Use of Eupatorium (Chromolaena odorata L.) in Biogas Production

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Abstract: Biogas technology in which biogas is derived through anaerobic digestion of biomass, such as agricultural wastes, certain weed species, municipal and Industrial waste (water), is one such appropriate technology. In this study the biogas production potential of eupatorium an obnoxious found in abundance in Western Ghat region of Karnataka in various proportions with cow dung has been studied under field conditions by using capsule model biogas plant. Volume of gas produced per day was measured by using IRGA Gas Flow Meter. The maximum biogas was recorded in treatment having cow dung and eupatorium in 3:1 proportion (757 litres per day) followed by 4:1 proportion (754 litres per day) and 5:1 (701 litres per day) proportions as compared to with that of cow dung alone (555 litres per day). Inclusion of eupatorium in higher proportions (1:5, 1:4, 1:3, 1:2 and 1:1) known to reduce the bio-gas production to a significant level.

Index Terms: Eupatorium, obnoxious weed, cow dung, biogas

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1. INTRODUCTION

Energy plays a significant role in the lives of the small and marginal farmers. They need energy mainly for cooking and lighting. Fuel wood is the principal farm-based source of energy but is often in short supply. Under the present situation, there is an urgent need in replacing conventional energy with the renewable energy to save our natural resources and our environment. Biogas holds the greatest promise as a cheap household energy source because it is renewable, simple to generate, convenient to use and cheap. Biogas is a gas produced by anaerobic fermentation of different forms of organic matter and is composed mainly of methane (CH_4) and carbon dioxide (CO_2). Various wastes have been utilized for biogas production and they include animal wastes [6-8], industrial wastes [9] and food processing wastes [10]. Certain weeds are one of such biomass being considered as a potential feed stock for biogas production [11-13].

Eupatorium (*Chromolaena odorata*), native to sub-tropical and tropical America is considered an obnoxious and rapidly spreading weed in many parts of the world and was reported to be introduced to India in the 1840's (Mc Fadyen, 1989). It is now well established in north-eastern and southern states particularly in Assam, West Bengal, Orissa, Karnataka, Maharastra, Tamil Nadu and Kerala. In Karnataka, eupatorium has been spread

extensively in Western Ghat section of Karnataka and became a menace in plantations, forests, marginal lands and open areas because of its capability to grow efficiently under wide variety of agro-ecological situations. Studies conducted under laboratory conditions revealed that eupatorium found to enhance the biogas production when used along with cow dung. (Jagadish *et al*., 1990 and Srinivas, 1999). There is a need to study the feasibility of using this eupatorium in biogas production under actual field conditions. Keeping these points in view, the present study was undertaken to investigate the production of biogas by using eupatorium along with cow dung under field conditions.

II MATERIAL AND METHODS

The present study was undertaken at Agricultural Research Station (Paddy), Sirsi of University of Agricultural Sciences, Dharwad, Karnataka, India. In this study, appropriate quantity of eupatorium to be used for supplementing/substituting cow dung for bio-gas production was studied. The details of the treatments are given in Table 1. Two capsule model biogas plants of 1 M^3 capacity were constructed for this experiment purpose. Each treatment was studied for a period of three months in which the first one and half months have been utilized for treatment stabilization and the remaining one and half months for taking observations. For biogas production, only the tender portion of eupatorium plant was used as per the treatments. Total mixture used per day per plant was 50 kg. In order to reduce the inhibitory effect of eupatorium on methanogenesis microorganisms, the eupatorium plant has been chaffed into small pieces of 1-2 cm and soaked in water for a week period in plastic trays (Plate 1) and then this partially decomposed eupatorium material was fed to biogas plant along with cow dung (Jagadeesh *et al.*, 1990). The biogas produced in each biogas plant has been recorded two times in a day by using IRGA Gas Flow meter for a period of one hour by leaving the gas to the air (Plate 2). Average daily production of biogas (liters/day) per unit was worked out and presented in the Table 1. After completion of each treatment, the biogas plants were cleaned thoroughly and used for next treatment. The biogas slurry at the completion of each treatment has been collected and subjected to nutrient analysis for major, secondary and micro nutrients by following standard methods.

III. RESULTS AND DISCUSSION

The results of the experiment conducted to know the feasibility of using eupatorium as a supplement along with cow dung in different proportions on biogas production indicated that the production of biogas (liters per day) was increased with supplementation of eupatorium with cow dung in various proportions. The bio-gas production with application of cow dung alone was 555 liters per day. The bio-gas production was increased when eupatorium was substituted with cow dung. The maximum biogas was recorded in treatment having cow dung and eupatorium in 3:1 proportion (757 litres per day) followed by 4:1 proportion (754 litres per day) and 5:1 (701 litres per day) proportions. The per cent increase in bio-gas production with various proportions of cow dung + eupatorium viz., 3:1, 4:1 and 5:1 as compared to using cow dung alone was 36.4%, 35.9% and 26.3%, respectively. The enhanced biogas production with use of eupatorium along with cow dung was due to favouring effect eupatorium on the growth of methanogenic bacteria (Jagadeesh, 1990; Srinivas, 1999). Several workers reported beneficial effect of different weeds in enhancing biogas production (Vaidyanathan et al., 1985; Verma et al., 2007; Momoh and Nwaogazie, 2008; Tika Sapkota, 2012; Sudhakar et al. 2013).

Inclusion of eupatorium in higher proportions (1:5, 1:4, 1:3, 1:2 and 1:1) known to reduce the bio-gas production to a significant level. The extent of reduction in biogas production in these treatments was more than 50% as compared to that of biogas produced in cow ding alone treatment. In these treatments, the bio-gas plant was completely clogged with eupatorium material within 15 to 20 days after imposition of these treatments. Hence, we were forced to remove all the un-digested material in the middle of the treatment period (Plate 3). The nutrient content of bio-gas slurry was also found to improve with inclusion of eupatorium as substrate along with cow dung as compared to use of only cow dung. The nitrogen content of biogas slurry in cow dung alone treatment was 1.68% and it was found to increase to 1.75 to 2.25% in treatments where eupatorium was supplemented with cow dung in varying proportions.

IV. CONCLUSION

The study has shown that eupatorium an obnoxious weed found in abundance in different parts of India particularly in Western Ghat region of Karnataka can be considered as good feed stock for biogas production. This weed is known to pose great problem in younger

plantations and also known to cause diseases in animals and human beings can be utilized for energy generation. The study has clearly shown that the biogas production was increased when pre digested eupatorium was added along with cow dung in different proportions. By considering the extent of increase in bio-gas produced and ease of using eupatorium (non clogging of biogas plant) for supplementing cow dung in bio-gas production, it can inferred that the ratio of cow dung and eupatorium in 4:1 and 5:1 proportions is ideal for bio-gas production.

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