc.; wastewater treatment and water quality treatment by using bioclean products, and supplied to plant trees and green areas by using the products of liquid biofertilizers biotech-1, 2 at the both temples were satisfactory, which overview obtained satisfactory results as 4.26 average score value or 85.3%, evaluated by the expert board of ten committees's considerations.



Fig. 4 Big cleaning services to the two temples

Service products applied along the main road and green areas

The serviced products of liquid biofertilizers biotech-1, 2 were satisfactorily applied as liquid biofertilizers for plant trees along the main road (Kaenkallapaphruek road) and green areas, living places at Khon Kaen University, during proceeding services as shown in Fig. 5.



Fig. 5 Liquid biofertilizers services along the main road and green areas

CONCLUSION

BioClean services to the temples: BioClean services consisting of 18 zymogenic synthetic microorganisms (18 ZSMs) could be used as an odour treatment for sanitary systems and environmental and healthy living places, and for temples.

Liquid biofertilizers services along the main road and green areas: Liquid biofertilizers services, consisting of 18 zymogenic synthetic microorganisms (18 ZSMs) could enrich much more to the plentiful trees along the main road and green areas for natural environment living places and related to climate change.

ACKNOWLEDGEMENTS

This research was financially supported by grants from the Academic Service Center of Khon Kaen University, Thailand. Acknowledgements are extended to the expert board of ten committee's considerations, to Mr. Boonyarit Sombutlai, Mr. Rachaporn Patawanit, Mr. Soontorn Sarapanich, Asst. Prof. Dr. Araya Ahromrit, Asst. Prof. Dr. Somsak Pitaksanurat, Assoc. Prof. Dr. Sirinda Yunchalard, and Assoc. Prof. Dr. Pinit Wangsomnuk, Pol. Sub. Lt. Suwith Nampan, Pra Petcharat Kachapanyo, and Pra Veerasak Jantemduang.

REFERENCES

- Pairintra, C. et al. 1991. Zymogenic synthetic soil and crop "Agricultural in the next new century". ISBN 974-55-251-3.
- Uparivong, S., Prachankanchana, S. and Pairintra, C. 2002. Product development on liquid biofertilizer of the theparuge's agricultural community. J. of Academic Service Center KKU, 11(3), 37-41.
- Uparivong, S. et al. 2004. Production of liquid biofertilizer to kitchen of the world. The 16th Annual Thai Society for Biotechnology. Phitsanulok, Thailand.
- Uparivong, S. 2005. The production of liquid biofertilizer. Asian Wetland Symposium 2005. Innovative Approaches to Sustainable Livelihood. Bhubaneswar, India.
- Uparivong, S. et al. 2006. Liquid biofertilizer fermentor and microorganism biofermentor of model BT-2. Int. Conf. on TISD. 2006. Technology and Innovation for Sustainable Development Conference, Khon Kaen, Thailand.
- Uparivong, S. 2006. 18 Zymogenic synthetic microorganism of liquid biofertilizer Biotech-3 for agricultural and environmental. The 18th Annual Thai Society for Biotechnology, Bangkok, Thailand.
- Uparivong, S. 2007. The development of biofermentor BT-3. Int. Conf. on IAEC2007 International Agricultural Engineering Conference. Asian Institute of Technology (AIT), Bangkok, Thailand.

- Uparivong, S. 2009. BioClean. Int. Conf. on Innovations in Agricultural, Food and Renewable Energy Productions for Mankind. The 10th Annual Conference of Thai Society of Agricultural Engineering, Surasammanakhan, Suranaree University of Technology, Nakhon Ratchasima, Thailand, 173-175.
- Uparivong, S. 2009. Utilization of liquid bioferilizer for mankinds. Int. Conf. on XXXIII CIOSTA CIGRV Conference 2009. Technology and Management to Ensure Sustainable Agriculture, Agro Systems, Forestry and Safety. Reggio Calabria, Italy, 1391-1395.
- Uparivong, S. 2010. BioClean a new friendly environmental cleaning product. Int. Conf. on Workshop on "Livelihood and Health Impacts of the Climate Change: Community Adaptation Strategies", Pullman Raja Orchid Hotel, Khon Kaen, Thailand, 122-128.
- Uparivong, S. 2010. BioClean for environmental biotechnology of canteens and green area. Int. Conf. on Biotechnology for Healthy Living. The 22nd Annual Meeting of the Thai Society for Biotechnology. Prince of Songkla University, Trang Campus, Trang Province, Thailand, 849-857.