UTILIZING SERI WASTE TO PRODUCE VALUABLE BIO-GAS AND PRODUCTION OF BIO COMPOST

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ABSTRACT

To avoid chances of spreading of diseases, recycling the silkworm litter for generation of bio gas along with cow dung slurry and generation of nutrient enriched compost is the best remedy found and hence a study was made to recycle the silkworm litter as a source of energy for bio gas production. Bio gas plants of 1 cubic metre (Cum) capacity were established at two farmers in Dasarpally village of Hosur Taluk and three farmers in Bagulur village of Denkanikotai in Krishnagiri district of Tamil nadu.

The results revealed that a farmer could generate bio gas by using cow dung in combination with silkworm litter in 3:2 ratios by consuming 15 kg of cow dung and 10 kg of silkworm litter daily. By mixing in the above ratio, the farmer could generate 433 m^3 gas per year. This helped to save 1.5 MT of Fire wood, 220 l of kerosene or 11 cylinders (157 kg) LPG-Liquefied Petroleum gas per year with corresponding savings of Rs.4000 to Rs.4520 per year. In addition to the saving of fuel, improved the sanitation surrounding the rearing house resulted in protection of crops from pathogens of protozoan, viral, bacterial and fungal origin. Added to this, conversion of cow dung mixed silkworm litter helped to generate nutrient enriched bio - compost that directly influences on the quality of mulberry leaf and ultimately on quality cocoon. This aspect broadly helped not only in reducing environmental pollution, crop failures due to contamination but also minimizing the expenditure on fuel to the Sericulturists.

Key words: Silkworm litter, bio gas, slurry, bio compost.

INTRODUCTION

In India, the mulberry leaf production of silkworm rearing is approximately sixty lakh MT/year from which about 6.0 lakh MT dry faces is produced every year. Since dry faces contain 2.5% - 3.0% nitrogen, approximately 18,000 MT of nitrogen can be produced annually. Usually, the silkworm would discharge 1 kg dry faces after consumption of every 10 kg mulberry leaf. The prevention of environmental pollution through recycling of waste is difficult to quantify but it will be several times valuable as clean environment is today's need. If 60% of the total dung available is fed in to biogas plant, this can generate 470 MT of organic manure.

Transfer of pathogens is possible through silkworm litter by which diseases like pebrine (Protozoan), grasserie (viral), flacherie (bacterial) and muscardine (fungal) spread and result in severe silkworm crop loss for the sericulture farmers. These pathogens are known to cause crop losses to an extent of 20-25% which is significantly higher compared to the loss due to diseases in China where it is as low as 3-5%.The crop loss and low production in India has been mainly attributed to the diseases in silkworm[3]. The diseases in silkworm are contagious and sanitation in silkworm rearing premises must be ensured to prevent contamination and disease spread. However, the concept has not gained ground among the farmers. Unscientific mode of disposal of the disease larvae/silkworm litter by the farmers' also increases the disease spread. These practices nullify the effect of disinfection and causes secondary infection leading to crop loss and melted cocoons. Crop failures and low harvest of cocoon in silkworm rearing are primarily due to diseases.

It may often be seen that the farmers practicing shoot rearing also dump the silkworm litter in the vicinity of the rearing atmosphere although burning the bed refuse in the form of shoot. Improper recycling of silkworm litter in the form of compost also enhances the chances of secondary contamination as many farmers are in the habit of directly applying the silkworm litter in the mulberry garden. To avoid such chances of spreading of diseases, recycling of the silkworm litter for generation of biogas along with cow dung slurry and generation of nutrient enriched compost is the best alternative suggested for biogas production as well as generation of compost.

MATERIAL AND METHODS

Biogas plants of 1 cubic meter (Cum) capacity were established initially with two farmers of Dasarpally village of Hosur taluk and three farmers of Bagalur village of Denkinikota in Krishnagiri district of Tamilnadu during 2013-14 with the co-operation of the District Manager, NEDCAP (Non conventional Energy Development Corporation of Tamil nadu.) Krishnagiri.

The farmers fed the plants initially with 2-3 cart loads of raw cow dung along with 850-900 gallons of water. When once the generation of biogas started, the farmers used to feed the biogas plants with cow dung slurry and silkworm litter in 3:2 ratio after thorough mixing of the both with 25 litres of water daily. The biogas slurry mixed with silkworm litter after utilization was again converted as enriched compost by diverting the same into adjoining pit dug at the mouth of the outlet of biogas plant from where the slurry comes out. The compost pit was added with a mixed culture of earthworms consisting of *Eudrilus euginae, Eisenia fetida and Perionyx excavatus* @ 1500 gram/ton followed by 400-500 g/ton of *T.viride* as a bio fungicide. This was

continued by sprinkling of supernatant of curd as a bacterium culture in the ratio of 1:10 with water to hasten the process of compost. The composting process was retained for a period of 4 months with one turning every month. The farmers could harvest enriched compost @ 1 MT for every 120 cubic feet in a period of 3 to 4 months. The pits were dug as per the convenience of the individual farmer. Economics of biogas production, production of bio compost and reduction in melting percentage of cocoons and yield improvements were studied. The data on decrease in melting percentage and cocoon yield improvements were statistically analyzed (ANOVA).

RESULTS AND DISCUSSION

The mixture of cow dung slurry and silkworm litter generated 1.16m^3 of biogas daily (Table 1). This could cater to the cooking need of a family size of four as 0.28 m^3 of gas is required/person/day. A farmer possessing one buffalo could get 25 to 30 kg of raw cow dung daily. Approximately, 3650 kg (3.65 MT) of silkworm litter was made available from tray rearing of 2500 dfls in 10 crops @ 250 dfls/ac/crop for two acres of land in a year, where as a farmer having one acre of mulberry could get approximately 1825 kg (1.83 MT) of silkworm litter from 5 crops in a year. Such litter was properly recycled using cow dung, and silkworm litter in 3:2 ratios. Likewise the farmers were benefited not only using silkworm litter for production of biogas but also generated their own source of enriched compost. The economics of biogas production using silkworm litter in combination with cow dung slurry helped to save 1.5 MT of fire wood worth of Rs.3000, or 220 liters of kerosene oil worth of Rs.3300 or 11 LPG cylinders worth of Rs.3520 per annum which are subject to variation in the day to day market (Table 2**).** Approximately 1.7m^3 of biogas can be generated by use of 30 - 40 kg of silkworm liter per day. This supplements the use of cowdung.

The biogas slurry was later diverted into pits of different sizes, where semi digested crop residue was applied layer by layer in which culture of bio control agents like *T.Viride* was added. *T.Viride* is a saprophytic fungi used as cellulose decomposer which also acts as a phosphate solubiliser and bio pesticide produce enough chitenase extra cellularly to lyses the walls of other pathogenic fungi. For this 40 kg of powdered neem cake was taken added with 400-500 g of *T.Viride* sprinkled with water and retained for one week covering with a wet gunny cloth. Also other agents like *Psedomonos fluorsecesns* were added which act as phosphate solubilizers and also has the ability to synthesize hydrogen cyanide which is known to inhibit expression of pathogenic fungi by hydrolyzing fusaric acid. In addition to the above regular sprinkling of culture of supernatant of curd as bacterium source in the ratio of 1:10 with water was done every alternate day to hasten the process of decomposition. This process was continued for one month and retained for degradation process for another 3 on this with two to three turnings in between. The farmer wise generation of bio compost @ 3 times/year like 4 months interval was calculated @ 1 ton/120 Cu ft of the pit (Table 3).

Biogas plant manure in addition to providing macro elements like N P & K and trace elements like iron, copper, boron etc., also improves soil's water retention capacity because of the humus content in it. Biogas manure also buffers pH change in the soil and thus equilibrium of the soil is maintained[1&4]. Biogas slurry, Poultry manure, compost and press mud have been found to be superior sources of Zinc as compared to zinc Sulphate particularly in zinc- deficient calcareous soil.

Proper recycling of silkworm litter not only helped to reduce the melting percentage in cocoons due to reduction in transfer of pathogens but also improvement in cocoon yields. The melting percent and cocoon yields of the farmers under study indicated that the melting percentage ranged from 9.78 to 10.28 where as the average yield was between 46.45 to 47.60 kg/100 dfls between 2013-2014 (April-Dec){considered 4 crops only as 4 crops could be harvested by the farmers between April-December during 2004-05 when the experiment was under progress} The proper recycling of silkworm litter could bring down the melting percentage up to 6.48 % and improvement in cocoon yield to 54.45 kg/100 dfls. (Table 4).

Thus proper recycling of silkworm litter not only helped to reduce the melting percentage in cocoons due to reduction in transfer of pathogens but also improved in cocoon yield. Added to this, systematic utilization of silkworm litter for generation of biogas saved expenditure on fuel to the farmer. Thus the farmers could reduce crop loss effectively by properly recycling silkworm litter and getting more benefits from biogas (fuel), slurry (fertilizer) and sustainability in cocoon production.

Table – 1

Generation of Biogas using silkworm litter in combination with cow dung (1 Cum capacity)

Requirement/day			**Requirement/year**			**Gas output/day (m^3)**			**Gas output/year (m^3)**		
Cow dung (kg)	Silkworm Litter (kg)	Water (l)	Cow dung (MT)	Silkworm Litter (MT)	Water (gallons)	Cow dung	Silkworm litter	Total	Cow-Dung	Silkworm litter	Total
15	10	35	6.48	465	2028	0.70	0.66	1.16	218	203	423

Table – 2

Economics of biogas production using silkworm litter in combination with Cow dung slurry (1 Cum capacity)

Gas out put/year (m^3)	Corresponding saving of fuel/year			Corresponding saving of Income (Rupees)			Calorific value of the biogas plant (K.cal)
	Firewood (MT)	Kerosene (l)	LPG (kg/cylin-ders)	Firewood	Kerosene	LPG	
523	1.50	220	157 (11cylinder)	3000.00	3300.00	3520.00	1988100

$1m^3$ gas = 3.5 kg firewood or 0.52 litres of kerosene or 0.37 kg of LPG.

$1m^3$ gas = 4700 Kilo calories or 20 MJ.

Table - 3

Farmers generating bio compost using biogas slurry mixed with silkworm litter

Name of the farmer	Village	Pit size (Cft)	Harvesting Capacity of the pit (MT)	Compost Generated/year (MT)*	Sufficient for (in ha of land)
Rajappa	Berigai	2525	31.00	73.00	4.15
Basker	Sigaralaplally	808	7.75	30.00	2.00
Basvaraj	sigaralapally	1004	7.35	35.00	1.25
Manjunath kumar	K.N.Doddi	700	5.00	22.00	0.60
Ramanathan	Narsipuram	500	6.00	17.00	0.75

*3 times in a year at every 4 months interval.

Table - 4

Influence of recycling of Silkworm litter on reduction in melting percent and silkworm cocoon yield improvement

Sl. No.	Year (period)	Melting % of cocoons	Average Yield of Cocoons/ 100 dfls (kg)
1	2016 (April-Dec)	10.81	47.60
2	2017 (April-Dec)	11.28	47.20
3	2018 (April-Dec)	8.78	46.45
4	2019 (April-Dec)	7.48*	54.45*
	CD at 5%	0.75	2.21
	CV%	12.91	7.10

* Decrease in melting percentage of cocoons and increase in cocoon yield

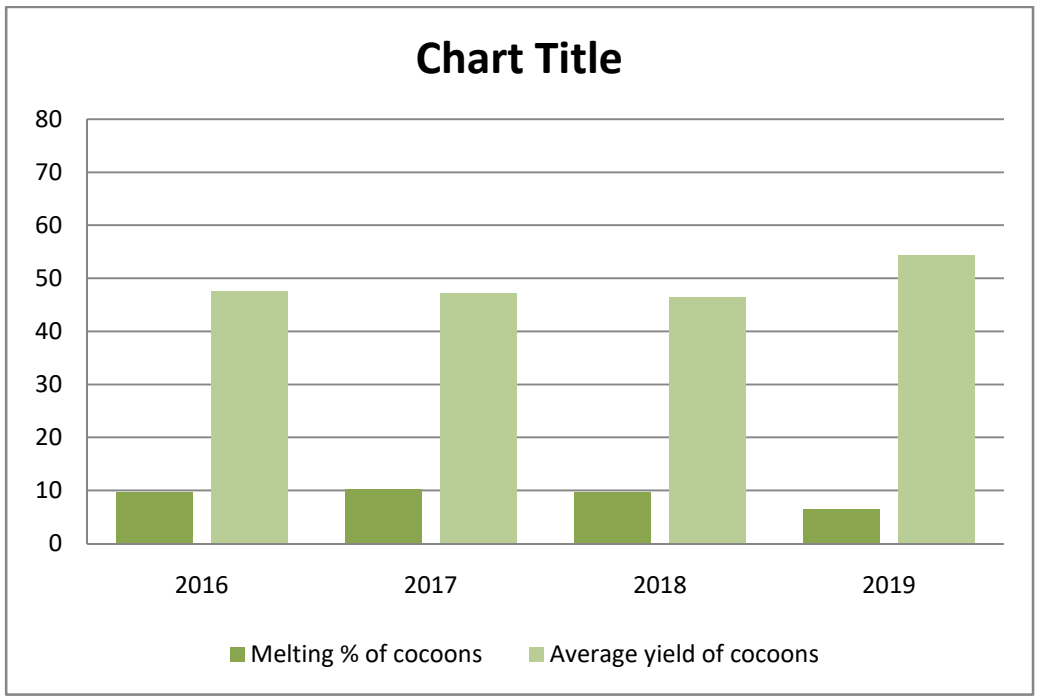

Fig.1. Decrease in cocoon melting percentage and increase in cocoon yield through recycling of silkworm litter.

CONCLUSION:

The growing demand for renewable energy compels the search for new substances and the adoption of new technologies for the biogas and bio-compost production. This study found that biological treatment using microorganisms is a viable alternative for generation of the bio-energy and bio-compost development. The process, which indicated that it is important to explore optimal conditions for anaerobic co-digestion of cow dung, as well as Seri waste treatment to manage the landfill crisis. The result showed that cow dung and silkworm litter has great potentials for generation of biogas and the use was encouraged due to its nutrient enriched bio-compost development along with the release of high volume of biogas yields. Anaerobic degradation of organic material requires a well functioning microbial consortium, and enriched bio-compost requires mixtures of earthworms and bio-fungicide, were responsible for the digestion process of organic nutrients. The anaerobic digestion is a carried out by complex microbial process, in future a broad range of studies have been aimed to understand the relationship between the microbial community, operating conditions and final yield by process performance. Depending on the source of the Seri waste, toxic level and the presence of the inhibitory compounds could be affecting the anaerobic digestion, which effects in biogas production and bio-compost. In addition, in this work, the full-scale deployment of t AD technology in the biogas plant will be significantly relay to the flux levels of the process of microbial digestion that have been achieved during long-term activity. The effect of organic composition in the substrates, which promotes upto 1 MT of bio-compost per 120 cubic feet area in period of 3 months. The study reveals that the mixture of cow dung slurry and silkworm litter was generated about 1.16m^3 of biogas as daily production. Moreover, further studies are needed to better understand the benefits of AD in bio manure and biogas production process. Our research evidently reveals that, Seri waste and cow dung bio-energy production were more economic feasibility. The study showed that it is possible to use biogas with at least In the future, the utilization of Seri waste for bio valuable products could be one of the options to treat the Seri waste and generating renewable energy.

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