Bangladesh J. Sugarcane, 21 : 19-23 *July, 1999*

Influence of Effective Microorganism on Sugarcane Production and Improvement of Soil

F. Alam, M.A. Majid, M. J. Islam and S. M. Bokhtiar
Bangladesh Sugarcane Research Institute,
Ishurdi, Pabna, Bangladesh.

Received on 12.2.97

ABSTRACT

To test the efficacy of effective microorganism (EM) for sugarcane production and its long term effect on the improvement of soil, field experiments were conducted in High Ganges River Floodplain soil (Eutrocept) of Bangladesh during 1994-95 and 1995-96 crop seasons. EM a source of microorganism from Japan was tested with two different organic manures viz., cowdung (CD) and press mud (PM) and recommended inorganic fertilizers (INF) including one control. Compared to control, EM application in most of the cases significantly increased tiller, millable cane and yield of sugarcane except per cent recoverable sucrose content. When EM was applied with CD, PM and INF, it gave higher yield of cane over CD, PM, INF and also EM alone in both the years. Highest cane yield of 77.0 and 60.4t ha^{-1} were recorded when EM was applied with inorganic fertilizer and CD in the first and second year respectively. Post harvest soil results indicated an improvement in soil chemical properties like organic matter, P and K in Em treated plots than non EM treatments.

Key words : Effective microorganism, cowdung, press mud, inorganic fertilizer, sugarcane production, soil improvement.

INTRODUCTION

Effective microorganism (EM) is a culture solution of microorganism, which live in fertile soil in nature and are useful for crop production. The technology of effective microorganism developed in Japan and are being formulated in various mixed culture viz., EM 2, EM 3 and EM 4 (Higa, 1988). A technology that improves the effectiveness of organic or nature farming by accelarating the breakdown of organic matter and releasing nutrients for plant use in a short period of time is the use of EM (Higa, 1991). The unique characteristics of some beneficial microorganisms are being used as a patent of EM. Microorganism, when applied in the correct manner, improve the rhizosphere by transforming the microflora and microfauna (Higa, 1998). Studies suggested that the application of EM over a long period of time along with suitable organic amendments can enhance the ability of the microorganism to increase the availability of plant nutrients in rhizosphere.

Nutritional requirements of sugarcane is much higher than any other field crops. Large amount of chemical fertilizer are applied to meet up its nutritional requirement. Cosico (1985) reported that the extensive use of chemical fertilizers have detrimental effects on the soil, water and environment although they have a distinct positive role in crop production. Higa and Wididana (1989) reported that frequent and excessive use of these chemicals often results in adverse environmental effects, disturbing the ecological balance of the soil, and making plants more susceptible to pest and diseases. The highly intensive farming method practiced in Taiwan are dependent on heavy application of chemical fertilizers to sustain a high level of agricultural production. This has caused serious pollution problems and gradual sterilization of arable land (Liu, 1989).

Organic matter is used in nature farming to supply plant nutrients to crops, maintain soil productivity and improve the sustainability of cropping systems. The efficacy of these compounds may vary, and the success of the use depends upon the source of biofertilizers, their characteristics, environment and the cultivated crop (Beets, 1990). After the EM treatment, organic nutrients in the soil are decomposed by EM and subsequently the humus, nutrients cycling function and oxygen content volume is increased, consequently, the physical nature of the soil is also improved which enhances, tilth, drainage and water holding capacity (Higa, 1987). In the developing worlds the use of organic matter has been a vital component in agriculture. In recent past, their role has been accentuated further, due to the spiraling cost of chemical fertilizer. Press mud a sugar industry effluent, has a potential use in combination with EM. The present long term experiment was undertaken to test the efficacy of EM in presence of different organic matter including press mud on sugarcane and improvement of soil.

MATERIALS AND METHODS

Field experiments were conducted in the alternate year in two selected plots at the Bangladesh Sugarcane Research Institute (BSRI) farm during 1994-95 and 1995-96 crop seasons. EM 4 of Japanese origin, is a mixed culture of Lactobacillus and microorganism producing lactic acid which is made from mixed solution culture of photosynthetic bacteria, ray fungi, yeast and moulds in which co-exists more than 10 genera and 80 species of beneficial microorganisms.

Sugarcane variety lsd 19 was used as a test crop. Before transplanting sugarcane, soil samples were collected at a depth of 30 cm for determination of major properties of soil. The soil was loamy with pH 7.8, organic matter 0.9%, available P 4.5 ppm, exhangeable K 0.17 meq/100mg soil and available S 29 ppm. The experiment was laid out in a randomized complete block design (RCBD) with three replications and maintaining a plot size of 8 m x 6 m. Eight treatments were arranged with two different sources of organic manures (viz., cowdung and press mud) and recommended inorganic fertilizers including one control as follows:

T_0 - Control
T_1 - Only EM
T_2 - Press mud (PM) @ 5 t ha^{-1}
T_3 - PM+EM
T_4 - Cowdung (CD) @ 5 t ha^{-1}
T_5 - CD+EM,
T_6 - Recommended inorganic fertilizer (NPKSZn)
T_7 - NPKSZn+EM.

Rock phosphate was applied @ 200 kg ha^{-1} during final land preparation. EM was applied in all plots as per desired treatment three weeks prior to sugarcane transplanting. EM was sprayed 1m/L water/m^2 of land. After transplanting sugarcane settling, EM was sprayed fortnightly upto sixty days and thereafter once in a month upto six month age of the crop. The crop was transplanted during November each year and harvested in mid December of the following year. Data on tiller, millable cane, yield of cane and per cent recoverable sucrose were recorded. Post harvest soil samples were also collected to analyse the major chemical properties of soil.

Soil texture was determined by hydrometer method, organic carbon by wet oxidation method, pH by glass electrode pH meter and total nitrogen by Kjeldhal method. Available P was determined by using 0.5 M $NaHCO_3$ extract in spectrophotometer. Exchangeable K was determined by 1M NH_4OAC extraction in flame photometer and available S was determined by turbidimetric spectrophotometer method (Black, 1965).

RESULTS AND DISCUSSION

Results obtained on different growth parameters of the crop and physico-chemical properties of the post harvest soil are presented in Tables 1 and 2.

Table 1. Effect of EM on different yield contributing parameters of sugarcane.

	Crop year 1994-95				Crop year 1995-96			
Treat ments	No. of tiller ($x10^3ha^{-1}$)	No. of millable cane ($x10^3ha^{-1}$)	Yield ($t\ ha^{-1}$)	Recoevry (%)	No. of tiller ($x10^3ha^{-1}$)	No. of millable cane ($x10^3ha^{-1}$)	Yield ($t\ ha^{-1}$)	Recovery (%)
Control	144.1 d	96.5d	57.7c	8.85	102.0c	63.82c	41.7d	8.41
EM	186.4ab	108.0abcd	64.8bc	9.01	115.6b	84.9b	50.1cd	8.92
PM	177.0bc	107.8cd	68.2ab	8.30	122.5ab	91.6ab	61.5abc	8.12
PM+EM	195.6a	114.8ab	74.3a	8.61	118.3ab	94.4a	67.1ab	8.74
CD	171.1c	103.5bcd	64.6bc	8.96	124.3a	94.9a	56.7bc	8.33
CD+EM	175.5bc	109.9abc	72.2ab	8.25	123.7ab	91.9ab	73.3a	8.78
INF	182.3b	112.6abc	71.5ab	8.86	118.5ab	95.8a	51.5cd	8.25
INF+EM	180.5bc	118.3a	77.01a	8.79	117.9ab	96.7a	60.4bc	8.68

CD-Cowdung, PM- Press mud, INF-Inorgainc fertilizer

Table 2 . Post harvest soil analysis.

Crop Year	Treatments	pH	Organic matter (%)	Total N (%)	Available p (ppm)	Exchangeable K (meq %)	Available S (ppm)
1994-95	Crontol	7.5	1.20	0.064	6.0	0.19	12.0
	EM	7.7	1.24	0.06	7.0	0.24	13.5
	PM	7.9	1.28	0.065	6.5	0.21	13.0
	PM+EM	7.8	1.23	0.07	7.0	0.24	14.5
	CD	7.7	1.19	0.063	7.1	0.20	12.5
	CD+EM	7.7	1.25	0.07	7.0	0.23	11.5
	INF	7.9	1.10	0.068	6.5	0.20	12.0
	INF+EM	7.8	1.17	0.06	7.0	0.23	11.5
1995-96	Control	7.6	1.04	0.068	5.5	0.15	11.5
	EM	7.7	1.11	0.07	7.0	0.18	11.0
	PM	7.6	1.18	0.07	6.5	0.16	15.0
	PM+EM	7.9	1.28	0.075	9.0	0.19	11.5
	CD	7.6	1.0	0.065	5.0	0.10	14.5
	CD+EM	7.8	1.24	0.07	8.0	0.16	9.5
	INF	7.0	0.97	0.063	7.0	0.10	13.5
	INF+EM	7.9	1.11	0.066	9.0	0.16	13.5

During 6th to 7th month growth stage visually the crop was more green in EM treated plots compared to non EM plots. Myint (1991) reported that rice plants treated with EM looked greener and visually better especially in the vegetative growth stage. In both the year effective microorganism (EM) application produced significant higher number of tiller compared to the control. In the first year when EM was applied along with cow dung (CD) and press mud (PM), it produced higher number of tiller than only CD and EM. Inorganic fertilizer along with EM failed to produce higher tiller than only inorganic fertilizer along. Except PM+EM, all other EM treated plots in first year failed to produce higher tiller than only EM treated plots. In second year EM along with CD, PM and inorganic fertilizer did not show any effect on tiller production compared to only CD, PM and INF treated plots, but in all cases this number was higher compared to only EM application. In the first year EM application produced mostly insignificant higher number of millable cane compared to control but this number was significant in second year and EM along with PM or inorganic fertilizer showed identical results. In both the year EM with CD, PM and inorganic fertilizer produced higher number of millable cane compared to only CD, PM and inorganic fertilizer treatments, except EM along with CD in second year, most of the cases this production was higher than only EM. It is also seen from the data EM application produced significant higher yield of cane compared to the control in both the years. When EM was applied with CD, PM and inorganic fertilizer, it gave higher yield of cane than only CD, PM and INF treatment except CD+EM in the second years. The yield of cane was always higher with EM treated plots than only EM in both the year. In the first year EM with CD and inorganic fertilizer gave identical results in respect of cane yield. However, the highest yield of cane was recorded with EM+inorganic fertilizer and EM+CD respectively in first and second year. This production is 33.4 and 75.7% higher over control and 7.7 and 29.2% higher compared to only inorganic fertilizer and CD treatments respectively (Figure 1).

Zacharia (1993b) reported that EM 4 application along NPK showed maximum cane yield of 26.31 tonnes ha^{-1}, he also reported than an increase of nearly 6.5 and 7.5% of the sugarcane yield could be obtained by the application of EM 4 along with FYM and NPK respectively.

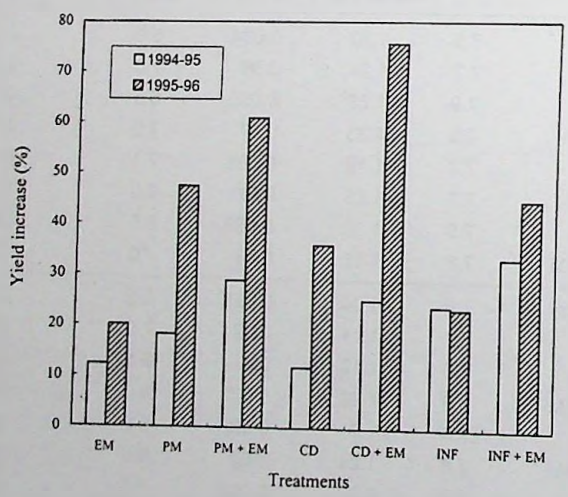

Figure 1. Yield increase (%) due to EM and sources of fertilizers.

Inorganic fertilizers with EM increased the rice yield marginally (4 per cent) over plot received inorganic fertilizer only (Sangakkara, 1991). Zacharia (1993a) reported EM 4 application along with FYM and NPK, NPK+EM gave 7.79% higher yield of cane compared to only NPK but FYM+EM failed to produce higher cane yield than NPK alone. EM application did not show any significant results on percentage recoverable sucrose content of sugarcane. Post harvest soil analysis showed a remarkable increase in organic matter content, available P and K content when EM was applied singly or in combination with both inorganic and organic fertiizers (Table 2). Higa and Wididana (1989) reported a little difference on such parameters compared to EM and non EM treatments.

REFERENCES

Black, C.A. 1965. Methods of Soil Analysis (part 2). Agronomy Series No. 9. American Society of Agronomy, Madison, Wisconsion, USA. pp. 924-1378.

Beets, W. 1990. Raising and Sustaining Productivity of small Holder Farming Systmes Tropics. Ag. Be Publishers, Holland. p. 731.

Cosico, W.C. 1985. Organic fertilizers : Their nature, perspectives and use. University of Philippines, Los Banos, Philippines. p. 136.

Higa, T. 1988. Studies on the application of microorganism in nature farming : The practical application of effective microorganisms in Japan. International Nature Farming Research Center, Atami, Japan. pp. 1-11.

Higa, T. 1991. Effective Microorganism : A Biotechnology for mankind. *In* : J. F. Parr, S. B. Hornik and C.E. Whitman (ed.) Proc. of First International Conference on Kyusei Nature Farming. U.S. Department of Agriculture, Washington, USA. pp. 8-14.

Higa, T. and Wididana, G. N. 1989. Changes in the soil microflora induced by effective microorganism, Proc. First International Conference on Kyusei Nature Farming. pp. 153-162.

Higa, T. 1998. Studies on the application of microorganism in nature farming. The practical application on effective microorganisms in Japan, Proc. 7th IFOM Conference, Ouagadougou, Burkina Faso. p.5.

Liu, S.D. 1989. Development and application of entomopathogenic fungi for agricultural pests control in Taiwan. First Coference on role of Microorganisms in Environmental Biotechnology, Taipei, Taiwan. pp. 9-10.

Myint, C.C. 1991. Effect of organic ammendments and EM on rice production in Myanmar. Proc. Second International Conference on Kusei Nature Farming, Brazil. pp. 82-91.

Sangakkara, U.R. and Higa, T. 1991. Effect of EM on the growth and yield of selected food crops in Srilanka, Proc. Second International Conference on Kyusei Nature Farming,Brazil. pp. 118-124.

Zacharia, P.P. 1993a. Profile of Agriculture in Pondicherry. Proc. Second Conference on Effective Microorganism (EM), Sara Buri, Thailand. pp. 100-105.

Zacharia, P.P. 1993b. Studies on the application of effective microorganism (EM) in paddy, sugarcane and vegetables in India, Proc. Second Conference on Effective Microorganism (EM), Sara Buri, Thailand. pp. 31-41.