Research Journal of Agriculture and Biological Sciences, 3(3): 153-156, 2007

Effect of Agro-Industrial Wastes on Soil Properties and Yield of Irrigated Finger Millet (*Eleusine coracana L. Gaertn*) in Coastal Soil

T. Rangaraj, E. Somasundaram, M. Mohamed Amanullah, V. Thirumurugan, S. Ramesh and S. Ravi

Department of Agronomy, Agricultural College & Research Institute, TNAU,
Madurai -625 104, Tamil Nadu, India.

Abstract: Field experiments were conducted at Coastal Saline Research Centre, Tamil Nadu Agricultural University, Ramanathapuram during the post monsoon 2003 and 2004 to study the effect of agro-industrial wastes like pressmud, coirpith and farm manure in comparison with gypsum. The experiments were laid out in randomized block design replicated thrice. The treatments consisted of no organics (control), farm yard manure @12.5 t ha^{-1}, pressmud @ 12.5 t ha^{-1}, composted coirpith @ 12.5 t ha^{-1} and gypsum as amendment @ 500 kg ha^{-1}. The results revealed that addition of agro-industrial wastes as organic manure favourably improved soil organic matter, pH, EC, microbial population and enhanced the soil macro (N,P,K) and micro nutrients (Zinc, copper, manganese and iron) and improved the crop yield in finger millet. Among the agro-industrial wastes as organic manure, application of pressmud @ 12.5 t ha^{-1} had greater influence on soil fertility and yield of finger millet followed by composted coirpith @ 12.5 t ha^{-1}.

Key words: Agro-industrial waste, soil properties, nutrients, yield, finger millet, coastal soil

INTRODUCTION

Disposal of agro industrial wastes is a major problem in many industries. Dumping of industrial wastes in the vicinity of industrial areas causes environmental hazards. Hence, a periodical disposal is inevitable. Recycling of industrial wastes is one way of disposal mechanism and another way of resource management. India has a vast scope for re-utilization of renewable agricultural wastes like farmyard manure, industrial wastes like pressmud, coirpith and industrial by-products like gypsum. Value addition and utilization of above wastes as raw materials for crop production with suitable technologies is the need of the day. Farm yard manure (FYM) incorporation at the rate of 10 to 15 tonnes ha^{-1} in conjunction with optimal NPK fertilizer enhance the efficiency of inorganic fertilizers leading to improved crop productivity in various soil conditions.

In addition to yield increase, FYM has also significant effect on increased availability of organic carbon, macro and micronutrients[1,2]. Thus, it helps in sustenance of the soil fertility. Raman *et al.*[3] reported that pressmud is having positive characters like possessing considerable quantities of macro and micro nutrients, besides having ameliorating effects and can be used to improve the soil physical, chemical and biological properties of the salt affected soils. Coirpith, a by-product of coir industry is available to the tune of 7.5 million tones per year in India[4]. The raw coirpith can be composted with fungi (*Pleurotus sajor caju*, *Trichoderma sp* and *Aspergillus sp*) and can be converted as an ideal manure with higher content of macro and micro nutrients[5].

MATERIALS AND METHODS

Field experiments were conducted at Coastal Saline Research Centre farm, Tamil Nadu Agricultural University, Ramanathapuram during the post monsoon 2003 and 2004 to study the effect of agro-industrial wastes like pressmud, coirpith and farm yard manure in comparison with gypsum. The experiments were laid out in randomized block design replicated thrice. The treatments consisted of no organics (control), farm yard manure @12.5 t ha^{-1}, pressmud @ 12.5 t ha^{-1}, composted coirpith @ 12.5 t ha^{-1} and gypsum as amendment @ 500 kg ha^{-1}. The raw pressmud was cured for 2 months and then applied. Coirpith and farm wastes were composted using *Pleurotus* and cow dung, respectively and used for field application.

The soil organic matter, pH, EC, bacteria, fungi, actinomycetes population, major and micro nutrients and yield of crop were recorded and the results presented.

RESULTS AND DISCUSSIONS

The post harvest soil organic carbon was found to be higher than that of initial content due to

Corresponding Author: T. Rangaraj, Department of Agronomy, Agricultural College & Research Institute, Tamil Nadu Agricultural University, Madurai- 625 104, India.
E-Mail: rangan65@yahoo.co.in Tel: + 91 098429 09034

Table 1: Effect of agro-industrial wastes on soil chemical properties.

Treatments	Organic carbon (%)		pH		EC(dSm^{-1})	
	2003	2004	2003	2004	2003	2004
No organics (Control)	0.24	0.25	8.45	8.45	0.41	0.41
FYM 12.5 t ha^{-1}	0.44	0.46	8.33	8.32	0.28	0.24
Pressmud 12.5 t ha^{-1}	0.45	0.47	8.27	8.27	0.27	0.22
Composted coirpith 12.5 t ha^{-1}	0.44	0.46	8.35	8.31	0.28	0.23
Gypsum as amendment 500 kg ha^{-1}	0.25	0.26	8.26	8.22	0.32	0.27
CD (5%)	0.06	0.04	0.11	0.12	0.05	0.05

Table 2: Effect of agro-industrial wastes on soil micro flora (colony forming unit).

Treatments	Bacteria (x 10^6)		Fungi (x 10^3)		Actinomycete (x 10^3)	
	2003	2004	2003	2004	2003	2004
No organics (Control)	27.27	29.11	8.23	9.29	6.96	7.12
FYM 12.5 t ha^{-1}	32.45	34.04	10.04	11.29	8.36	8.53
Pressmud 12.5 t ha^{-1}	33.36	34.98	10.32	11.59	8.58	8.75
Composted coirpith 12.5 t ha^{-1}	32.72	34.30	10.12	11.40	8.40	8.57
Gypsum as amendment 500 kg ha^{-1}	28.64	29.51	9.06	10.13	7.41	7.55
CD (5%)	0.65	0.67	0.21	0.23	0.16	0.17

the application of organics (Table 1). The powdered form of pressmud, composted form of coirpith and well decomposed FYM accumulated more than twice the amount of raw material. Application of organics improved the organic carbon content. It corroborates the findings of Tompe *et al.*[6]. The post harvest soil showed considerable reduction in soil pH and EC due to application of organics (Table1). This could be due to the organic acids released by the organic sources[7]. In the present study, the continuous availability of moisture in the root zone in organics (pressmud, composted coirpith and FYM) applied treatments might have prevented the capillary rise of the salts from the sub surface layer but not in the case of no organics applied plot. This is in accordance with the finding of Sharma and Bali[8]. The reduction in pH might be attributed to the production of CO_2 and inorganic acids due to incorporation of organics[9].

Application of pressmud and composted coirpith registered comparable population of soil microbes (Table 2). Increase in microbial population due to addition of organics might have regulated soil temperature and continuous available soil moisture and the humus content of soil. This might have created favourable soil environment for sustenance, rapid multiplication and their activity on nutrient availability. Woods and Schuman[10] reported linear increase in microbial biomass due to addition of organics.

Application of organics (pressmud, composted coirpith and FYM each @ 12.5 t ha^{-1}) positively influenced the soil available nutrients (Table 3). Mandal *et al.*[11] found that application of organics increased the N content. Among the organics, pressmud recorded increased availability of nitrogen. This might be due to the congenial environment for soil organisms involved in nitrogen transformation[12]. Paramasivam[13] also reported increased available nitrogen status and retention capacity of nutrients due to application of pressmud. Incorporation of pressmud increased the available 'P' status at a maximum level followed by composted coirpith and FYM. The reason might be the slow releasing nature of the organics. It is the capacity to form phospho-humic complex with anion replacement of the phosphate by humate ion and the coating of sesquioxide by humus to form a protective cover and thus reducing the phosphate fixing capacity of the soil[14]. Similarly, K availability found to be higher due to addition of organics like pressmud, composted coirpith and FYM each @12.5 t ha^{-1} compared to non application of organics. This is in line with the findings of Parasuraman and Mani[15].

The micro-nutrients (Zn, Fe, Cu and Mn) were found to be higher due to addition of organics such as pressmud, composted coirpith and FYM (Table 4). Addition of organics might have increased the microbial population in turn; the microbes resulted in

Table 3: Effect of agro-industrial wastes on available soil nutrients (kg ha^{-1}).

Treatments	Nitrogen		Phosphorus		Potassium	
	2003	2004	2003	2004	2003	2004
No organics (Control)	112	127	5.34	6.14	116	117
FYM 12.5 t ha^{-1}	127	137	6.23	7.29	122	124
Pressmud 12.5 t ha^{-1}	130	142	9.45	11.18	142	133
Composted coirpith 12.5 t ha^{-1}	129	141	5.21	7.15	137	130
Gypsum as amendment 500 kg ha^{-1}	120	129	5.49	6.44	118	118
CD (5%)	2.5	3.6	0.14	0.16	2.7	2.6

Table 4: Effect of agro-industrial wastes on soil micro nutrients (ppm).

Treatments	Zinc		Copper		Manganese		Iron	
	2003	2004	2003	2004	2003	2004	2003	2004
No organics (Control)	2.31	2.37	0.60	0.61	2.88	2.92	10.6	10.9
FYM 12.5 t ha^{-1}	2.77	2.87	0.73	0.73	3.48	3.49	12.9	13.1
Pressmud 12.5 t ha^{-1}	2.84	2.95	0.75	0.75	3.57	3.59	13.2	13.5
Composted coirpith 12.5 t ha^{-1}	2.79	2.90	0.73	0.74	3.51	3.52	12.9	13.2
Gypsum as amendment 500 kg ha^{-1}	2.46	2.57	0.65	0.66	3.11	3.09	11.6	11.7
CD (5%)	0.04	0.07	0.05	0.04	0.07	0.08	0.19	0.23

Table 5: Effect of agro-industrial wastes on grain yield of finger millet.

Treatments	Grain yield (kg ha^{-1})	
	2003	2004
No organics (Control)	2464	2721
FYM 12.5 t ha^{-1}	3066	3387
Pressmud 12.5 t ha^{-1}	3215	3555
Composted coirpith 12.5 t ha^{-1}	3147	3484
Gypsum as amendment 500 kg ha^{-1}	2768	3065
CD (5%)	55	61

the release of chelating agents, which have prevented micronutrient from precipitation, oxidation and leaching[16].

Application of pressmud @ 12.5 t ha^{-1} increased the grain yield of finger millet during both the seasons (Table 5). This was followed by composted coirpith, FYM and gypsum. This might be due to improved chemical and microbial properties of soil due to use of agro-industrial wastes.

Conclusion: In coastal soil, application of agro-industrial wastes significantly improved soil organic carbon, pH, EC and soil bacteria, fungus and actinomycetes population and enhanced the soil fertility status (macro and micro nutrients) and improved the crop productivity of finger millet. Application of pressmud @12.5 t ha^{-1} recorded better growth and yield of finger millet followed by composted coirpith @ 12.5 t ha^{-1}.

REFERENCES

1. Nambiar, K.K.M. and I.P. Abrol, 1989. Long term fertilizer experiment in India. An over view. Fert. News, 34(4): 11-20, 26.
2. Vats, M.R., D.R. Sehgal and D.K. Mehta, 2001. Integrated effect of organic and inorganic manuring on yield sustainability in long term fertilizer experiments. Indian J. Agric. Res., 35(1): 19-24.
3. Raman, S., R.G. Patil and N.M. Zalawadia, 1999. Pressmud as a potential source of nutrient, amendment and wax. Fert. News, 44(11): 25-26, 29-31.
4. Upadhyay, A.K., D.V. Srinivasa Reddy and C.C. Bidappa, 1998. Organic farming technology for coconut. Indian Coconut J., 29(4): p.77.
5. Savithri, P. and H. Hameedkhan, 1994. Characteristics of coconut coirpith and its utilization in agriculture. J. Plantation Crops, 22(1): 1-18.
6. Tompe, S.V. and S.D. More. 1996. Influence of pressmud on soil characteristics on vertIsol. J. Maharashtra Agric. Univ., 21: 6-8.
7. Anandswarup, 1992. Effect of organic amendment on the nutrition and yield of wetland rice and sodic soil reclamation. J. Indian Soc. of Soil Sci., 40(4): 814-822.

8. Sharma, M.P. and S.V. Bali, 1998. Effect of rice residue management and wheat yield and soil properties in rice-wheat cropping system. Indian J. Agric. Sci., 68(10): 695-696.
9. Yaduvanshi, N.P.S., 2001. Effect of five years of rice-wheat cropping and NPK fertilizer use with and without organic and green manures on soil properties and crop yield in a reclaimed sodic soil. J. Indian Soc. of Soil Sci., 49(4): 714-719.
10. Woods, L.E. and G.E. Schuman. 1986. Influence on soil organic matter concentration on carbon and nitrogen activity. Soil Sci. Soc. Am. J., 50(5): 1241-1245.
11. Mandal, B.C., M.N. Saha. and M. Adhikari, 1991. Yield of rice and nutrient status of soil due to continuous cropping and manuring in a jute-rice-wheat sequence on Indo-Gangetic alluvial soil. J. Indian Soc. Soil Sci., 39(4): 689-692.
12. Muthuraju, M., M.V. Ravi and R. Siddaramappa, 2005. Effect of application of enriched pressmud on changes in chemical properties of an alfisol. Mysore Agrl. Sci., 39(2): 207-213.
13. Paramasivam, P., 1991. Effect of pressmud on rice yield and nutrient movement in major soil series of Madurai district. Madras Agric. J., 78(5-8): 308-309.
14. Gaikwad, S.S., R.B. Puranik and S.D. Deshmukh, 1996. Dynamics of soil microbial population and nutrient availability as influenced by application of pressmud cake in an entisol. J. Soils and Crops, 6: 82-85.
15. Parasuraman, P. and A.K. Mani, 2001. Influence of coirpith on yield and economics of rainfed crops. Mysore J. Agric. Res., 35: 316-322.
16. Bellakki, M.A. and V.P. Badanur, 1997. Long term effect of integrated nutrient management on soil properties of vertisol and dryland agriculture. J. Indian Soc. Soil Sci., 45(3): 437-442.