INTRODUCTION

The pesticides are being extensively used in agricultural fields so as to control attack of insects on cereal, vegetable and fruit crops to improve the yield from agricultural fields (Dragun et al. 1984; Linan 1994; Hua et al. 2009). They are designed to be persistent to achieve effectiveness over a longer period of time after their application. In India among the total consumption of pesticides the major share is of insecticides (76%) followed by fungicide (13%), herbicides (10%) and 1% by others (Aktar et al. 2009). Chlorpyrifos (O, O-diethyl-O-3,5,6 trichloro-2-pyridyl phosphorothioate), an organophosphate insecticides commonly used in agricultural fields is also used as termiticide in and around the residential areas (Racke et al. 1994). The organophosphate pesticides (OPs), in use since 1937, were initially thought to be safe alternative to organochlorinated pesticides like hexachlorobenzene, heptachlor etc. However, over the years due to their indiscriminate usage and their bioaccumulation had resulted in acute toxicity to mammals and other non-target organisms (Sogorb et al. 2004).

Chlorpyrifos is considered as the fourth commonly consumed pesticide after monocrotophos, acephate and endosulfan in India (Ansaruddin, 2003). Chlorpyrifos acts primarily at the synapses, altering the regulation of the transmission of the signal by inhibiting the enzyme acetylcholine esterase. This inhibition causes convulsion, paralysis and finally death (Ragnarsdottir, 2000). Although, its concentration required causing such manifestations in mammals/humans is significantly higher than in insects but its high concentrations in environment over the years has resulted in human deaths due to chlorpyrifos poisoning have been reported in literature (Karalliedde and Senanayak 1999; Sogorb et al. 2004). Chlorpyrifos, although is not prone to accelerated degradation however, its transformations to 3,5,6-trichloro-2-pyridinol (TCP) at sites of application/spillage is of concern. TCP is known to have antimicrobial properties and affect the microbial numbers and diversity of affected sites.

Thus, there is a need to explore microbial diversity which can either transform TCP to non-toxic forms or could survive in presence of high concentrations of TCP. In this regard, the consortium based on stable association of microbes, belonging to different groups, is an attractive option to achieve mineralization of chlorpyrifos and its toxic intermediates.
Different sets of studies are required to evaluate the degradation potential of individual isolates and their combinations under varying physico-chemical and nutrition conditions. It is difficult to evaluate the effect of each such variable on overall degradation efficiency of axenic or mixed cultures. Thus, the statistical studies based upon response surface methodology could give insight regarding the role of each variable to achieve efficient transformation of the target molecule.

The persistence of pesticides, apart from their recalcitrant structure and related toxicity to living forms, might be due to their low aqueous phase solubility. Thus, the compound would not be bioavailable to the microbial populations which may have all the biochemical components to mineralize them. Therefore, use of surfactants of chemical or biological origin is investigated to improve aqueous phase partitioning of these compounds so that potential microbes can mineralize them (Noordman and Janssen 2002). The chemical surfactants or organic solvents apart from being of petrochemical origin are also a source of secondary pollution as they are not efficiently cleared from the environment after their role has been achieved.

Biosurfactants, the surface active molecules produced by microbes growing in presence of water insoluble substrates have been explored for their ability to improve the degradation of different pollutants. However, lack of data regarding their biological activity, safe use and cost of production are major deterrents in their field scale applications. The optimum concentrations of biosurfactant to be used for a particular site may vary depending upon the characteristics of the site and pollutant. The studies to understand these variations would immensely help in opening up the field of applications of these molecules to bioremediation studies.

In light of this, present study involved the isolation of naturally adapted microbial diversity to mineralize potentially toxic chlorpyrifos and it’s intermediate. The development of efficient consortia using selected degraders which may pave the way to effective bioremediation during their field scale application. The present study also involves the isolation of microbial population’s with ability to produce surface active compounds. The biosurfactant may improve the bioavailability of the target compounds to efficient degraders so as to achieve effective clean up of polluted site. Being of biological origin they would be easily degraded once their specific role has been achieved at the polluted site. In light of these advantages biosurfactants are molecules of choice to replace chemical surfactants to attain environment friendly bioremediation.