ABSTRACT: Arsenic is found naturally and exists in both organic and inorganic form in the environment. The toxicity of arsenic in soil and ground water is one of the most important environmental problems particularly in Murshidabad district of West Bengal. Indo-Gangetic regions is one of the most arsenic contaminated zones in the world. Long term irrigation of agricultural soils with arsenic contaminated water can lead phytoaccumulation and food chain contamination of the food crops. The present study emphasis on the potential utilization of the Cyanobacteria and fungi for the arsenic removal along with the toxic effect imposed by the pollutant. Cyanobacterial species and some fungi have a huge potential towards the arsenic removal from the aqueous system ranging from very low to high concentration.

KEY WORDS: Murshidabad, Arsenic, Phytoremediation, Cyanobacteria, Fungi.

INTRODUCTION: Arsenic is a carcinogenic metalloid released into the environment from both natural and anthropogenic source. The transfer of As in soil plant systems represents one of the principal pathways for human exposure. In particular, As contamination in food crops through irrigation, water possess a serious threat to food chain. The increase in the world’s population has led to the exploitation of bioresource to overcome the demand for water, land, food and energy, resulting in cascading the effects on both environment and health. The continuous human growth and their requirements have led to the developments of industries, which resulted in the manufacture of various toxic compounds. The increased industrialization also resulted in an imbalance situation for both flora and fauna. Various pollutants such as heavy metals, polycyclic aromatic hydrocarbons, halogenated aromatic compounds benzene, toluene, ethylbenzene and xylene compounds are continuously being released from petrochemicals, oil refineries, pharmaceutical companies, agrochemical industries etc. The residual of these compounds in the environment has adversely affected the yield and productivity of soil, water and air, thus imposing severe health issues to the living biota. Owing to the non-biodegradable nature, they continue in the ecosystem for longer duration and cause toxic effects on both soil microbial diversity and plant growth. Phytoremediation is a unique survival method by microorganisms or plants under stress conditions. They gain the ability to break down and utilize complex toxic compounds such as metals, polyhydroxybutyrate into non-toxic form. The use of Cyanobacteria and some fungi for phytoremediation is an eco-friendly process. Cyanobacteria can remove toxic contaminants occurring naturally or xenobiotically. They are well capable in adapting in the adverse environments, ranging from halophilic to cryophilic. The outer layer comprised of extra polymeric substance possessing several binding sites for environmental remediation. It is also capable to synthesize the metal binding proteins that are capable to binds with the inorganic pollutants such as heavy metals. The present study discusses the heavy pollution and its toxic effect on surface water, ground water, humans and also to the environments. Further, aiming at a potential of Cyanobacterial derived composites polysaccharides based biomaterials for heavy metal removal from waste and polluted areas. The fungi used for enhancing phytoremediation basically consists of two types, arbuscular mycorrhizal fungi and rhizospheric fungi. The AM fungi help in enhancing phytoremediation by increasing the absorption area of roots and increasing the contaminant uptake capacity of the plant. The AM fungi can also produce organic acids, glycoproteins and cyclosporin to form metal complex which affect the availability of the metal particles for translocation. The mychorhizal inoculation helped in fighting the phosphorus deficiency caused due to As, thereby maintaining the P: As ratio. Mainly three AM fungi (Glomus geosporum, Glomus versiforme and Glomus mosseae) were used for rice plants in As contaminated fields. Rice plants showed improved grain quality due to less As accumulation in the rice grains through enhancements of P: As ratio. Piriformospora indica when inoculated along with the rice plants decreased the As bioavailability in the soil. Trichoderma sp. is one of the important filamentous fungi that can be used effectively for phytoremediation of As. Therefore fungi can also find application for supplementation to plants for both phytoextraction and phytostabilization angles.

PHYTOREMEDIAL METHODS: Phytoextraction: Phytoextraction is a method of phytoremediation in which plants uptake the contaminant from the medium via their roots and the contaminants are subsequently translocated for accumulation and storage in the shoot part of the plant. In this way, the metal present in soil is extracted with the help of plants and concentrated in specific harvestable tissues and therefore be
Phytostabilization: Phytostabilization is a method of phytoremediation in which the heavy metal contaminants are immobilized in the medium itself with the help of plants. The bioavailability of As depends on a number of factors, including pH and redox state, level of iron hydroxides and oxyhydroxides, level of other mineral elements like manganese and phosphate, organic matter content etc. The plants are known to excrete a number of chemicals to the soil through roots that mainly include various organic acids like citric acid, malic acid (Jones and Darrah, 1994; Jones, 1998). The secretion of acids alters the pH of soil and affects chemical and biochemical reactions. In this way, the growth of some plants can stabilize As in soil and restrict its access to crop plants in subsequent season. There are certain metalloic plants, which are able to grow in highly As contaminated sites without its much accumulation in their tissues.

Phytovolatilization: As is known to exist in several inorganic and organic forms. Trimethylarsine is the volatile form of As (Frankenberger and Arshad, 2002). Apart from As, mercury and selenium also have volatile form. Phytovolatilization is a method of phytoremediation in which the plants uptake and transpire the contaminants into the atmosphere by converting the metals into lesser toxic organic and volatile forms and release the metal into the atmosphere through the leaves (Limmer and Burken, 2016). However, in case of As, the plant enzymes and processes involved in the conversion of As to volatile forms are not discovered yet. It is known that the presence of organic As forms in plants is due to direct uptake of from soil where organic As are formed in microbes and released to the soil (Wang et al., 2014). Hence, till date, it is known that it is the microbes in soil which actually convert As to organic and volatile forms. Therefore, phytovolatilization strategy for As can only be achieved via co-inoculation of microbes or via transgenic development (Guarino et al., 2020). Further, this method may not be feasible for use in the fields as it releases As vapours into the atmosphere, which can further be transferred in the people working on and near the contaminated fields.

<table>
<thead>
<tr>
<th>SL NO.</th>
<th>NAME OF THE MICROORGANISMS ALGAE</th>
<th>ADSORBATE</th>
<th>NAME OF THE MICROORGANISMS FUNGI</th>
<th>ADSORBATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Scytonema sp.</td>
<td>As</td>
<td>Penicillium sp.</td>
<td>As, Ni</td>
</tr>
<tr>
<td>2.</td>
<td>Chroococcus sp.</td>
<td>As, Pb</td>
<td>Arthrodema sp.</td>
<td>As, Ra</td>
</tr>
<tr>
<td>3.</td>
<td>Lyngbya sp.</td>
<td>As, Cr</td>
<td>Trichoderma sp.</td>
<td>As, Cd</td>
</tr>
<tr>
<td>4.</td>
<td>Spirulina sp.</td>
<td>As, Zn</td>
<td>Aspergillus sp.</td>
<td>As</td>
</tr>
<tr>
<td>5.</td>
<td>Oscillatoria sp.</td>
<td>As, Cd</td>
<td>Emericella sp.</td>
<td>As, Cd</td>
</tr>
<tr>
<td>6.</td>
<td>Nostoc sp.</td>
<td>As, Ni</td>
<td>Myrothecium sp.</td>
<td>As, Zn</td>
</tr>
<tr>
<td>7.</td>
<td>Anabaena sp.</td>
<td>As, Cd</td>
<td>Fusarium sp.</td>
<td>As, Cr</td>
</tr>
<tr>
<td>8.</td>
<td>Graesiella sp.</td>
<td>As, Ra</td>
<td>Mucor sp.</td>
<td>As, Pb</td>
</tr>
<tr>
<td>9.</td>
<td>Spirogyra sp.</td>
<td>As, Cu</td>
<td>Rhizopus sp.</td>
<td>As, Cr</td>
</tr>
<tr>
<td>10.</td>
<td>Arthrospira sp.</td>
<td>As, Pb</td>
<td>Corynascus sp.</td>
<td>As, Ni</td>
</tr>
</tbody>
</table>

DISCUSSION:
The removal of heavy metals from the environment by blue green algae is a novel and cost effective approach. Blue green algae take up these pollutants to enhance the metabolism and decrease the contaminant from the environment. Blue green algae can be used as wild type, mutant or genetically modified forms for bioremediation of heavy metals. The presence of diverse proteins and polysaccharides on the blue green algal surface helps to bind with the heavy metals with enhanced efficiency. Biosorption has various advantageous, including cost effective, the selective expulsion of species and high adsorption rate. Blue green algae are the most diverse group of photosynthetic prokaryotes and can be present in marine, fresh water and terrestrial conditions. Blue green algal outer layer is composed of polysaccharides having an enormous number of binding sites for the adsorption of organic and inorganic pollutants. The occurrence of various fungi such as Aspergillus, Rhizopus, Penicillium, Fusarium species in soil polluted with heavy metals has also been reported by some workers from different parts of the world. They have reported that increasing heavy metal contamination may promote fungi in the contaminated soils. Likewise, numbers of fungi is non-significantly correlated with variation in soil As content. It exhibits that soil fungal population may remain unaffected under varying levels of As contamination in soils. Fungi were found least affected amongst all the microbes in a study revealing impact of As on soil microbial populations. As is used by microbes for cell growth and metabolism. Microorganisms have evolved biochemical mechanisms to exploit As, either as an electron acceptor for anaerobic respiration or as an electron donor to support chemo-autotrophic fixation of carbon dioxide into cell carbon. Binding of As with fungal cell wall and intracellular transport are also involved in fungal cellular response to As. Exposure of enumerated soil fungal strains to As might lead to physiological adaptation which may be associated with increased As bioaccumulation. These mechanisms might lead to metal tolerance in fungi. Bioaccumulation and biomethylation have been suggested as detoxification mechanisms for microbes exist in As contaminated zones. Different strains of Trichoderma, Penicillium, Fusarium were found capable of reduction and methylation of As. Aspergillus sp removed As through bioaccumulation and biowolatilization during 30 days cultivation period. Fusarium sp was accumulating arsenite and volatile dimethylarsenate. As uptake takes place through different transporters like phosphate, glycerol and hexose transporters, arsenate enters the cell through specific or unspecific phosphate transporters. The variability in biomethylation may be due to different metabolic mechanisms of different fungi used to deal with As. Methylated As compounds are the metabolites of intracellular mechanism know as the challenger pathway for As biomethylation through transfer of carbonium ions from S-adenosyl-methionine. The net result of biowolatilization is the loss of As, from the broth and fungal biomass. In the study those fungal strains which showed better As tolerance, exhibited higher As removal. Among the fungal isolates from the Murshidabad
district, some fungal strains have shown the highest level of As tolerance and removal in the study. Exploitation of native soil fungal strains and understanding of their potential for As removal are now being necessary to develop effective As mycoremediation technology. The novel soil fungal strains enumerated from the Murshidabad district have possessed As detoxification mechanism and may reduce As contamination from soil to the crops in the root zone under in-situ conditions. These fungal strains could be studied in details of their in-situ application to reduce As toxicity to crops in the As contaminated agricultural soils. It could be a realistic and desirable strategy using these fungal strains in maintaining the crop production in As contaminated soils along with mitigating As contamination to crops.

CONCLUSIONS:
Owing to the different merits and edges, bioremediation has risen as an appealing option in contrast to the current traditional remediation techniques that has enormous application in ecological administration and contamination control. Assesment and improvement of biosorbent materials from microbial biomass is a quickly expanding thirst area in academia and in industries. Blue green algae and fungi are a captivating and extraordinary class of microorganisms with wonderful versatility, omnipresence and assorted variety. In spite of the facts that the presence of blue green algae and fungi in the terrestrial and aquatic environment are easily available, screening and determination of the promising cyanobacterial and fungal species with a high metal adsorption limit is a demanding task. The encouraging species can be an appropriate possibility for the improvement of new and productive biosorbents, which can be packed in the bioadsorption column so as to completely use the capability of blue green algae and fungi in bioremediation of toxic metals. Henceforth, the waste derived biomass for environmental remediation application resulted in advancement of the ecofriendly, green and sustainable materials further contributing to the sustainable circular economy and industries.

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REFERENCES: