



EFFECT OF SYNTHETIC DETERGENT ON SOIL MICROBIAL POPULATION AND NITROGEN FIXING BACTERIA PRESENT IN CONTAMINATED SOIL : A REVIEW

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ABSTRACT:

Among the different contaminants, detergent as an important pollutant has serious risks on soil microbial population. Environmental soil get contaminated when the residuals of detergents are dispersed into it after use and thus this has an effect on decreased microbial growth of soil. Synthetic detergents can destroy organisms that live in the soil and synthesize food into nutrients. Nitrogen fixing bacteria provides vital nutrients to plants that they cannot obtain from the air themselves. Nitrogen-fixing microorganisms do assimilated Nitrogen for them. Biological nitrogen fixation serves as an important factor for agricultural crops and plants. Present study reports the estimation of total population of microbes in soil contaminated by detergents and nitrogen fixation ability of soil. In this review, the environmental impacts of synthetic surfactants on microbial population in soil as well as on nitrogen fixers are explored.

Keywords: - Detergent, Nitrogen fixers, surfactant.

INTRODUCTION :

Detergents have application in industry and home cleaning activities including laundry and dishwasher detergents. It is usually available in powders or concentrated forms (Effendi et al 2017). Synthetic detergents have properties similar to that of soap. They are extra soluble in water and could be used in both soft and hard water. They are present in consumer and industrial products from foods, healthcare products, as well as it is an important component of many industrial processes that leads to environmental pollution because of various discharging contaminates into the soil. (Mousavi, & Khodadoost, 2019).

Essentially, detergents are poorly bio-degradable two-component pollutants. The first component, belonging to sulfonates, is actually a surface active substance (providing the detergent properties) and the other one, the carrier, is mostly in the form of polyphosphates or other substances with conditioning and softening properties. Detergents can be anionic and

cationic by their structures and application. Anionic detergents are mostly used for laundry washing while cationic can be used for dish washing, for eliminating colours, other organic stains, etc. (Mandic, et.al 2006).

Studies have shown about 60% (by weight) of the total surfactants produced enters the environment and cause toxicity to some of the organisms living in soil. The mechanism for the surfactant effects on micro-organisms depends on its nature. Cationic surfactants interact with the cytoplasmic membrane of bacteria (McDonnell & A Denver Russell 1999) whereas anionic surfactants bind to enzymes and DNA (Olkowska, et al 2014).

Biological nitrogen (N₂) fixation is very essential for limiting the growth of plants and agricultural crops. Nitrogen fixing organisms play important role in bioremediation. These organism carried out nitrogen fixation in which atmospheric nitrogen is converted into organic compound (ammonia) and enhance the nutrient in soil which is utilize by plants for their growth. The nitrogen

fixing bacteria are widely distributed in soil. Moreover, nitrogen fixing bacteria like Rhizobium stimulate the survival and action of other biodegrading bacteria, thereby lowering the concentration of pollutants (Shomi, et al 2021)

Because of the environmental risks associated with detergents, it's important to study their effects and to produce more environmentally friendly detergent.

REVIEWS :

The corresponding review is chosen for exploring and understanding various impacts of detergents on soil microbial community as well as its effect of various concentrations on nitrogen fixing bacterias. The following literature reviews are studied to gain the understanding of the research and to present that study so that new ideas related to research can be framed.

Z. Baker et al.(1941) studied on “The bacteriocidal action of synthetic detergents. Gram-positive-*Staphylococcus aureus* sps, *Staphylococcus albus* sps, and oral strains of lactobacillus and streptococcus (probably *Streptococcus salivarius*); Gram-negative-*Proteus vulgaris*, *Escherichia coli*, and *Eberthella typhi* sps were studied in the research. The bacteria were grown for 14 hours, centrifuged, washed, and suspended in distilled water. The suspensions were diluted to provide a final concentration of 10 billion microorganisms per cc³. Results obtained after exposure of the various organisms for 10 and 90 minutes to the detergents at concentrations of 1:1000, 1:3000, 1:6000, and 1:30,000 and at pH 7. It was found that none of the anionic detergents was effective against any of the three species of Gram-negative organisms even at the highest concentration studied .The cationic detergents are less effective against these Gram negative organisms than against the Gram-positive ones.

Effendi et al. (2017) conducted a study on “Detergent Disposal into Our Environment and Its Impact on Marine Microbes”. They collected

seawater from Sungai Kayu Ara village. A detergent brand such as ‘ATTACK’, ‘RINSO’ and ‘SURF’ and detergent with different concentration such as 0%, 0.3%, 0.6%, 0.9% and 1.2% was applied. The research showed that bacterial population get affected by the addition of detergent, period of exposure and doses of increasing concentrations to the soil. More depressed population results got from the areas where there was higher level of detergents in water as well as longer contamination duration .

T. Pescatore et al. (2020) conducted a study “Co-presence of the anionic surfactant i.e sodium lauryl ether sulphate and the pesticide i.e chlorpyrifos and its effects on a natural soil microorganism. “The soil sample containing microbial community was treated with 70 mg/kgs SLES and 2 mg/kgs and with the mixture of both the compounds. One microcosm that was without the contaminant was taken as a control. Soil samples was collected over the experimental period of 0,7,14,21 and 28 days. They were analysed for CPF, SLES and main metabolite of CPF. Evaluation of abundance, activity and structure of microbial community as well as estimation of half life of each compound was done. The results showed that co-presence of SLES & CPF did not substantially affect their persistence in soil. The higher amount of metabolite TCP (main metabolite of CPF) was found in presence of SLES. As the condition varies , some differences were seen in the bacterial community, activity, abundance and structure.

C. Pozo, et.al (2002) conducted a research on Linear alkylbenzene sulfonates (LAS) and soil microbial activity. The research stated that linear alkylbenzene sulfonate denatures soil micro-organisms and depolarise their cell membranes. Thus potentially soil microbial community. It was suggested that recovery of microbial population occur because the inhibitory effects of LAS was seen on some microbial parameters was

decreased after long incubation period. Also, the toxicity of LAS in soil depends on the form in which LAS was applied as well as the characteristics of each particular soil.

R. Ernst et al.(1970) studied on “biological effects of surfactants on “Influence on the growth of Orchid seedling. Relative phytotoxic activity of purified and biodegradable surfactants was determined in the research. For this study, Orchid seedlings are used for observing their effects on plant growth. phytotoxic effects occurred on culture media which had high concentrations of surfactants .concentration above 100ppm had more damaging effects on Orchid seedlings also a interfacial tension of 90% or greater was observed. Non ionic surfactants reduced growth and viability when when added in lower concentrations than ionic surfactants. But many seedlings survived at the concentrations of 1000ppm of these agents which had less efficiency in reducing interfacial tension.

S.R.D. Tözüm-Calgan and N.Z. Atay-Güneyman (1993) studied on “The effects of an anionic and a non-ionic surfactant on growth and nitrogen fixing ability of cyanobacterium, *Gloeocapsa*”. A unicellular cyanobacterium, *Gloeocapsa* were examined for its growth and nitrogen fixation capacity in the presence of surfactants with various concentrations. The surfactants used were; anionic sodium dodecyl sulphonate (SDS) as anionic and Tween 80 as a non ionic surfactant. Spectrophotometry technique was used for estimation of growth of cyanobacteria. Acetylene reduction method, using gas chromatography was performed for nitrogen fixation ability. Amount of SDS when taken with a concentration of 50ppm caused more inhibition to the growth of *Gloeocapsa* as well as inhibited its nitrogen fixing ability. At lower concentrations, no inhibition was observed. when Tween 80 was added in a concentration of 500 ppm, strong inhibition of nitrogen fixation was observed. Thus

it was stated that presence of anionic SDS is more lethal.

L. Mandic et al. (2006) studied on “Effect of different detergent concentration on the soil microbial community”. In this study total number of bacteria was determined using medium such as Torlak, Belgrade. The results have shown that the lowest possible toxic effect on the microorganism groups was observed at lowest detergent concentration (0.001 %), whereas the concentrations of 0.1% and of 1% solution showed inhibition of microbial growth.

Shomi et al.(2021) isolated the nitrogen fixing bacteria from garden soil sample. They used dilution and plating techniques and N₂ free Jensen’s media containing BMB (Bromothymol blue) as well as Yeast extract mannitol agar (YEMA). Nitrogen fixation ability of the isolates was confirmed by using ammonification test. Nessler’s reagent was used for confirming nitrogen fixation capacity. It was shown that *Azotobacter sp* isolated from the soil sample was found to be capable of exhibiting nitrogen fixing capacity. Thus the isolate therefore was used for N₂-fixation required in plant growth.

CONCLUSION :

As per the research results on the effect of detergent concentrations on the number of soil microorganisms, the following conclusions can be drawn –

the total number of bacteria was significantly decreased by introducing different types of detergent such as ‘Rinso’, ‘Surf’ and ‘Attack’ with concentrations (1%, 0.1%, 0.01% and 0.001%) into the nutritive medium, and less toxic effect was shown when soil solutions introduced were more diluted. The higher levels of detergent causes decreased nitrogen fixing bacterial populations thus decreased nitrogen fixing ability of soil.

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