STUDY OF SOIL MICROFLORA IN TWO SACRED GROVES OF MEGHALAYA

ABSTRACT

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The present research investigation deals with bimonthly enumeration and isolation of soil fungi and bacteria, microbial biomass C, enzymes activities and soil physico-chemical characteristic. The investigation was carried out at two sacred groves (Khloo Langdoh and Khloo Paiung) and pine forest of Jaintia Hills Meghalaya situated at Jowai the head quarter of Jaintia Hills, which is 60km away from Shillong.

The geographical position of Jowai is at 25^0 26' 32" N Latitude, and 29^0 12' E Longitude and situated at 1300m asl. The average maximum and minimum temperature during the study period was recorded are 25^0C and 13.1^0C in 2002 and 26^0C and 14^0C in 2003 respectively. The average rainfall was 360.6mm in 2002 and 265.2mm in 2003. The month of June was recorded the higher rainfall in both the years (i.e. 1283.8mm and 1178.6mm respectively). The soil samples were collected from three soil depths, (0-10cm, 10-20cm, 20-30cm), and the soil were analyzed for a variety of physical and chemical characteristics.

The fungal populations were higher in sacred groves than in the pine forest. In the first year (2002) of study, maximum fungal population was observed in rainy season in June and October and minimum in winter season in February and December in both the sacred groves. The fungal population in most cases is generally high at the surface soil layer (0-10cm) than at the sub surface soil layer (10-20cm and 20-30cm). In the second year (2003) of

study, maximum fungal population showed in April and August in Khloo Paiung and minimum in December in both the sacred groves. In both the years (2002 and 2003) the fungal populations were lower in pine forest in comparison to the sacred groves.

The investigation also showed that there is a declined of soil fungal population with soil depths. The population is higher at the surface soil layer (0-10cm) and lowers at the sub surface soil layer (10-20cm, 20-30cm). In Khloo Paiung fungal population showed positive correlation with total nitrogen, organic carbon, urease activity, dehydrogenase, moisture content and bacterial population. In Khloo Langdoh it showed positive correlation with total nitrogen, microbial biomass carbon, moisture content and bacterial population. In pine forest it showed positive correlation with total nitrogen, organic carbon, microbial biomass carbon, dehydrogenase, phosphatase activity moisture content and bacterial population.

All together 90 fungal species and 5 sterile mycelia were isolated (75 species = Khloo Paiung, 66 species = Khloo Langdoh and 59 species= Pine forest) and out of these, *Aspergillus* sp, *Penicillium* sp, *Oidiodendron* sp and *Trichoderma* sp. were the dominant species, *Alternaria tenuissima, Broomella acuta, Papula spora, Penicillium rubrum, Zygorrhynchus heterogamous, Scopulariopsis brevicaulis*, were isolated from Khloo Paiung only, while *Alternaria alternata, Cylindrocarpon didymum, Oidiodendron rhodogenum, Preussia fumiculata, Penicillium herquiei* and *P. ilandicum* were isolated from Khloo Langdoh only. 54 species are common to both the sacred groves, 46

species are common to Khloo Paiung and Pine forest, while 39 species are common to Khloo Langdoh and Pine. In general, high species diversity of fungi was noted in the two sacred groves than in the pine forest. In the first year (2002), diversity of fungi were high in Khloo Paiung, while in the second year (2003),high diversity of fungi were observed in Khloo Langdoh, except in few cases it showed some increase in pine forest. Similarity index showed a similar trend in all the three forest stands.

Bacterial population increased in rainy season in all the three forest stands. In the first year (2002), maximum bacterial population was observed in August and minimum in February in Khloo Paiung. In the second year (2003), maximum bacterial population in June in all the three forest stands and minimum in December in the two sacred groves and in August in the pine forest. Between the sampling periods the bacterial population declined with soil depth, which recorded highest population at the surface soil layer (0-10cm) and minimum population was recorded at the sub surface soil layer (10-20cm, 20-30cm).

In Khloo Paiung the bacterial population showed positive correlation with moisture content, organic carbon, total nitrogen, available phosphorus, dehydrogenase phosphatase and fungal population. In Khloo Langdoh the bacterial population showed positive correlation with moisture content, organic carbon, total nitrogen, microbial biomass carbon, dehydrogenase, urease and fungal population. In pine forest the bacterial population showed positive correlation with total nitrogen, microbial biomass carbon, urease,

phosphatase and fungal population. Altogether, 8 bacterial species were isolated *Micrococcus* sp, *Arthrobacter* sp and *Rhizobium* sp were the dominant species. In general diversity index of bacteria was noted in the two sacred groves. It was high at sub surface soil layer in June and October in Khloo Paiung in year first (2002). While, it was high at sub surface soil layer in February in pine forest in the second year (2003). Similarity index showed similar trend in all the three forest stands.

The soil moisture content was higher at the surface soil layer (0-10 cm) and lower at the subsurface soil layer (10-20cm & 20-30 cm). The soil pH ranged between 4.75 - 6.5 in all the depths (0-10cm, 10-20cm and 20-30cm), the soil pH showed negative correlation with all soil parameters.

Seasonal fluctuation of soil organic carbon was observed, where it was higher during warm season and lower during cold season. There is an increased percentage of organic carbon in both the sacred groves than in the pine forest. The organic carbon varied with soil depth as it tends to be more at the surface soil layer (0-10cm) than at the subsurface soil layer (10-20cm and 20-30cm). In Khloo Paiung the correlation coefficient values of soil moisture content showed a positive correlation with total nitrogen, available phosphorus potassium, microbial biomass carbon, dehydrogenase, phosphatase, bacterial population and fungal population. In Khloo Langdoh the correlation coefficient values of soil organic carbon showed a positive correlation with total nitrogen, available phosphorus, potassium, microbial biomass carbon, dehydrogenase, and bacterial population

Organic carbon varied significantly ($P \leq 0.001$) at 0-10cm x 10-20cm,0-10cm x 10-20cm x20-30cm,0-10cm x20-30cm and 10-20cm x 20-30cm in all the three forest stands.

Total nitrogen showed increased percentage in both sacred groves than in the pine forest. Peak percentage of total nitrogen was observed in August 2002 and October 2003. While it also showed peak percentage at the surface soil layer (0-10cm) than at subsurface soil layer (10-20cm and 20-30cm). The correlation coefficient values of soil moisture content showed a positive correlation with available phosphorus, potassium, organic carbon, microbial biomass carbon, dehydrogenase, phosphatase, moisture content, bacterial population and fungal population in Khloo Paiung. In Khloo Langdoh the correlation coefficient values of soil organic carbon showed a positive correlation with organic carbon, dehydrogenase, phosphatase, moisture content, bacterial population and fungal population. In pine forest the correlation coefficient values of soil organic carbon showed a positive correlation with available phosphorus, organic carbon, microbial biomass carbon, bacterial population and fungal population. Total nitrogen varied significantly at 0-10cm x 10-20cm,0-10cm x 10-20cm x20-30cm,0-10cm x20-30cm and 10-20cm x 20-30cm in all the three forest stands.

The soil phosphorus is high in both sacred groves than in pine forest. Seasonal fluctuation was observed, where it was high in June and low in December in both the year but it was higher in the first year of study. Soil phosphorus was high at the surface soil layer (0-10cm) and low at the

subsurface soil layer (10-20cm and 20-30cm). In Khloo Paiung the correlation coefficient values of available phosphorus showed a positive correlation with total nitrogen, potassium, organic carbon, phosphatase and bacterial population. In Khloo Langdoh the correlation coefficient values of available phosphorus showed a positive correlation with organic carbon, potassium and microbial biomass carbon. In pine forest the correlation coefficient values of available phosphorus showed a positive correlation with total nitrogen, organic carbon and microbial biomass carbon. Available phosphorus varied significantly with soil depth between 0-10cm x 10-20cm,0-10cm x 10-20cm x20-30cm,0-10cm x20-30cm and 10-20cm x 20-30cm in pine forest and Khloo Paiung and at 0-10cm x 10-20cm,0-10cm x 10-20cm x20-30cm, 0-10cm x 20cm x 30cm in Khloo Langdoh.

Soil potassium showed more concentration in both sacred groves than in pine forest. It showed seasonal variation where it tends to be more in winter season and low in rainy season. In Khloo Paiung the correlation coefficient values of potassium showed a positive correlation with total nitrogen, available phosphorus organic carbon, and microbial biomass carbon. In Khloo Langdoh the correlation coefficient values of potassium showed a positive correlation with available phosphorus, organic carbon, microbial biomass carbon and moisture content. In pine forest the correlation coefficient values of potassium showed a positive correlation with moisture content only. Soil potassium varied significantly with soil depth between 0-10cm x 10-20cm,0-10cm x 10-20cm x20-30cm,0-10cm x20-30cm in Khloo Paiung and Khloo

Langdoh and at 0-10cm x 10-20cm x 20-30cm, 0-10cm x 20-30cm and10-20cm x 20-30cm in pine forest.

The soil microbial biomass C increased in both sacred groves than in pine forest. Soil microbial biomass C declined from the surface soil layer (0-10cm) to the sub surface soil layer (10-20cm, 20-30cm). It showed seasonal variation where it is more in the spring or warm season and low in winter or cold season and rainy season in few cases. In Khloo Paiung soil microbial carbon was positively correlated with total nitrogen, potassium, organic carbon and urease. In Khloo Langdoh soil microbial carbon was positively correlated with available phosphorus, potassium, organic Carbon, dehydrogenase, bacterial population and fungal population. In pine forest soil microbial carbon was positively correlated with total nitrogen, available phosphorus, organic carbon, dehydrogenase, bacterial population and fungal population. Microbial biomass C varied significantly ($P \leq 0.001$) between 0-10cm x 10-20cm x 20-30cm, 0-10cm x 20-30cm and 10-20cm x 20-30cm soil depths in Khloo Paiung between 0-10cm x 10-20cm, 0-10cm x 10-20cm x 20-30cm, 0-10cm x 20-30cm and 10-20cm x 20-30cm soil depths in Khloo Langdoh and pine forest.

The activities of soil enzymes (dehydrogenase, urease and phosphatase) were quite similar in all the three forest stands, except in few cases where it is more in the two sacred groves. Enzyme activities showed seasonal variation. It is high in rainy and low in winter season. It is more at the surface soil layer (0-10cm) than in the subsurface soil layer (10-20cm and

20-30cm). Dehydrogenase activity was high in June and August and low in February in 2002. In 2003 it was high in August and low in February and December in Khloo Paiung which is similar to that of Khloo Langdoh and pine forest. In Khloo Paiung dehydrogenase activity showed positive correlation with total nitrogen, organic carbon, soil moisture bacterial population and fungal population. In Khloo Langdoh it showed positive correlation with total nitrogen, Cmic, urease, phosphatases, and bacterial population. In pine forest it showed positive correlation with organic carbon, Cmic, and fungal population. Dehydrogenase activity varied significantly ($P \leq 0.001$) between 0-10cm x 10-20cm, 0-10cm x 10-20cm x 20-30cm, 0-10cm x 20-30cm and 10-20cm x 20-30cm soil depths in all the three forest stands.

Phosphatase activity was high in June for Khloo Paiung and October for Khloo Langdoh and pine forest in 2002. In 2003 it showed high activity in October for Khloo Paiung and Khloo Langdoh and minimum in February. Phosphatase activity varied significantly ($P \leq 0.001$) between 0-10cm x 10-20cm, 0-10cm x 10-20cm x 20-30cm and 0-10cm x 20-30cm soil depths in Khloo Langdoh, between 0-10cm x 10-20cm, 0-10cm x 10-20cm x 20-30cm, 0-10cm x 20-30cm and 10-20cm x 20-30cm soil depths in Khloo Paiung and between , 0-10cm x 10-20cm x 20-30cm, 0-10cm x 20-30cm and 10-20cm x 20-30cm soil depths in pine forest.

Urease activity was high in June in 2002 but low in February in 2002 and 2003 respectively for all the three forest stands. Urease activity is more at the surface soil layer (0-10cm) that at the subsurface soil layer (10-20cm) and

(20-30cm). In Khloo Paiung, urease activity was positively correlated with C_{mic}, available phosphorus and fungal population. In Khloo Langdoh urease activity was positively correlated with dehydrogenase, available phosphorus and bacterial population. In pine forest, urease activity was positively correlated with bacterial population. Urease activity varied significantly ($P \leq 0.001$) between 0-10cm x 10-20cm x 20-30cm, 0-10cm x 20-30cm soil depths in Khloo Paiung. Insignificant variation in Khloo Langdoh and pine forest in all the soil depth.

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