Seaweed Res. Utiln., 25 (1 & 2) : 165 - 168, 2003

Agar factory discharge as fuel and manure

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ABSTRACT

Agar factory waste was tried as fuel for cooking and manure for cow pea. Seedlings of cow pea (*Vigna ungiculata*) supplied with agar factory waste powder, showed improved seedling vigour. The total length of the seedlings (85 - 87%), wet weight (194 - 329%), number of leaves (31 - 38 %) and number of root nodules (42 - 92%) increased than those of control. Out of the two treatments of basal application of agar waste powder, one time application at the time of sowing seeds registered maximum vigour over the control as well as the other treatment which received similar quantity in three intervals. As the 'fuel cakes' prepared out of agar factory waste registered high energy content (19 %), high ash content (20 %) and high rate of combustibility (5 min and 20 sec), these ' fuel cakes' can be ideally used as fuel for cooking .

Introduction

Utilization of seaweeds for commercial purposes was started in India since three decades ago. Coastal farmers with ready access to sea have used seaweeds as green manure (Booth, 1967). Compared to the popular brand of farmyard manure, seaweeds are known to contain similar nitrogen values, about one third as much as phosphate and about three times as much as potassium (Chapman and Chapman, 1980). Besides phycocolloid production, use of seaweeds as bio fertilizers and liquid seaweed fertilizers are on the rise (Bukhari and Untawale, 1978; Gandhiappan and Perumal, 2001; Anantharaj and Venkatesalu, 2002; Rajkumar and Subramanian, 1999; Arunkumar *et al.*, 2002). In India, now exists nearly 40 factories producing agar and algin. All these factories are cottage industries utilizing one ton dry raw materials per week (Kaladharan and Kaliaperumal, 1999). Polysaccharide yield from such factories is not more than 15% and daily discharge of 80 - 85% waste is being piled up in huge quantities unutilised. The maiden attempt on the use of Agar Factory Discharge (AFD) as manure for field crops and as a fuel for cooking is presented in this paper.

Materials and Methods

Fresh Agar Factory Discharge (AFD) was collected from the factory functioning at the CMFRI Regional Centre, Mandapam. A part of AFD was used as fuel in the form

of fuel cakes. Fuel cakes were made by mixing fresh AFD (paste like)with equal proportion of rice husk or saw dust and made into small flat cakes and dried in sun. The dried fuel cakes were tested for energy content (Bomb calorimetry), ash content and burning efficiency. Burning efficiency of fuel cakes were compared with fire wood and the ingredients separately from the time taken to reach boiling point of 100 ml water.

Another part of the AFD was dried in sun over a nylon mesh screen to obtain powder upon crushing. The powdered AFD was used as manure. 15 pots of uniform size were selected and filled with sand washed with excess water. Five pots were mixed with 30 g of powdered AFD and labelled as E-1 and another set of five pots were mixed with 10 g of powdered AFD and labelled as E-2. Remaining five pots were not mixed with AFD and labelled as C (control). Seeds of cow pea (*Vigna unguiculata* L.) were sown in pots at 2 numbers in each pot. All the pots were kept in sunlight and watered 100 ml per pot twice a day so that no water drained out of the pot and was just sufficient to keep the contents of the pots moist. After 10 days and 20 days, 10 g of powdered AFD was added to each E-2 pots by forking the base of the germinated seedlings. Other sets of E-1 and C were just forked without adding AFD. After 30 days, the cow pea seedlings were plucked carefully from each set of pots and washed in water to take measurements of shoot length, root length, total length and weight, number of leaves and root nodules.

Results and Discussion

Fuel cakes made out of AFD were comparable and higher than the energy content and the rate of combustion of fire-wood (Table 1). Energy content in the fuel cakes made of FAD was 19 % higher than the AFD itself and 15 % higher than the firewood pieces. Similarly the ash content and rate of combustion of fuel cakes made of AFD were considerably higher than the firewood indicating the superiority of the AFD fuel cakes as fuel for cooking. The Government of India set up a Fuel Policy Committee (FPC) to assess the nation's energy scenario and found that nearly one half of the total energy comes from the non conventional resources that are biomass - based fuels such as fire wood, charcoal, cowdung and vegetable waste. According to 1991 census, it is known that 39 % households in urban area and 92% households in rural areas use biomass based fuels. AFD can be incorporated in to fuel cakes at least in areas where agar factories are functioning.

Although agar has wide applications, AFD, nearly 80% of the raw material used for agar production is discharged and is unutilised and gets accumulated in the factories. The total

Table 1. *Energy and ash content and combustibility of AFD fuel cakes and their ingredients*

Sample	Energy content (calories/g)	Time taken by water to attain 100°C	Ash (%)
Agar factory discharge	2758±39.50	6 min. 25 sec	14.15
Fire wood pieces	2865±36.43	6 min. 15 sec	20.17
Fuel cake made with rice husk	3345±31.02	5 min. 20 sec	22.36
Fuel cake made with saw dust	3238±34.24	5 min. 30 sec	21.04

annual agar production in India ranges from 110- 132 tonnes utilising about 882-1110 tonnes dry weight annualy (Kaladharan and Kaliaperumal, 1999). AFD mixed with sawdust or rice husk is the cost effective source of fuel for cooking or for boiling seaweeds in the agar factories itself. Although a number of studies have been conducted on production of fuel gas from *Sargassum* (Sreenivasa Rao *et al.*, 1979), methane and alcohol (Flowers and Byrle, 1977), production of fuel cake from AFD that can be used conveniently as fuel for cooking, probably be the first of its kind.

When AFD powder was used as manure as basal application to cow pea, the number of leaves (31- 38%), length (85- 87%) and weight (194 - 329%) of seedlings, number of root nodules (42-92%) were higher in seedlings supplied with AFD than the control (Table 2). These results clearly indicate the nutritive value of AFD to cow pea seedlings. The striking increase in the growth characteristics of cow pea seedlings might be due to the organic matter, humic materials and trace elements present in the AFD, besides improving the soil characteristics such as water holding capacity and high levels of nitrogenous materials (Newton,1951; Chennubhotla *et al.*,1987; Kaladharan *et al.*, 1998). In the present study, among the two treatments (E-1 and E-2) of basal application of AFD, one time application of 30 g per seedling (E-1) is recommended, as this treatment resulted maximum seedling vigour than the periodical application (E-2) or nil (C) application (Table-2). It can be hence surmised that AFD is no more a waste and can be processed and marketed to use as manure for field crops and as fuel for cooking.

Acknowledgements

The authors thank the Director CMFRI and to the Head of FEM Division for the encouragements extended. One of the authors (SKK) is grateful to the ICAR, New Delhi for financial support received while carrying out the study.

Literature cited

Anantharaj, M. and V. Venkatesalu 2002. Studies on the effect of seaweed extracts on *Dolichos biflorus*. *Seaweed Res. Utiln.*,24(1): 129-137.

Arunkumar, K., T. Puhazhendi, S. Subramanian, N. Thangaraju and R.Rengasamy 2002. Alleviating the effect of seaweed liquid fertilizer on water stressed black gram Vigna mungo(L.) Hepper. *Seaweed Res. Utiln.*, 24 (1) : 151-158.

Booth, E. 1965. The manurial value of seaweed. *Bot. Mar.*, 8: 138-143.

Table 2. *Effect of basal application of AFD on the growth of cow pea seedlings (mean ± SD, n = 10)*

Treatment	Length of seedlings (cm)	Weight of seedlings (g)	No. of root nodules	No. of leaves
C	21.4±01.78	04.79±0.92	12±1.58	16±2.05
E-1	42.0±13.45	20.23±6.36	23±1.58	22±1.64
E-2	39.6±05.22	14.24±0.80	17±1.58	21±1.34

Bukhari, S. M. and A.G. Untawale 1978. Seaweeds as liquid fertilizer and foliar spray. *Seaweed Res. Utiln.*, 3 (1 & 2) : 71 - 78.

Chapman, V.J. and D.J. Chapman 1980. *Seaweeds and their uses.* Third edition, Chapman and Hall, London. 243p.

Chennubhotla, V. S. K., N. Kaliaperumal and S. Kalimuthu 1987. Common seaweed products. *CMFRI Bulletin,* 41 : 26-30.

Flowers, A. and A. J. Bryle, 1977. Energy from marine biomass. *Sea Technol.,* (October 1977). 18-21.

Gandiyappan, K. and P. Perumal 2001. Growth promoting effect of seaweed liquid fertilizer (*Enteromorpha intestinalis*)on the Sesamum crop plant (*Sesamum indicum,* L.). *Seaweed Res. Utiln.,* 23 (1 &2): 23-26.

Kaladharan, P. and N. Kaliaperumal 1999. Seaweed industry in India. *Naga, KLARM Quarterly,* 22 (1) : 11-14.

Kaladharan, P., N. Kaliaperumal and J.R. Ramalingam 1998. Seaweed-Products, Processing and Utilization. *Mar.Fish.Infor.Serv.(T & E) Ser.,*157:1 - 9.

Newton, L. 1951. *Seaweed Utilization.* Sampson Low, London.

Rajkumar Immanuel, S. and S.K. Subramanian 1999. Effect of fresh extracts and seaweed liquid fertilizers on some cereals and millets. *Seaweed Res. Utiln.,* 21 (1 & 2) : 91-94.

Sreenivasa Rao, P., J.Tarwade, K.S.R. Sarma, K.K. Anjaneyalu and H.M. Mody 1979. Seaweed as a source of energy: Production of fuel gas from seaweed *Sargassum. Proc. Int. Symp. Marine algae of Indian Ocean region.* CSMCRI., Bhavnagar, India.