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Importance of Organic matter content in Upland Soils of Bangladesh for Sustainable Sugarcane Production-A Review

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The importance of organic matter has been recognised in farming all over the world. The organic matter plays many important roles to improve soil conditions for plant gorwth. The value of organic matter lies more in its actions as a soil ameliorant, corrective for physical conditions, and as a promoter of bilological activity to enhance soil productivity than that nutrients content (Parthasarathy, 1972). It is a nitrogen reservoir and it furnishes large portion of phosphorus and sulphur (Donahue *et al.* 1977). The nitrogen in organic matter is chemically bound mostly in complex organic compound and it becomes available to plant through microbial decomposition into simpler inorganic forms (Idris, 1975). So, the presence of organic matter enhances availability of mineral elements in soils by chemical and biological actions. Therefore, organic matter increase utility of applied fertilizers and increases availability of plant nutrients from the parent materials and also by making favourable for plant growth (Anon. 1986; Sarkar, 1983). It is observed from various reports that organic matter status of upland soils in sugarcane belt of Bangladesh is found to be very poor. In some soils, it is less than 1%. The content of organic matter is being depleted day by day. The main reasons are (i) intensive cultivation,(ii) imbalanced use of chemical fertilizers and (iii) poor replishment of organic manures. Because, many cultivators use cowdung as fuel and leave very few crop residues in their field for recyclying. Moreover, Bangladesh falls within tropical and subtropical, and humid climatic zone. Sanchez (1976) and Miah *et al.* (1993) reported that tropical and subtropical soils have low organic matter content because of high temperature and high decomposition rate.

Sugarcane is grown in high and medium high land. In general, the typical soils for sugarcane are clay loam, loam and fairly heavy alluvial possessing abundant organic matter and sufficient level of available plant nutrients (Islam *et al.* 1995). It also improves physical condition of soil which provides better aeration and water movement favourable for sugarcane production. Besides, application of organic manures not only increase cane yield but also compensates deficiency of micro nutrients for sugarcane production (Islam *et al.* 1995). Therefore organic matter conservation is essential in maintaining productivity potential of soils for sustainable sugarcane production.

SOURCES AND USES OF ORGANIC MATTER

There are various sources of organic matter which are generally used by famers. The sources of organic matter, and its preparation for application are described below in brief:

Farm Yard Manure (FYM)

It is good and available source of bulky organic matter. But now a days, a big portion of cowdung is being used as a fuel by rural people. Moreover, farmers pay little attention to preserve remaining portion of cowdung. The manure is thrown in open heaps, carried to field and spread it after long time. The nutrient value is lost in this manner (Parthasarathy, 1972). The liter along with urine and crop residues should be heaped in a pit under shed and it should not be exposed to sun and rain. When manure is well decomposed, it should be applied in the field and mixed up thoroughly with the soils. In case of sugarcane, 50% of FYM is to be applied in the field during land preparation and remaining portion be applied in trenches along with other fertilizers and thoroughly mixed with soils by spading (Anon., 1984). It is found that the application of FYM increases availability of applied N to sugarcane crop (Anon., 1970).

Green Manure (GM)

At growing stage of leguminous crops like sesbania, sunhemp, cowpea, indigo are incorporated in the soil. It adds nearly 15 $t.ha^{-1}$ biomass and fix sufficient quantity of atmospheric nitrogen in the soil by *Rhizobium*. The freshly decomposed organic matter of GM crop provides a favourable environment for many physical, chemical and biological activities *(Tamhane et al.* 1970) Buckman *et. al.* (1971) reported that there are several beneficial effects of GM on soil improvement such as, (i) addition of organic matter through decomposing biomass of the crop, (ii) Addition of atmospheric N to soil through symbiotic fixation, (iii) Improve soil conditions, and increase availability of plant nutrient.

Since availability of FYM is poor, cultivation of GM should be given more emphasis. To avoid hampering of crop sequence, cultivation of GM as intercrop with sugarcane may be done (Parthasarathy, 1972).

Wastage Products (WP)

Municipal wastes and industrial by-products like pressmud are to be decomposed and be applied like FYM. On an average, one ton of millable cane contains 30 kg of pressmud in the mill waste (Quilloy, 1974). Physically pressmud is a soft, spongy, light, amorphous, dark-brown to black material. it easily absorbs large quantity of moisture. Generally, it contains 55-70% of moisture on wet basis, and on average pH is 6.4 (Sarkar *et al.* 1983). Like FYM, application of pressmud imporves soil conditions and increases availability of plant nutrients. Nwaral *et. al.* (1990) reported that application of pressmud increases availability of native as well as fertilizer P.

Cake

Mustard oil cake, sesame (til) cake, caster cake, neem cake, ground nut cake etc are the most important organic concentration. These are relatively expensive items but less

quantity is required to apply. Generally, it is applied in the field during land preparation. But in case of suagrcane, powder cake may be applied in trenches along with other fertilizers and thoroughly mixed up with soils by spading.

Compost

There are various sources of organic wastes that can be converted into productive organic bulky manure. The nutrient value is almost equal to FYM. Ingredients those are used to make compost are dead leaves, straw, municipal garbage, sawdust, farm yard wastes, sugar mills bagasse, rice husk etc. The materials are placed in a layer, one above another. Each layer may be 25-30 cm thick. Heaps are preferably be 1.5-2 m wide and not more than 1.5m in height. Different kinds of micro-organisms are responsible for decomposition of composting materials. To promote microbial activities, thin layers of soil or cowdung along with small quantity of urea and TSP should be placed in between the layers. The heap should be covered with soil and be kept moist through spraying of water if needed. After 45-60 d the layers should be reversed in a new heap to allow uniform decomposition. After proper decomposition, it becomes ready for application in the field.

Crop Residues

Crop residues are crop wastes. These waste materials are trash, cane top and part of millable cane, rice stubbles etc. A sugarcane crop leaves at harvest about 12-15% on weight of millabe cane. At gowing stage of sugarcane, trashes obtained after detrashing bottom portion of cane plants are placed at both sides of cane row following light application of urea and covered the trashes with soils. Aternately, when crop is grown up, transhes at bottom along with late sprouts and water shoots are removed and burried in alternate furrows for conservation into organic matter (Parthasarathy, 1972). Burning cane trash, in addition to get ash is helpful in field sanitation and elimination of pests and diseases.

It is found from different analytical data of soils that organic matter status of Bangladesh soils is very low. In some upland soils, it comes down below 1%. Analysis of some AEZ soils was done during 1969-70 and 1989-90 to see the status of organic matter, pH and CEC and consequent effects of the same after long 20 years (Table 1). The soils of different AEZ, such as Madhupur Tract, Barind Tract, Old Himalayan Peidmont plain, Tista Meander Floodplain, High Ganges River Flood plain and old Brahmaputra Floodplain were selected for analysis. All above mentioned locations are considered as sugarcane belt in Bangladesh. The soil smaples from high and medium high lands of the noted AFZ were collected and analysed for organic matter, pH and CEC during 1969-70 and 1989-90. The results of soil analysis have been shown in the Table 1 that organic matter, pH and CEC have been depleted over the period of 20 years. Cropping intensity has increased in all the locations where as organic matter content in soils has been shown depletion from 9.0-32.56% (Table 2). It is indicated that productivity of soils is deteriorating. To conserve soil productivity it is needed to replenish organic manures for getting sustainable yield.

Table 1. Status of some physico-chemical properties of important soil series in different Agro-Ecological Zones (AEZ) in Bangladesh.

Name of AEZ	Location of soil series	Land type	Organic matter (%)		pH		Cation Exchange capacity (CEC) m eq/100g	
			Pr.	P.	Pr.	P.	Pr.	P.
1. Madhupur Tract	1. Kashimpur	High land	0.08	1.30	5.3	5.6	7.7	8.1
	2. Tejgaon	High land	1.53	2.12	5.1	6.1	12.0	12.5
	3. Chhiata	High land	0.60	1.28	5.0	5.3	12.5	8.6
	4. Kalma	Med high land	11.70	2.40	5.1	5.3	7.7	12.4
2. Barind Tract	1. Noadda	High land	1.30	1.38	5.6	5.7	8.0	8.1
	2. Chandra	Med high land	1.20	1.29	5.4	5.6	6.0	7.7
	3. Belabo	High land	1.30	2.00	4.8	4.9	7.0	9.3
	4. Amnura	High land	0.90	1.43	5.5	4.7	7.5	8.5
	5. Lauta	High land	1.40	1.55	4.6	4.8	10.0	11.4
	6. Ekdata	High land	0.80	1.06	4.3	4.6	11.0	12.0
3. Old Himalayan Piedmont plain	1. Baliadangi	High land	1.30	1.32	4.9	5.0	10.0	11.3
	2. Rani Sankail	High land	1.50	1.65	4.8	5.1	8.0	10.0
	3. Pirgacha	High land	1.08	1.60	5.7	5.0	6.0	8.6
4. Tista Meander Floodplain	1. Domar	High land	1.40	1.60	4.8	5.3	5.0	5.2
	2. Gangachara	High land	1.50	1.58	5.8	6.6	11.0	11.7
	3. Kaunia	High land	0.80	1.46	5.4	5.5	8.0	9.7
	4. Polashbari	High land	1.30	1.50	5.6	5.7	10.5	13.0
5. High Ganges River Flood plain	1. Sara	High land	0.90	1.09	7.9	7.8	9.0	10.9
	2. Darsana	High land	0.30	0.64	7.5	6.8	10.0	11.7
	3. Ishurdi	High land	1.30	1.50	7.9	7.9	25.0	26.7
	4. Gopalpur	High land	1.40	1.61	7.7	7.9	16.0	17.1
6. Old Brahmaputra Floodplain	1. Sonatala	High land	1.0	1.09	5.7	6.8	12.0	12.3
	2. Silmandi	High land	0.90	1.32	5.4	5.6	8.0	9.3
	3. Lokdeo	High land	1.50	2.16	5.6	5.6	11.0	11.6
	4. Dramral	Med high land	1.50	1.65	5.5	5.6	16.0	17.5

Pr=Present i.e. in 1989-90

P=Past i.e. in 1969-70

Source : AGROKEMIA ES TALAJTAN Tom. 42 (1993) No. 1-2.

Table 2. Increasing cropping intersity and depletion of organic matter of upland soils of some cane growing AEZ during last 20 years.

Name of AEZ	Land type	Average cropping intensity %		% Organic matter (Average)		Depletion of O.M. (%)
		1969-70	1989-90	1969-70	1989-90	
1. Madupur Track	High land	150-200	150-300	1.78	1.20	32.58
2. Barind Track	High land	100-200	100-200	1.45	1.15	20.69
3. Old Himalayan Piedmont plain	High Land	100-200	200-300	1.32	1.20	9.00
4. Tista Meander Floodplain	High land & Med high land	150-200	200-300	1.55	1.23	20.60
5. High Ganges River Floodplain	High land	100-150	200-300	1.21	0.98	19.00
6. Old Brahmaputra Floodplain	Med high land	150-250	200-300	1.56	1.23	21.15

Source : Z. Karim *et al.* 1995, Bangladesh : Fertilizer and Environment.

Higher yield of cane and sugar were obtained during 1984-85 cropping season under Old Himalayan Piedmont plain soils where chemical ferilizers along with organic manures were applied (Anon. 1986). During 1978-79 cropping season under High Ganges River Floodplain, application of organic manures gave significantly higher yield of cane. Under Barind Tract number of tillers, millable cane and yield of cane were significantly increased by application of organic manures along with chemical fertilizers. Sarkar *et al.* (1983) reported that application of 10 tons of pressmud per hectare along with chemical fertilizer gave higher cane yield compared to use of chemical fertilizers alone. An experiment conducted at Thakurgaon under non calcareous soils of Old Himalayan Piedmont plain, higher number of millable cane and yield of cane were found due to application of different nutrients. But the highest number of millable cane ($138.4 \times 10^3 ha^{-1}$) and yield of cane (85.9 TCH) were obtained when 461 kg MOC ha^{-1} was applied along with NPKS. BSRI scientists found that application of 100 mds of pressmud per acre at two splits 50% at planting and 50% at tillering stage of cane increased cane yield by 10-12 t. ha^{-1} (Anon. 1984) Parthasarathy (1972) observed that higher cane yield cane be obtained in the 1st year by use of chemical fertilizers but in the long run, bullky organic manures were needed to maintain higher yield for a longer period. It is reported that N fixing bacteria *Azospirillum, Azotobacter* and *Beijerinckia* are widely present in different sugarcane growing zones of Inida (Anon., 1983). Recently, Boddey *et al.* (1994) reported that in Brazil, a new species of N fixing bacteria *Acetobacter diazotrophicus* was found to occur in large numbers in the root and stem of some sugarcane varieties. These bacteria help

to supply N to sugarcane plant and ultimately increase cane yield. In addition, organic matter increases the population of the N fixing bacteria (Anon., 1989). However, many investigators gave similar opinion that the application of organic matter imporves soil conditions and increases sugarcane yield (Parthasarathy, 1972; Islam, 1995; Anon., 1986, Anon., 1990; Sarkar, 1983).

Thus, it could be concluded that sugacane is required abundant organic matter and high amount of available nutrients in soils for its proper growth. At present, organic matter content of upland soils of sugarcane belt in Bangladesh is very poor, and it is depleting day by day. So, prior emphasis should be given to maintain an optimum level of organic matter in upland soils of Bangladesh by growing green manure and/or by applying different organic manures available at the site for increased and sustainable sugarcane production.

REFERENCES

Anonymous, 1970. Annual Report, Indian Institute of Sugarcane Research (IISR), p. 58.

Anonymous, 1983. Isolation of N fixing bacteria from sugarcane rhizosphere and possibility of its use as a bio-fertilizer. Annual Report, Indian Institute of Sugarcane Research (IISR). p. 48

Anonymous, 1984. Proceedings of the workshop on sugarcane production technology, Sugarcane Research & Training Institute, Ishurdi, pabna, Bangladesh. p. 174.

Anonymous, 1986. SRTI Annual Report, 1986. Sugarcane Research & Training Institute, Ishurdi, Pabna, Bangladesh. pp. 14-42.

Anonymous, 1990. SRTI Annual Report, 1990. Sugarcane Research & Training Institue, Ishurdi, Pabna, Bangladesh. pp. 29-31.

Anonymous, 1997. Fertilizer Recommendation Guide, BARC, Dhaka. pp. 24-28.

Boddey, R.M. die Oliveiria, LO.C.; Urquiaga, S.; Reis, V.M.; die Oliveres, F.L.; Baldani, V.L.D. and Dobereiner, J. 1994. Nitrogen fixation associated with sugarcane and rice: contributions and propspects for improvement. 15th World Congress of soil Science. International Society of Soil Science, Acapulco, Mexico. pp. 273-292.

Buckman, H.O. and Brady, N.C. 1971. The nature and properties of soils. Eurasia Pub. House (Pvt) Ltd., New Delhi. pp. 573-575.

Donahue, R.L.; Follet, R.H. and Tulloch, R.W. 1976. Our soils and their management. p. 239.

Donahue, R.L.; Miller, R.W. and Shickluna, J.C. 1977. An introduction to soils and plant growth. Prentice Hall, Eggle Wood, Clifts, New Jersery. p. 152.

Islam, M.J.; Majid, M.A. and Hossain, A.H.M.D. 1995. Updating fertilizer recommendation of sugarcane based cropping pattern. The paper presented in the workshop on "Updating Fertilizer Recommendation Guide" held on 5-7 June at BARC, Dhaka.

Idris, M. 1975. The infleuence of organic matter and fertility treatments on nitrification in soils. *Bangladesh J. Agril. Sci.*, **2**: 113-118.

Karim, Z.; Miah, M.M.U. and Razia, S. 1995. Fertilizer in the national economy and sustainable environmental development, Bangladesh: Fertilizer and Environment.

Miah, M.M.U.; Habibullah, K.M. and Ali, M.F., 1993. Depletion of organic matter in upland soils of Bangladesh. AGROKEMI ES TLJTN Tom, **42**:70-78.

Nawral, R.P.; Gupta, A.P. and Anil, R.S. 1990. Efficiency of triple super phosphate and Mussoorie rock phosphate mixture incubated with sulfitation process pressmud. *J. Indian Soc. Soil Sci.*, **38**:51-55.

Parthrasathy, S.V. 1972. Sugarcane in India, K.C.P. Ltd. Madras-6. pp. 332-348.

Quilloy, O.T. 1974. Studies on the Amelioration of sugarcane soils with mudpress, bagasse, cane trash and rice hull. PHIL SUG IN REs. An. Report 1973-74.

Sarkar, M.A.A.; Saha, S.C.; Rahman, M.F. and Hoque, M.J. 1983. Effect of pressmud on the yield and quality of sugarcane. *Bangladesh J. Sugarcane*, **5**: 20-22.

Sanchez, P.A. 1976. Properties and Management of soils in the Tropics. John Wiley & Sons, New York. pp. 162-165.

Tamhane, R.V.; Motiramani, D.P.; Bali, Y.P. and Donahue, R.L. 1970. Soils: Their chemistry and fertility in tropical Asia. Prentice-hall of India (pvt) Ltd., New Delhi., pp. 260-261.