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IMPACT OF NATIONAL HIGHWAY (NH-22) EXPANSION ACTIVITIES ON SOIL MICROBIAL DIVERSITY IN FOREST LOCATED ALONG SHOGHI-SHIMLA DHALI BYPASS, HIMACHAL PRADESH, INDIA

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Abstract–The study was conducted to analyze the impact of highway expansion activity on soil microbial diversity. The study area was divided into four equal sites based on distances viz. Site 1, Site 2, Site 3 and Site 4. The surface soil samples from each site were collected at three horizontal distances from the edge of the National Highway during pre- monsoon and post-monsoon seasons. The horizontal distances to collect the soil data considered were 0–10-meter, 10-10 meter and > 20 meter which were replicated four times in randomized block design. The total microbial count in the surface soil lies in between from 31 x 10^6cfu /g to 156 x 10^6cfu/g. The highest value of total microbial count 156 x 10^6cfu /g was recorded in pre-monsoon season at a distance of > 20 m at Dhali and lowest of 31 x 10^6cfu /g at a distance of 0-10 m in post-monsoon season at Raghanv. The spatial variation showed an increasing trend with the increasing distances from the highway.

INTRODUCTION

Road construction has been the main activity for development in rural areas. It has lead to loss of forest cover and ultimately loss of soil fertility. Vehicular discharge of gaseous and trace metal contamination due to incomplete combustion of petroleum fuel adversely affect microbial population (Joshi *et al.,* 2010). Soil microorganisms play a vital role in soil fertility. Bacteria constitute the main component of soil microbial biomass (Oliveria and Pampulha, 2006). Microbial contamination in soil is thought to be highly diverse. A gram of soil may contain as many as thirteen thousand species of bacteria (Torsvik *et al.,* 1990, 1994). Soil organisms including bacteria, fungi actinomycetes and algae mediate many of the processes that influence soil fertility. Microorganisms are involved in various ecological processes such as biogeochemical cycles of various elements like C, N, S and P (Paul and Clark, 1996). A decrease in soil microorganisms due to road expansion activites affect the cycling and availability of various plant nutrients in soil (Masil Khan, 2000).

MATERIALS AND METHODS

Study Area

The study area located in Mashobhra division of district Shimla and part of this also falls under the jurisdiction of Solan in Himachal Pradesh at altitude ranges from 1493 m to 2250 m and slope range is in between 300 m to 400 m per km in Shimla district and 100 to 300 m per km in Solan district. In order to study the effect of highway expansion activity on soil quality, the National Highway 22 bypass Shoghi - Shimla - Dhali was divided into four uniform segments based on distance viz: Site 1, Site 2, Site 3, Site 4 and each site was considered as replication. The surface soil samples from each site were collected at three horizontal distances from the edge of the National Highway during pre-monsoon (April and May) and post-monsoon (October and November) seasons in the year 2018 and 2019.

Sampling method and analysis

The soil samples from surface (0-15 cm) layer were collected by using tube auger. The samples were dried in the shade and grounded using wooden pestle and mortar. The grounded soils were passed through a 2 mm sieve and stored in polythene bags for subsequent analysis of soil microbial diversity.

The serial dilution and plating technique following Rao and Burns (1990) was used for isolation and identification of viable microbial count. Media were prepared for desired micro flora. The autoclaved and cooled 45 °C medium was poured into sterile plates and allowed to solidify. One gram of sieved (2 mm) soil was added to 9ml sterile water and shaken for 15-20 minutes. Serial dilutions of 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6} were prepared and 0.1 ml of aliquots of various dilutions was added, over cooled and solidified medium in petri plates. Spread plate method was employed. The plates were rotated for uniform distribution of microbial spores in the aliquot under the media and allowed to solidify. After the media solidified, the plates were inverted and incubated at 28 °C for 3-4 days. The appearances of colonies on the surface of medium in the plates were observed. The microbial population was enumerated as colony-forming units (CFU) from a serial dilution of the soil suspension. For fungi and bacteria potato dextrose agar, nutrient agar media were used respectively (Table 1). The counts were calculated on per gram soil basis using the formula:

$$\text{Microbial count} = \frac{\text{No. of CFU (colony forming units)} \times \text{dilution factor}}{\text{Volume taken (ml)}}$$

RESULTS AND DISCUSSION

The surface soil around the National Highway exhibited variation in seasonal and spatial distribution of total microbial count (Table 2). The total microbial count in the surface soil in the study area ranged from 31 x 10^6 CFU/g to 156 x 10^6 CFU/g. The results are in line with the findings of Ogunmwonyi *et al.*, (2008) who also reported microbial count of the roadside soil occurred ranged in 10^6 CFU/g of soil, fell within the range. The general soil microbial count was shown in (Plate 1 and Plate 2). The highest value of total microbial count 156 x 10^6 CFU/g was recorded in pre-monsoon season at a distance of > 20 m at Dhali and lowest of 31 x 10^6 CFU/g at a distance of 0-10 m in post – monsoon season at Raghanv. The soil samples were collected for two seasons (pre-monsoon and post-monsoon), and from the obtained results, no marked fluctuation was noticed in the total microbial counts of the soil samples irrespective of the seasonal variations as reported in the findings of Ferando *et al.* (1994). The spatial variation showed increasing trend from 0-10m < 10-20 m < 20 m among all sites in both the seasons. The higher microbial count at a distance of >20 m may be due to high organic carbon and adequate moisture which is decomposed into

Table 1. Different media composition

Media	Composition	Quantity
Nutrient Agar media (NA)	Beef extract	3g
	Peptones	5g
	NaCl	5g
	Agar- Agar	20g
	Distilled water	1000ml
Pentose dextrose Agar media (PDA)	Potatoes	250g
	Dextrose	20g
	Agar-Agar	20g
	Distilled water	1000ml

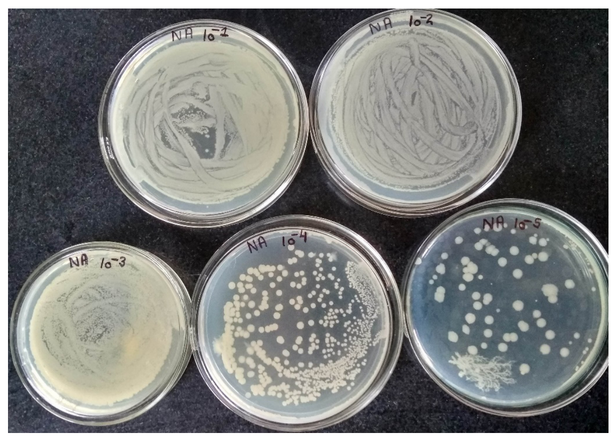

Plate 1. Soil microbial count on nutrient agar media.

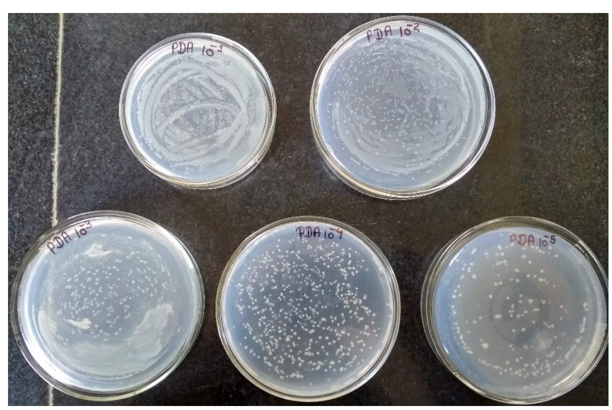

Plate 2. Soil microbial count on potato dextrose agar.

Table 2. Total microbial count CFU/g (10^6) of roadside soil samples from National Highway at different sites

Sites	Season		Pre-monsoon		Post-monsoon	
	0-10 m	10-20 m	>20 m	0-10 m	10-20 m	>20 m
Shunghal	37 x 10^6	83 x 10^6	123 x 10^6	36 x 10^6	81 x 10^6	119 x 10^6
Raghanv	33 x 10^6	71 x 10^6	127 x 10^6	31 x 10^6	69 x 10^6	125 x 10^6
Majjhar	47 x 10^6	91 x 10^6	131 x 10^6	45 x 10^6	88 x 10^6	129 x 10^6
Dhali	54 x 10^6	98 x 10^6	156 x 10^6	51 x 10^6	95 x 10^6	148 x 10^6

simpler form (Acaea and Carballas, 1985). The lower value of microbial count in the roadside soil may be due to deposition of various gaseous and trace metals during road construction activities which resulted in reduced rate of microbial mediated litter decomposition at roadside (Joshi *et al.*, 2010). The reduced microbial count in the roadside soil is due to vehicular pollution (Post and Beeby, 1996).

CONCLUSION

The study revealed that the spatial and seasonal changes during highway expansion have started to influence the soil microbial diversity of the region. To mitigate the adverse effect of highway expansion activities, tree plantation should be done to recover the soil nutrients and microbial population.

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Conflict of Interest

There is no conflict of interest for this manuscript.

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