I. INTRODUCTION

With the exponential increase in the number of industries, there has been a substantial increase in generation of industrial wastewater, which is discharged either into open land or nearby aquatic ecosystems. This activity promotes varying degree of pollution load in water, soil and air. The effluent is an inevitable consequence of industrial process. In arid and semi arid regions of the country, where shortage of water becomes limiting factor, the effluent is being used for irrigational purposes by the farmers in agriculture and agro-forestry practices. Since the production of wastewater is a continuous process, hence it can cater for substantial irrigation requirements. This alternative use of wastewater will not only prevent the waste from becoming an environment hazard but also will serve as a potential source of fertilizer if used rationally and at appropriate concentration.

The problem of environmental pollution on account of essential industrial growth is, due to the problem of disposal of industrial waste as well, whether solid, liquid or gaseous. Polluted water, in addition to other effects, directly affects soil not only in industrial areas but also in agricultural fields and river beds, thereby creating secondary source of pollution. Various industries have been continuously adding lot of waste water containing high level of nutrients, heavy metals and hazardous substances to the cultivable land. These effluents not only increase the nutrient level, but also excess tolerance limits and cause toxicity Sangeetha et al., (2012).
Industrial revolution is a great boon to mankind but there is a wide range of environmental impacts created by industries. Majority of these industries are water based. Over 3/4th of fresh water drawn by the domestic and industrial effluents inevitably end up in surface water bodies or in the ground water affecting water quality. Though the industrial use of water is very low as compared to agricultural use, the disposal of industrial effluents on land or surface water bodies make water resources unsuitable for other uses Mehdi et al., (2003).

Industrialization is an important tool for the development of any nation. Consequently, the industrial activity has expanded so much all over the world. Today, it has become a matter of major concern in the deterioration of the environment. Pollution of natural water by industrial waste water has increased tremendously. The effluent discharging industries are distilleries, sugar mills, pulp and paper mills, detergent, chemical factories, and textile dyeing industries, tanneries, electroplating, pharmaceuticals and dairy industries. Among them, the tanneries are occupying an important place and play a major role in polluting the environment by releasing a variety of pollutants as effluents. About 80 per cent of the tanneries in India are engaged in chromium tanning processes and they use nearly 40,000 tonnes of chromium every year. Only a fraction of the chromium is absorbed in the tanning process and a major part of it is discharged through the effluent. It has been reported that these industries release 12,000–20,000 tonnes of chromium in effluent annually (Shukla et al., 2007). The concentration of chromium in tannery waste is about 20,000 ppm, about 1800 ppm in sludge and 200 ppm in composite effluent, and these are disposed of without any treatment. In addition, the physicochemical analysis of tannery effluent showed that the effluent normally contains 100 to 200 mg/l of chromium [Manivasakam.1997].
Among the effluent discharging industries tanneries play a major role in creating serious pollution problems than other industries. There are about, 1000 tanneries in India, of which 568 are located in Dindigul, Vellore, Trichy and Vaniyambadi areas in the southernmost state of Tamil Nadu. (Indira et al., 2012).

Owing to rapid development of tannery processing units in India, the disposal of effluents has become a serious problem. It has been estimated that several industries release effluents at the rate of 1.5 mgd (7 million liters day$^{-1}$). The release of these effluents without proper treatment into the nearby rivers, irrigation canals and streams adjacent to agricultural fields cause serious hazards intensifying the adverse effects on ecosystems like water, soils and plants . (Shukry.2001)

The salts of sodium chloride, sodium sulphate, lime and chromium are commonly used in the tanneries in the process of tanning day in and day out. About 80 per cent of the tanneries in India are engaged in ‘chrome tanning processes’, whereby nearly 40,000 tonnes of basic chromium is discharged as effluents every year. This spiral effect on water pollution impacts on soil pollution and threaten the fertility of and sustainability of land, as a whole. Thus the wastewaters emanating from tanneries are sufficient to cause damage to water and soil thus making the vicinity unfit for the habitation of living organisms.

In leather industry, tanning is the main process that protects leather against some environmental effects such as microbial degradation, heat, sweat or moisture (Erdem 2006). About 90 per cent of tannery industries in the world use chromium as tannage materials because of the excellent properties of the chromium compounds in the tanning (Ortega et al., 2005). During the tanning process, chromium forms
crosslinks between the collagen fibers and the resulting hides have a good mechanical resistance, an extraordinary dyeing suitability and a better hydrothermic resistance in comparison with hides treated with vegetable substances (Dantas Neto et al., 2004). However, only 60 per cent of the total chromium reacts with the hides. The rest of the chromium remains in the tanning effluent and are subsequently sent to a tannery wastewater management plant where the chromium metal end up in the sludge. (Cassano et al., 1997; Basegio et al., 2002).

Tannery effluents are strongly alkaline with a high oxygen demand and a high content of salts, one of which is chromium (Bajza and Vrcek, 2001). Nowadays tanning is favoured by the majority of the leather industry because of the speed of processing, low cost, colour of leather and greater stability of the resulting leather (Hafez et al., 2002). However, uptake of the chromium into the leather is not complete and relatively large amounts are found in the effluent. Estimates range from 2000–3000 mg dm\(^{-3}\) to 3–350 mg dm\(^{-3}\) (Vlyssides and Israelides, 1997).

Tannery effluent cause severe environmental impacts due to the pollutant levels that are commonly present, the main problems, depending on the productive cycle, are the presence of solids, nitrogen, chromium and the high organic loading. This issue has been identified by the European Commission and is described in detail in the reference document on best available techniques for the tanning of hides and skins (EC, 2003). The need for environmental and economically feasible systems is a real demand worldwide. Emphasis is given here to tannery wastewater since the search for best available technologies to accomplish the legal discharge targets may contribute, in a certain way, to the preservation of this industry, which in Portugal is considered to be of great importance due to the historical and economic value that it represents (INETI, 2000).
The tannery industry converts rawhide or skin, a putrescible material, into leather, a stable material, so that it can be used in the manufacture of a wide range of consumer products. Most of the steps of the tannery operations are carried out in water. Consequently, the wastewater treatment is of major concern. Tannery effluent composition varies considerably with the production process that is engaged by the specification of the final product. Problems related to high organic content, and the presence of sulphides and chromium are often encountered imposing treatment needs in order to avoid negative impacts on the environment (COTANCE, 2002).

When the effluent is released into the environment without proper treatment, it alters the characters of ecosystem. Farmers are using these raw effluents for irrigation and found that the growth, yield and soil health are reduced (Nandy and Kaul, 1994). The tannery industry represents an important sector in the economy of many countries. On the other hand, depending on the leather process, it generates large quantities of wastewater with ammonium, sulfates, surfactants, acids, dyes, sulfonated oils and organic substances, including natural or synthetic tannins. These chemical substances are applied to transform the animal skin into products with great capacities for dyeing, as well as to increase the mechanical and hydrothermal resistance. Considering that the greater part of these organic compounds are resistant to conventional chemical and biological treatments, the wastes discharged into natural waters increase environmental pollution and the health risks (Krishnamoorthi et al., 2009).
Dye effluents normally characterized by high chemical and biological oxygen demands (COD and BOD), suspended solids and intense colour due to dye intermediates or residues and auxiliary chemicals from the process. Direct discharge of these effluents into municipal wastewater plants and/or the environment may cause the formation of toxic carcinogenic breakdown products (Chung and Cerniglia, 1992) while certain metal complex dyes are of health concern (Eggert et al., 1996). Since dyes with complex aromatic structures are resistant to biodegradation by the typical microbial populations in activated sludge systems and may even be toxic to many of the microbial species present, discharge of the raw effluent to the treatment plants may lead to their failure (Ahn et al., 1999).

The raw hide undergoes a series of chemical treatments before it turns into flattening leather. This includes soaking, liming, dehairing, deliming, bating, degreasing and pickling. For all these steps the chemicals like sodium sulphide, ammonium chloride, sodium sulphite, hydrogen peroxide, formate, sodium bicarbonate, chromate and chloride are used which are quite toxic. Thus due to these multifarious operations with an array of chemicals, the leather processing industry is one of the worst offenders of the environment (Murugan and Sohaibani, 2010). Thus the impact of leather tanning industry on the environment is ongoing and increasing problem (Kurt et al., 2007, Vishnu et al., 2008; Preethi et al., 2009; Belay, 2010). The effects of various industrial effluents, sludge materials and metal elements on seed germination, growth and yield of crop plants have captivated the attention of many workers (Yu and Gu, 2007).
Bio fertilizers are more commonly known as microbial inoculants, are artificially multiplied cultures of certain soil organisms that can improve the soil fertility and crop productivity. Although the beneficial effects of legumes in improving soil fertility was known since ancient times and their role in biological nitrogen fixation was discovered more than a century ago, commercial exploitation of such biological processes is of recent interest and practice.

Bio fertilizers are commonly called microbial inoculants which are capable of mobilizing important nutritional elements in the soil from non-useable to usable form by the crop plants through their biological processes. For the last one-decade, bio fertilizers are used extensively as an eco-friendly approach to minimize the use of chemical fertilizers, improve soil fertility status and for enhancement of crop production by their biological activity in the rhizosphere. The *Rhizobium, Azospirillum*, phosphobacteria as bio fertilizers to supplement nitrogen and phosphorus fertilizers and observed considerable improvement in the growth of crop plants

A bio fertilizer (also *bio-fertilizer*) is a substance which contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant (Vessey 2003). Bio-fertilizers add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances. Bio-fertilizers can be expected to reduce the use of chemical fertilizers and pesticides. The microorganisms in bio-fertilizers restore the soil's natural nutrient cycle and build
soil organic matter. Through the use of bio-fertilizers, healthy plants can be grown, while enhancing the sustainability and the health of the soil. Since they play several roles, a preferred scientific term for such beneficial bacteria is "plant-growth promoting rhizobacteria" (PGPR). Therefore, they are extremely advantageous in enriching soil fertility and fulfilling plant nutrient requirements by supplying the organic nutrients through microorganism and their byproducts. Hence, bio-fertilizers do not contain any chemicals which are harmful to the living soil.

*Rhizobium* is a free living gram-negative, non-sporulating, aerobic, and motile and rod shaped bacterium which resides in soil and is capable of infection, nodulation, establishing symbiosis and N\(_2\) fixation. If grows on organic nutrients, *Rhizobium* are more prominent in the rhizosphere of leguminous plants.

*Azospirillum* lives in soil. It is able to live on its own in soil, or in close associations with plants in the rhizosphere. It is helpful to plants and important to farmers because it is able to fix nitrogen. It can convert nitrogen gas in the air into nitrogen bound up in amino acids and proteins.

*Phosphobacteria* is microbial inoculants capable of solubilizing phosphate. It is commonly used *Phosphobacteria is Bacillus megaterium*. Around 95-99 per cent of the total soil phosphorus is insoluble which is directly not available to plants. Multiplies fast in the root zone. The P-solubilizers containing bacteria or fungi may convert isolable form of phosphate to soluble form by producing organic acids in general. About 15-25 per cent of insoluble phosphate can be solubilized, saving
chemical fertilizers significantly. *Phosphobacteria* can solubilize about 30 kg of insoluble source of phosphorus and making it available to plants. Application of phosphobacteria along with nitrogen fixing bacteria promotes growth and yield of the crops by 30 per cent.

As this polluted water is being used for irrigation, the present research work has been carried out to find the effect of tannery effluent on germination, growth and yield of seven varieties of horse gram (*Dolichos biflorus* L.). By this way, a study was undertaken to identify the tolerant nature of *Dolichos biflorus* varieties under tannery effluent. The research work comprises the following aspects.

1. To find out the physico-chemical properties of tannery effluent.
2. To assess the tolerant variety of horse gram (*Dolichos biflorus* L.) at various treatment of tannery effluent, estimated through germination studies.
3. To evaluate the seedling growth of the seven select varieties of horse gram (*Dolichos biflorus* L.) grown under tannery effluent.
4. To find out the fresh weight, dry weight, phytotoxicity, vigour index and tolerance index of horse gram (*Dolichos biflorus* L.) subjected to tannery effluent as a main source of irrigation.
5. To measure the growth performance of horse gram (*Dolichos biflorus* L.) under tannery effluent with biofertilizers.
6. To figure out the biochemical constituents of horse gram (*Dolichos biflorus* L.) under tannery effluent with biofertilizers.
7. To discern the yield performance of horse gram (tolerant variety) (*Dolichos biflorus* L.) under tannery effluent with bio fertilizers.

8. To find out the nutrient contents of horse gram (*Dolichos biflorus* L.) under tannery effluent with bio fertilizers.

9. To estimate the physico-chemical properties of soil before sowing and after harvesting.