Introduction

Waste management is a global issue, worsens by population and economic growth. It is increasingly serious problem in developing countries like India. Globally 140 billion tones of agricultural biomass waste is produced annually, most of it either left to rot in field or burnt. During past years pesticides, herbicides and chemical fertilizers have become the foundation of highly productive form of agriculture. However, accompanying their indiscriminate use, cirrus the risk of population serious changes in ecological symmetry and poisoning (Daniele and Rai, 2006).

In the 1970’s, ‘Green Revolution’ was questioned in the wake of energy crisis and concern over soil erosion, ground water contamination, soil compaction and decline of natural soil fertility and destruction of traditional social systems, led to a reappraisal of what were then considered to be the most advanced agricultural production techniques. Organic farming as a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, insecticides, growth regulators and live stock additives (Magar, 2004) which is the best possible method for ‘Evergreen Revolution’.

Compost has been considered as a valuable soil amendment for centuries. Composting is the decomposition of plant remains
and other once living materials to make the earthy, dark, crumbly substance that is excellent for soil and crop growth. Use of compost in agriculture is increase as both are alternative to land filling for the management of biodegradable waste as well as means of increasing or preserving soil organic matter and nutrients. Composting is a biological process, in which heat is produced as a byproduct of microbial breakdown of organic matter. Composting process is completed mainly by two processes degradation by fungi bacteria and actinobacteria (physically and biochemically) and synthesis of Stabilized humic substances (Kadalli et al., 2004).

Infact, composting is the conversion by microorganisms of complex mixtures of quickly degradable organic materials to stable, humified materials, usually in a warm, moisture and relatively aerobic environment (Vicky et al., 1985). It is governed by composition of organic substrates undergoing decomposition besides the methodology adopted (Gaur, 1999).

Mechanization in modern agriculture has caused an acute shortage of livestock population, which decrease organic matter in the country. Organic manure such as compost, FYM, biofertilizers, press mud cake, etc. are the important source to increase the soil organic matter content, soil microflora population and sustain agriculture production (Christopher Loudraj, 2002).
Now-a-days, the use of industrial organic wastes (liquid and solid) is recognized as stimulant in composting (Howard, 1935, Hajra and Kole, 1998) and also maintaining soil health and environment related atmosphere (surface or ground water pollution) and lithosphere (productive soil profile). There is certainly a thrust on land use planning of several threats which are giving alarming situation (Ramtake et al., 2004). Microbes feed on the organic matter and produce phosphorus, nitrogen and potassium which keep the soil in a healthy, balanced condition and inhibit growth of weeds, enhances soil quality/fertility and encourages healthy root development (Masood, 2006).

India is major producer of sugar in the world and sugar industry offers second largest agro-based processing industry after the cotton textiles industry in country which has a lion’s share in accelerating industrialization process and bringing socioeconomic changes in undeveloped rural areas.

The agro-based sugar mill (565) and distillery industry (319+) have been identified to be most polluting red category industries in India. Distilleries producing alcohol from molasses are considered to be one of the most polluting agro-based industries. The distillery wastewater known as spentwash is characterized by its colour, high temperature, low pH (4.0-4.3) with high rates of biochemical and chemical oxygen demand (BOD) : 52-58 kg/m³,
COD : 92-100 kg/m$^3$ and suspended solids : 2.0-2.5 kg/m$^3$, (Nandy et al., 2002). It contains about 90-93 % water and 7-10 % solids, sugar being 2-20 % and protein 10-11 % in the dry spent was. The metals present in spent wash are Fe-348 mg/ltr, Mn-12.7 mg/ltr, Zn-4.61 mg/ltr, Cu-3.65 mg/ltr, Cr-0.64 mg/ltr, Cd-0.48 mg/ltr and Co-0.08 mg/ltr with electrical conductivity in the range of 15-23 dSM$^{-1}$. The brown colour could be ascribed to the presence of melanoidin, the reaction products of sugar amine condensation. The unpleasant odour is due to the presence of Skatole, indole and other sulphur compounds which are not effectively decomposed by yeast or methane bacteria (Rajukannu and Mannickam, 1997, Mahimaraja and Nanthi, 2004).

Disposal of distillery effluent has become an acute problem which is creating pollution problem of air, water and soil. However, it contains 7 % organic and 3 % minerals which can be used as liquid fertilizers after proper treatment (Ali and Dhaka, 1989, Ali, 1997). Ali Khan and Kashyap (2010) developed microbial ecofriendly technology for production of biocompost from agrobased waste and its impact on Phaseolus aureus Roxb. and Coriandrum sativum.

Nearly, 10 million tones of solid waste (press mud) is being produced by the sugar industry alone (Shalini et al., 2007), which is a soft, spongy, amourphous and dark brownish fibre, sugar,
coagulated colloids including cane wax, albluminoids, inorganic salts, soil particles and generally containing about 55-65 % moisture. The composition varies depending upon the quality of cane crushed and the process followed for the clarification of cane juice in a sugar factory (Kumar and Mishra, 1991 and Yadav, 2001). PMC is a valuable nutrient resource and it contains the macro and micro nutrients throughout in small amounts essentially required for the growth of plants (Soundarajan et al., 2007). It is also rich source of phosphorus inorganic form, N, K, Ca, Fe and Mn, etc. PMC contains all the nutrients (macro and micro) through in small amount, essentially required for the growth of plants. All these nutrients became available to the growing plants upon their release from the degradation of PMC added to the soil.

PMC is rich in organic carbon as well as P₂O₅ and when it is applied to soil as organic manure, it is bound to increase the status of organic carbon or source of organic phosphorus.

It is being used as a source of organic matter because of its high organic carbon contents, soil conditioner or as an soil ameliorating agent as a FYM and organic manure and improved soil fertility and crop productivity (Bawaskar, 1968 and Zende et al., 1968). Its best use in preparing compost alongwith other byproducts and its used under water stress or drought conditions. The utility of PMC to improve crop yields under water stress
Introduction

conditions has been reviewed (Zende, 1992). PMC contains NPK and improves physicochemical properties of soil and maintain soil pH (Alexander, 1997).

A number of clean up technologies has been put into practice and novel approaches for treatment of distillery spent wash are being worked out. Potential microbial (anaerobic and aerobic) as well as physicochemical processes as feasible remediation technologies to combat environmental pollution are being explored.

Indiscriminate disposal of spent wash has become an acute problem due to the waste water (Basker et al., 2004). The total alcohol production spent wash is generated in massive quantity approximately 40 billion litre of spent wash annually. It has high COD, BOD and TDS. It is dark coffee colour, foul odour, highly biodegradable, dissolved solid content that creates problems of disposal and increase pollution problem.

DSW is also characterized by its high temperature, low pH, high ash content, high percentage of dissolved organic and inorganic matter which 50 % may be present as reducing sugar and large particle of potassium, nitrogen, phosphorus, calcium, chloride and sulphates. However, Ca, Mg and Cl are also present in appreciable amount (Rajukannu et al., 1997). Thus it can be effectively used as a source of plant nutrients and as soil
amendment agent (Jadhav et al., 2005). The micro nutrient content was relatively small amount in distillery spent wash except Fe. The BOD and COD content of distillery spent wash were very high. However, the distillery spent wash was biodegradable since the ratio of COD and BOD is more than 2.5. The high BOD and COD content in distillery spentwash might be due to the soluble form of organic matter present in it.

Fresh organic matter should not be added directly to soil. However, because the initial degradation process may produce considerable microbial growth with temporary N immobilization, the possible formation of allelopathic products and exothermal reactions which can damage plant roots (Zucconi and De Bertoldi, 1986). Microorganisms may also immobilize soil nutrients, mainly in soils with residues which have a wide C/N ratio, thereby inducing nutrient-starvation should be composted to narrow the C/N ratio during humification before being applied to soil as crop amendments. During the composting process, the organic substrate present in organic residues in mineralized and converted through humification into a stabilized organic matter.

Lowering pH value of stream increase inorganic load which caused ecological imbalance in climate, terrestrial aquatic habitat and depletion of O₂ content in water (Chauhan, 1991). Instead it can be used as nutrients for composting press mud (Ali Khan et al., 2006).
The potassium salts were mainly responsible for increasing in the EC of the effluent (Sharma, 2001). In general, among the plant nutrients, K was in larger amounts compared to N and P. Distillery spentwash contained large amount of K and SO$_4$ followed by N and P (Pathak et al., 1999). The calcium content was higher than Mg content. The presence of calcium is considerable amounts makes spentwash a potential amendment in reclaiming the sodic soils (Valliappan, 1998).

A low SAR, resulting from small amount of Na in the spentwash is unlikely to create sodicity hazard in the soil. Very high concentration of Cl and HCO$_3$ were observed. Similar reports were given by Saliha (2003). The distillery spentwash possess the microbial population, particularly bacteria, fungi and actinomycetes.

Distillery effluent contains a considerable amount of plant nutrient. In field study soil amendment with diluted post methanated distillery effluent increased the yield of wheat and rice grown in sequence. Organic carbon, available potassium content of post harvest soils were also increased saturated hydraulic conductivity, bulk density and volumetric water content of the soils improved with effluent application. There was no change in pH after harvest of wheat and rice. Thus effluent could be used as soil amendment. However, EC of soil also increased indicating the possibilities of salinity in long run with higher levels of effluent applied (Pathak et al., 1998).
The treatment of distillery waste water has gained worldwide attention as in some regions it is posing a serious threat to ground water quality (Jain et al., 2004). Extensive research has been carried out on treatment of distillery wastes in many parts of the world.

Kulkarni et al. (1987) classified spentwash as dilute liquid fertilizer with high potassium contents and its nitrogen was mostly in colloidal form behaving as a slow release fertilizer better than most inorganic nitrogen sources. Two kind of phosphorus was in organic form and metabolic availability of which was more than inorganic source. Moreover, it contains large amount of important secondary elements like Ca, S, Mg as well as trace elements viz. Cu, Mn and Zn. As a liquid fertilizer and possible to convert distillery effluent to a bioassimilable form which has a great promise for effluent disposal for soil health management in agriculture.

However, it cannot be regard nearly as K fertilizers and its nitrogen present in mostly in organic state behaving as a slow release fertilizer better than most other inorganic N sources. It can be advantageously used for compost (Rajanan et al., 1996a).

Since the effluent is an organic nutrient solution, it has a wide spectrum of utility. There have been attempts to use spentwash as substrate for yeast growth or for biochemical production. Saliha et al. (2005). However, the BOD of the effluent
still remains quite high (>5000 ppm) necessitating further treatment which would be difficult as all easily degradable organics are already consumed.

Disposal of spentwash is creating environmental problem of water, air and soil pollution. Thus it is hazardous causing “Chemical Time Bomb” but also contains many plant nutrients (Ali Khan, 1998). Discharge of distillery waste into water results high concentration of organic matter and salts in the river which is vanishing aquatic life. It produces obnoxious odour after fermentation and pollutes the water nearby wells (Singh et al., 2007).

Sustainable development is a certain compromise among environmental, economic and social goals of community, allowing for well being for the present and future generations. Designing appropriate policies and strategy that lead to conservation of natural ecosystems and biological diversity and ecologically sustainable development is not an option but a necessity. With expanding pollution and increasing human needs, the only way to plan sustainable development and alleviating poverty is ecosystem conservation and restoration. Effective conservation is the cheapest and most optimal option for securing ecosystem services and restoring degraded ecosystems which is a key challenge of today. Ecological restoration is a critical component in the application of an ecosystem approach to management.
Sugarcane produces about 10 to 12 tonnes of dry leaves per hectare per crop. The detrashing is done on 5<sup>th</sup> and 7<sup>th</sup> month during its growth period. The trash contains 28.6 % organic carbon, 0.35 to 0.42 % Nitrogen, 0.04 to 0.15 % phosphorus and 0.42 to 0.50 % Potassium. The sugarcane trash incorporation in the soil influences physical, chemical and biological properties of soil. Using cane trash alone is the standard technique of composting in comparison of any other means.

When sugarcane trash is burnt, most of the organic matter and nutrients in the trash are lost.

*Trichoderma viride*-the cellulolytic fungi multiplies very fast, spreads in soils and fight against other pathogenic fungi and more efficient for quick biodegradation of PMC. It grows quickly in the soil organic matter and competes with pathogenic fungi, cause hyper parasitism (physical destruction of pathogens and induced antibiosis or inhibition of toxins, production of toxins or poisonous substances which ultimately destroy the pathogen and protects the plants from diseases.

It has the capacity to convert wastes into useful products (non toxic). External sources of inoculums start microbial activity earlier and reduced composting period. It can be used for various agricultural wastes and byproducts for multiplication of decomposers as well as prophylactic agent against several
diseases and effective in decompose of PMC and yielding compost of good quality (Anandraj and Sharma, 1997).

Wheat is a cereal grass of the genus *Triticum* belongs to family Poaceae wheat plant has long, slender leaves. The stem is hollow in most varieties. The head is composed of varying number of flowers and the flower are grouped together in spikelet. *Triticum aestivum* is most common variety used to make bread and other food products.

Wheat grains are stable food for human and rich in protein and provide energy. It works as a good laxative. It contains manganese, phosphorus, magnesium and calcium in small amount. It is rich in Vitamin B₆. Consumption of wheat is necessary for a healthy metabolism. It prevents heart risks, gallstones and childhood asthma. It also reduces risk of high B.P., diabetes and high cholesterol.

*Trigonella* (Fenugreek) belongs to the family Leguminosae. Fenugreek (*Trigonella foernum-graeicum*) is annual and grown as green leafy vegetable and for the seeds. It is used as herb as well as spice. The plant is said to have several medicinal values. The seeds are rich in protein, mineral, starch, sugar, vitamins, enzymes and essential amino acids. The flowers and seeds are used for medicinal purposes to promote weight gain, in saote gastric disorder, in anorexics to lower B.P. The extracted oil from
seeds is used as skin softner. The research has shown that it may inhibit liver cancer growth and help in the treatment of diabetes.

Keeping in view disposal and the utilization of distillery spentwash (DSW) of distilleries into compost from PMC+Sugarcane trash+Tricho to minimize the pollution for environmental conservation through ecotechnology with following objectives as under:

**OBJECTIVES**

1. To utilize maximum distillery waste in PMC and sugarcane trash compost.
2. To observe the effect of *Trichoderma viride* on composting process in treatments (PMC + trash + distillery waste + *Trichoderma*) than control.
3. To evaluate maturity of compost by C/N ratio and plant bioassay test.
4. To study the effect of compost on growth and yield of *Triticum aestivum* L. and *Trigonella foenum-graecum* L.

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