Preparation of Compost culture for Degradation of Press mud from Sugar Industry

Deepak B. Dakare[1], Saee H. Thakur[2], Rajeshwari Birje[3] Aishwarya Nair[4] Sayali Deshpande[5] Tanul Jeetkar[6]

[1] ***Department Of Biotechnology Engineering,***
Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

---

Abstract - Sugar press mud is one of the waste products from sugar industry which is produced in very large amount (3-4% per tons). Consist of various macro and micro nutrients which are useful for growth of various micro-organisms. These micro organisms can be used as Biofertilizer.

In this project the *B. Megatarium, T. Viridae, A. Niger, Rhizobium, B. Polymyxa, Azotobactor, P. Fluroscence* and mixture of all these micro organisms were applied on the SPM to compost it and use it as carrier or supporter for their growth. These micro organisms show significant results towards their growth and composting of SPM. The N, P, K, Sulphur, crude protein, moisture and physical properties were checked for raw SPM as well as culture mixed SPM.

Keywords: - Sugar Press Mud (SPM), Nitrogen (N), Phosphorus (P), Potassium (K), Biofertilizer

1. INTRODUCTION

Biologically active substance or microbial and fungi inoculum e.g, formulations containing one to more beneficial bacteria or fungal strains which are very easy to use and economically carrier materials and those can conserve, add and mobilize crop nutrients in the soil. It can promotes growth by making high amount ot the availability of important nutrients to the host plant is known as Biofertilizer

Microbiology in agriculture is connected with bacteria-fungi and crops with which can help for improving crop yields and also combating plant diseases "(*Pelczar et al*, 1988)". In agriculture field the microorganisms have many important roles. Some microorganisms are beneficial and some are harmful to the soil. The Soil flora (bacteria and fungi) are most useful for decomposing organic matter and re usage of old plant material. Some soil flora (bacteria and fungi) form symbiotic relationships with plant roots which can provide important nutrients like nitrogen or phosphorus for the growth. The most of Fungi can grow and spread on topmost part of plants, crops. Fungi can give high benefits, like drought tolerance, heat tolerance, resistance to insects and resistance to plant diseases.

Bio-fertilizers increase their concentration through the ordinary processes of solubilizing phosphorus, nitrogen fixation and stimulating plant growth by the synthesis of growth promoting substances. Bio-fertilizers are the replacement for the use of chemical fertilizers and pesticides. The bacteria and fungi in bio-fertilizers repair the soil's natural macro and micro nutrient cycle and build soil organic matter. By using bio-fertilizers, the healthy plants can be grown, although the enhancing the sustainability and the health of the soil. Hence they can be extremely advantageous in enriching soil fertility and fulfilling plant nutrient requirements by supplying the organic nutrients through bacteria and fungi with their

byproducts. The bio-fertilizers do not contain any harmful chemicals for the living soil.

The Bio-fertilizers is technically living bacteria and fungi and it can symbiotically associate with plant roots. Involved bacteria and fungi could readily and safely convert complex organic material in simple compounds, so that plants are easily taken up. The bacteria and fungi function is in long duration, causing improvement of the soil fertility. It maintains the natural habitat of the soil. It increases crop yield by 22-34%, and replaces chemical nitrogen and phosphorus by 25%, and also stimulates plant growth. Biofertilizer also provide protection against drought and some soil-borne diseases to different areas.

Some important groups of Bio-fertilizers-

Rhizobium:

The process of symbiotic nitrogen fixation by use of Rhizobium with legumes gives the to total nitrogen fixation. These are Gram negative soil Bacteria Colonize with plant cells called root nodules to convert atmospheric nitrogen into ammonia.

Trichoderma Viridae:

Form a symbiotic relationship with plant roots increasing tolerance to plant stress such as drought Production and release of beneficial plant growth hormones. It is helpful to reduce N, P, K level in soil.

Pseudomonas Putida:

It solubilises the organic and inorganic phosphate through production of phosphates and inorganic acids. It is also help in growth of crop or plant.

Azotobactor:

It plays important role nitrogen cycle of nature by nitrogen fixation. They work without symbiotic relations with plants

Bacillus Megatarium:

It produces amino acids such as lactic acid, gluconic acid, citric acid, succinic acid, propionic acid and enzymes that help solubilizing the fixed phosphorus into exchangeable form. Phosphorus is very high amount in the soil and it is one of the major nutrients limiting the plant growth

Sugar press mud is waste product from the sugar industry which is produced in very large volume i.e. 3-4% per ton of sugar crushing.

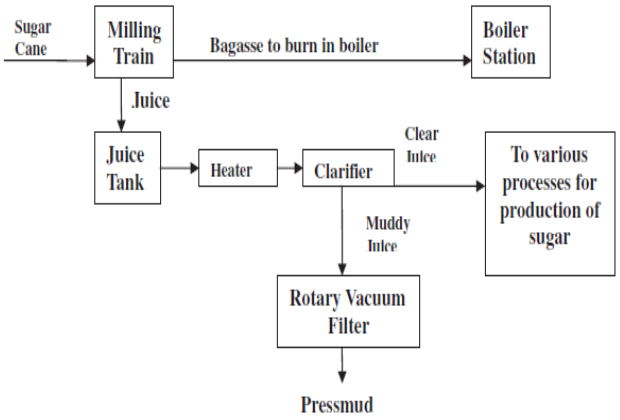

Fig. 1. A schematic diagram of formation of pressmud waste in sugar mill.

Fig. 1.1 -: Gupta N. et al. / Fuel 90 (2011) 389–394

The raw sugarcane were weighed and transfer for the crushing in milling train, where it is crushed to remove the juice and baggase, the baggase is remaining hard part of sugar cane after crushing which is also waste product of sugar industry. Baggase is used as raw material for boiler station.

The remaining juice is collected in big vessel or collecting tank where is heated and transferred to clarification unit. The crude juice consists of more amount of mud so after clarification the clear juice is transferred for various processes of production of sugar. The remaining mud is dried through rotary vacuum filter, where semi liquid material is produced which called as sugar press mud and spent wash is also generated in other processes which again waste product of sugar industry

The produced SPM is much large volume so it is stored in open space for drying. The windrows are prepared for proper mixing of press mud and to maintain aeration, temperature, humidity for degradation of SPM.

2. PREPARATION OF CULTURE:

The following cultures were applied on the press mud

- ✓ **TrichodermaViridae**
- ✓ **Pseudomonas Putida**
- ✓ **Azotobactor**
- ✓ **Bacillus Megaterium**
- ✓ **Rhizobium**
- ✓ **Pseudomonas Fluorescens**

1. The 110ml culture was prepared in 500ml flask for each culture.
2. The Nutrient broth was used for growth of bacteria and Potato dextrose broth was used for fungi as per following table.

Table 1.1: Raw material table media composition

Sr no.	Micro-organism name	Potato dextrose powder	Nutrient Broth Powder	Total RM required	Final volume
1	T. Viridae	2.64gmX 3	NA	20gm	110ml in 500ml each flasks
2	A. Niger	2.64gmX 3	NA		
3	P. flourescence	NA	1.43gm X 3	12gm	
4	P. Putida	NA	1.43gm X 3		
5	Azotobactor	NA	1.43gm X 3		
6	B. Megaterium	NA	1.43gm X 3		
7	Rhizobium	NA	1.43gm X 3		

3. As per above table was prepared and autoclaving was done at 121°C for 15min.
4. The autoclaved media was cooled and inoculated with loop ful of culture.
5. The inoculated flasks were kept in shaker incubator for 24-72hrs.
6. Based on the turbidity the Bacterial culture OD was taken at 600nm.
7. The culture was inoculated in each tray with mixed culture tray.
8. One control was kept as raw press mud.
9. After 25-30 days based on physical properties the press mud was sampled for analysis
10. All this procedure will be done in triplicate format

3. RESULTS AND DISCUSSION

1) Temperature-

Temperature plays very important role in growth of micro organisms on press mud. The temperature varies from the 36°C and 47°C and it was maintained by rotatating press mud hip on every alternate day and humidity was maintained by sprinkling water on it.

2) Phosphorus content

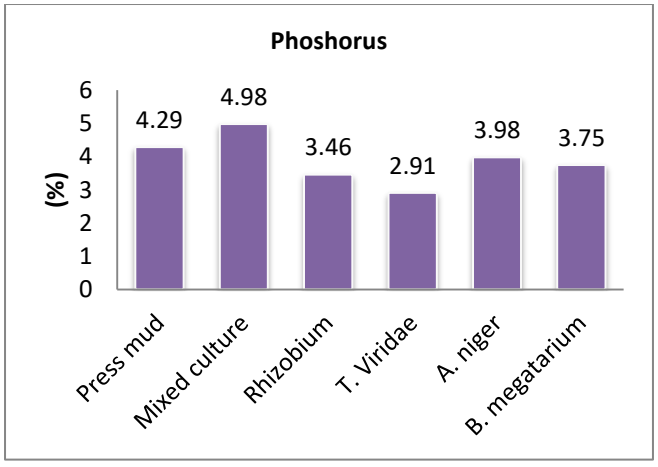

Fig. 3.1: Phosphorus content in press mud

The phosphorus content in press mud is efficient, which is essential source for soil fertility. The mixed culture found to be good amount of crude phosphorus in press mud Biofertilizer than raw press mud and other single culture press mud Biofertilizer.

3) Nitrogen content

The Nitrogen source found to be adequately efficient in raw press mud and all culture Biofertilizer. The Bacillus Megatarium culture press mud Biofertilizer shows higher concentration of nitrogen than other culture press mud and raw press mud.

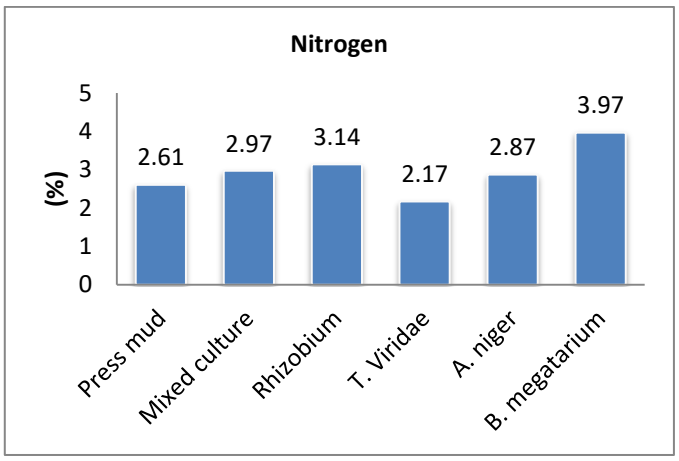

Fig. 3.2: Nitrogen content in press mud

4) Potassium content

The source for potassium in culture for soil fertility is adequate in the press mud culture Biofertilizer. This is one of major source of macro nutrient in soil for good crop yield

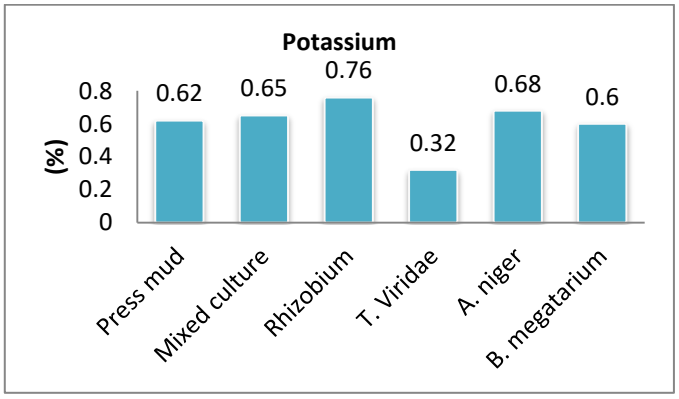

Fig. 3.3: Potassium content in press mud

5) Protein content

The crude protein content in raw press mud and culture press mud biofertilizer is produced from the cellulose, hemicelluloses and wax.

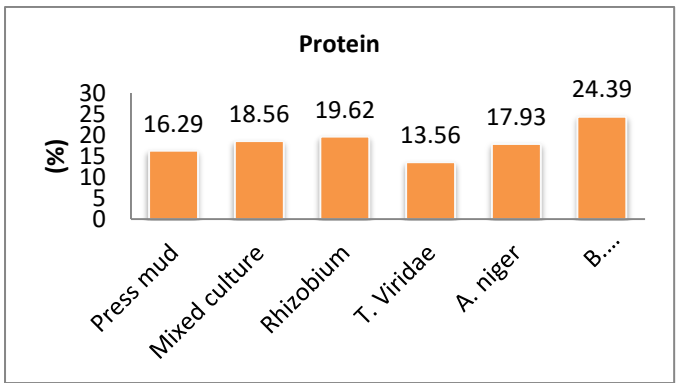

Fig. 3.4: Protein content in press mud

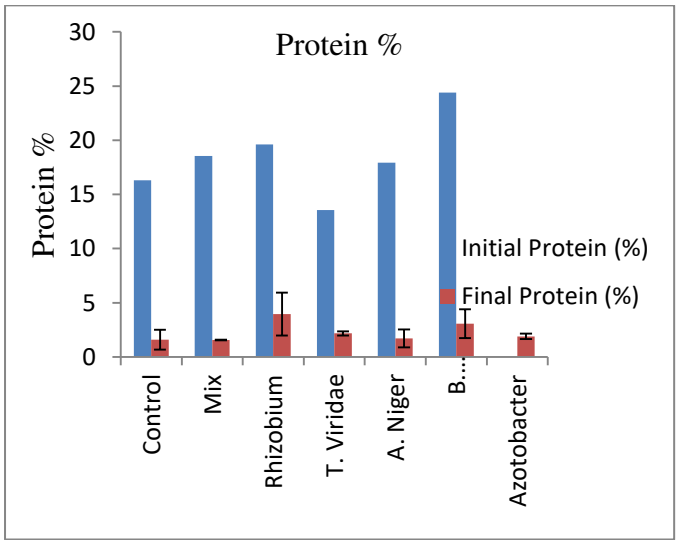

Fig. 3.5: Protein content in press mud

6) Sulphur content

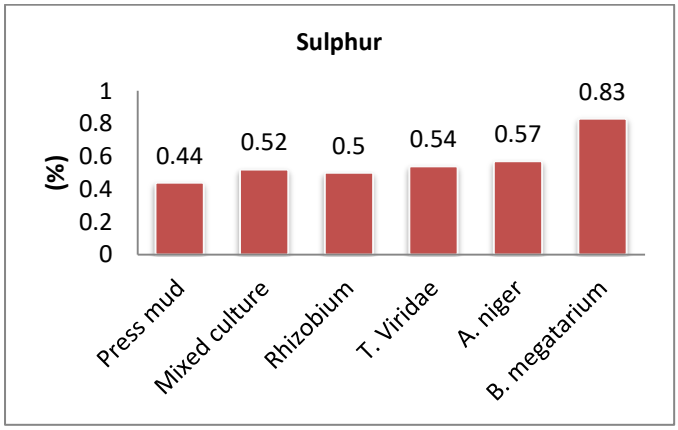

Fig. 3.6: Sulphur content in press mud

7) Moisture content

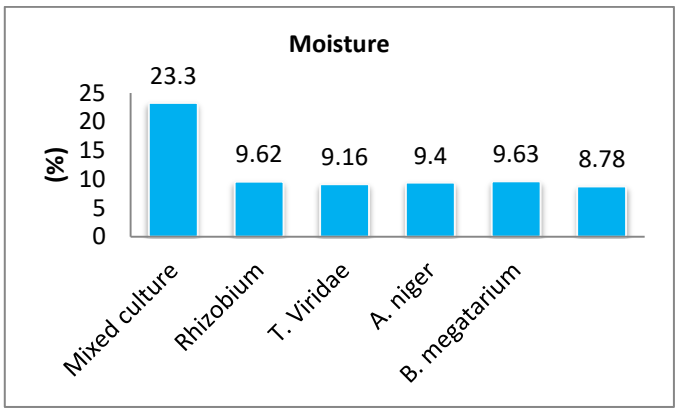

Fig. 3.7: Moisture content in press mud

8) Sugar Content

The press mud consists of more sugar than all mixed culture and individual press mud with culture. Sugar is source for growth and to sustain on press mud. As per analysis results T. Viridae consumed more sugar than other micro organism.

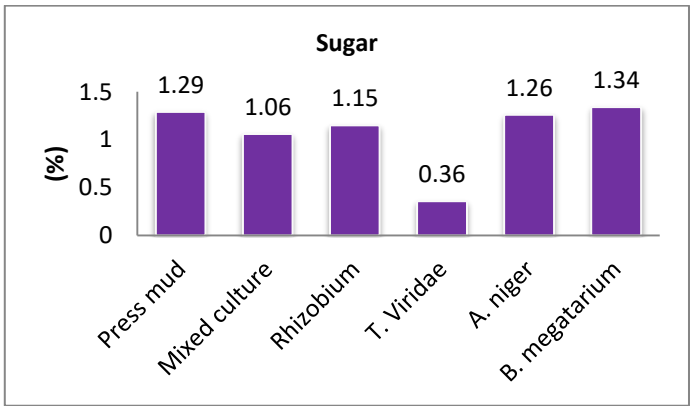

Fig. 3.8: Sugar content in press mud

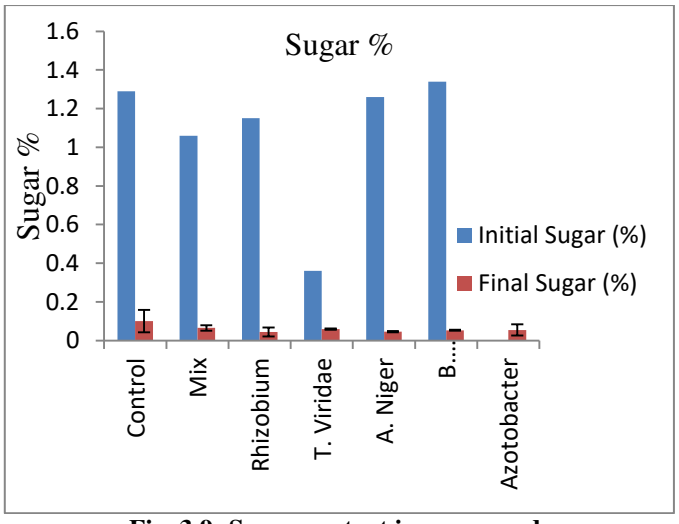

Fig. 3.9: Sugar content in press mud

9) Total viable count

As per FCO guidelines the biorfertlizer should contain the total viable cell count more than 5x106 cells/100gm Biofertilizer whereas per above graph the presmud with culture consist of sufficient number of total viable count. The mixed cultures consist of higher number of total viable count than any other press mud count.

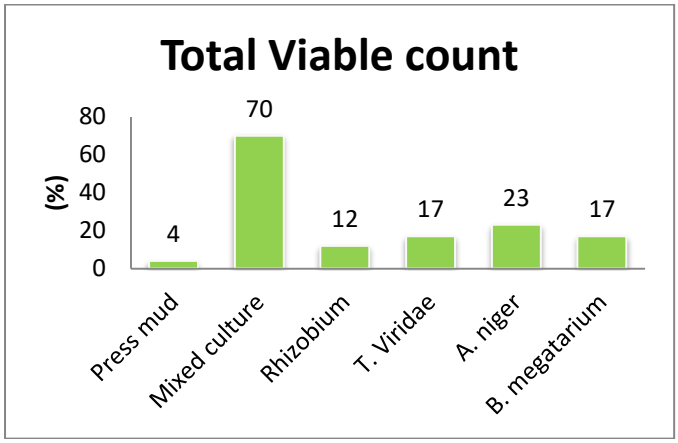

Fig. 3.10: Total Viable count in press mud

4. CONCLUSIONS

Raw press mud can we used as carrier and growth supporter for various micro organisms which can be used as Biofertilizer. In this project various micro organisms were tried and some of them shown good results in state of growth and composting of press mud.

The mixed culture showing good results than individual results which can beneficial for soil and good crop yield.

Raw press mud consist of various micro nutrients and rich source of N, P, K and carbon source which are beneficial for growth and maintenance of various micro organisms. The micro organisms which are shown the growth on press mud are beneficial for betterment of soil; these are useful for increase water holding capacity, fertility of soil, helps to increase the concentration of N, P, K in the soil.

5. ACKNOWLEDGEMENT

I would like to take this opportunity to express the gratitude that have felt towards my teachers, family and friends who have helped and supported me throughout the journey of the years of master's degree and made this thesis possible. I would like to express my heartfelt gratitude to my project guide **Mrs. Saee H. Thakur** Ma'am (Asst Prof, Dept of Biotechnology Engineering, KIT's COE (Autonomous), Kolhapur) for her great support, guidance along with thoughtful suggestions and appreciation of my work. I am fortunate to have her by my side as teacher and mentor from second year of engineering and have always been supportive and encouraging since then till date.

Third year students, **Ms. Rajeshwari Birje, Ms. Aishwarya Nair, Ms. Sayali Deshpande, Ms. Tanul Jeetkar Ms. Nikhataliya Mhaisale, Ms. Manali Gulwade, Ms. Bilwa Navare, Ms. Snehal Yadav, Mr. Mayur Desai and Mr. Prathmesh Suryavanshi** are part of my project and backbone for lab work during my curriculum. Without them this project wouldn't have run at this smooth pace. Their helping attitude and sincerity helped my work in meaningful ways.

I am very much thankful to **Mrs. Yasmin Attar** Ma'am (HOD, Microbiology department, Rajaram College, Kolhapur) and **Mr. Suryakant Shinde** (Manager, BAIF, Pune) for providing me with required microbial cultures.

I am very much thankful to **Mr. Arun Aswale** and **Mr. Dipak Pisal** for always supporting me in all the lab works since second year engineering to M. Tech. Thank you for being the help and assistance in all practical problems in lab work!

Mr. Rutuparn Karkare and **Dr. Monica R. Sanandam** have contributed in the project with their expertise and advice at time whenever required. Their

coordination has been of significant importance in the fulfillment of all essentials during the course work of M. Tech. I am blessed and thankful to them for encouraging me throughout.

6. REFERENCES

1. Khaleel R, Reddy k. r, and Overcash m. r., Changes in Soil Physical Properties Due to Organic Waste Applications: *A Review1, J. EnvironQ.ual.,* Vol. 10, no. 2, 1981
2. Yadav A. N. Verma, P., Singh B., Chauahan V.S. Suman A. and Saxena A. K. Plant Growth Promoting Bacteria: Biodiversity and Multifunctional Attributes for Sustainable Agriculture. *Adv Biotech & Micro 5(5): AIBM.MS.ID.555671* (2017).
3. Gupta N., Tripathi S., Majumdar C. B., Characterization of pressmud: A sugar industry waste. *Fuel 90* (2011) pp.389–394.
4. Kumar R., Verma D., Singh B. L., Kumar U,, Shweta, Composting of sugar-cane waste by-products through treatment with microorganisms and subsequent vermicomposting, *Bioresource Technology 101* (2010) pp.6707–6711.
5. Diaz P. M., Consequences of Compost Press Mud as Fertilizers: A review, *DJ International Journal of Advances in Microbiology and Microbiological Research, Vol. 1(1),* 2016 pp. 28-32.
6. Kumar V. Chopra A.K. Effects of sugarcane pressmud on agronomical characteristics of hybrid cultivar of eggplant under field conditions. *Int J Recycl Org Waste Agricult DOI 10.1007/s40093*-016-0125-7
7. Ambigar S. Byakodi A., Comprehensive Study On Characterization of Sugar Pressmud Along with Suitable Microbial Consortium For Pressmud Composting.
8. Patil N. N., Jadhav S. Ghorpade S.S., Sharma A. K., Isolation and enrichment of sugar press mud (spm) adapted microorganism for production of Biofertilizer by using sugar press mud. *International Journal of Advanced Biotechnology and Research, Vol 4, Issue 1*, 2013, pp 96-104.
9. Ryckeboer J., Mergaert J., Coosemans J. Deprins K., Swings J., Microbiological aspects of biowaste during compostingin a monitored compost bin, *The Society for Applied Microbiology, Journal of Applied Microbiology, 94*, pp 127–137.
10. Joshi N., Sharma S., Physico-Chemical Characterization of Sulphidation pressmud Composted pressmud and Vermicomposted pressmud 2010;2(3).
11. Kumar S., Meena R. S., Jinger D., Jatav H. S., Banjara T., Use of pressmud compost for improving crop productivity and soil health, *International Journal of Chemical Studies 2017; 5(2):* pp 384-389.
12. Balakrishnan M., Batra V. S., Valorization of solid waste in sugar factories with possible applications in India : A review, *Journal of Environmental Management 92* (2011) pp 2886-2891
13. Saranraj P., Stella D., P. Composting of Sugar Mill Wastes: A Review, *World Appl. Sci. J.* 2014; pp2029-2044.
14. Salama Y. Chennaoui M., Amraoui M. E., Mountadar M., A Review of Compost Produced from Biological Wastes: Sugarcane Industry Waste, *International Journal of Food Science and Biotechnology 2016;* pp 24-37.

15. Bokhtiar S.M., Roksana S., Moslehuddin A. Z. M., soil fertility and productivity of sugarcane influenced by enriched pressmud compost with chemical fertilizers, *SAARC J. Agri.2015;* pp 183-197.
16. Sardar S., Ilyas U., Malik S. R., Javaid K., Compost Fertilizer production from Sugar Press Mud (SPM).
17. Kavitha R., Kanchana D., Analysis of nutrient status and bacterial population in bacterially composted pressmud, *Int.J.Curr.Res.Chem.Pharma.Sci*.(2014), pp 174–178.
18. Chandra R. Yadav S. Use of PMDE with Sugar Industries Pressmud for Composting: A Green Technology for Safe Disposal in the Environment, 2014.
19. Mazid M., Khan T. A., Future of Bio-fertilizers in Indian Agriculture: An Overview, *International Journal of Agricultural and Food Research* | *Vol. No. 3*, pp. 10-23
20. Pelczar, Jr. M. J., Chan E. C. S., and Creig N. R; Microbiology. Tata Mcgraw-hill, publishing company limited, New Delhi. (1988); pp. 560-580.
21. Vessey, J. K. Plant growth promoting Rhizobacteria as bio-fertilizers, Plant Soil. 255, (2003); pp 571-586.
22. Use of micro organisms in agriculture. Book.