

**ECOLOGICAL STUDIES ON VESICULAR - ARBUSCULAR
MYCORRHIZAL (VAM) FUNGI IN SECONDARY
SUCCESSIONAL PLANT COMMUNITY AT HIGHER
AND LOWER ALTITUDES OF MEGHALAYA**

ABSTRACT

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The entire work was divided into two broad categories - field work and experimental work, the latter being conducted in net house. The field work was conducted in order to evaluate the distribution and successional pattern of soil and mycorrhizal fungi besides, studying the impact of disturbance in vegetation and soil on the population of microbes, mycobionts and microbial enzyme activities. The field work was carried out at two altitudes, one in Shillong at an elevation of 1560m (MSL) and another at Byrnihat at 100m (MSL). At both the altitudes two forest stands showing two different secondary successional stages were selected. The sites were selected keeping in view the uniformity of cause of disturbance as far as possible.

In general, the microbial population i.e. fungal, bacterial and mycorrhizal spore population was adversely affected by disturbance. At both the altitudes the microbial population showed a marked seasonality. Quantitatively bacterial population was more than the fungal population.

At lower altitude, the less disturbed/degraded forest stand had more fungal population than the more disturbed one. The fungal population showed its peak in May followed by another peak in September. However, during rainy season the soil harboured less fungal population. But at higher altitude, the fungal peak was recorded in July. Here both the forest stands showed a similar pattern of seasonal variation.

The bacterial population at lower altitude showed two

peaks one in September and another in May. At both the altitudes the minimum bacterial population was recorded in July.

Most of the fungal species isolated during the entire course of investigation belonged to Deuteromycetes. Both the forest stands at lower altitude harboured a similar array of fungal species composition excluding few which were present only in less degraded forest stand. However, the fungal species mosaic was quite similar in both the forest stands at higher altitude. The fungal species namely, Penicillium chrysogenum and Trichoderma viride were dominant respectively at lower and higher altitudes.

At lower altitude all the plants, studied for mycorrhizal infection, showed vesicular-arbuscular mycorrhizal (VAM) infection. Plants were highly mycotrophic compared to those inhabiting at higher altitude. At higher altitude both ectomycorrhizal as well as endo mycorrhizal plants were present. Besides, some of the tree species also had actinomycetous root nodules in addition to mycorrhizal infection. At lower altitude plants inhabiting the more degraded forest stand were more mycotrophic compared to those growing on less degraded habitat. But the situation was reverse at higher altitude. The root infection intensity was high in May-July and low in winter.

The endogonaceous spore population varied from rhizosphere to rhizosphere and from season to season. During winter the rhizospheric soil harboured more spores than rainy season which showed less spores. Altogether three endomycorrhizal

spores namely, Glomus, Gigaspora and Acaulospora were isolated. Among the endomycorrhizal fungi Glomus sp. was dominant.

The soil samples collected from different forest stands were analysed for different soil physico-chemical properties. At both the altitudes, the less degraded forest stand contained more moisture than more degraded one. The soil at lower altitude was less acidic compared to the same at higher altitude. The soil nutrients were also affected by the degradation processes. The nutrients were more in less degraded soil compared to more degraded one. The different nutrients also showed a marked seasonal variation.

The microbial activities were measured in terms of different enzymes; dehydrogenase, urease and phosphatase and the microbial respiration. All these activities were higher in less degraded forest stands compared to more degraded ones. Less CO₂ was evolved in winter compared to rainy season. The CO₂ evolved was less at lower altitude compared to higher altitude. At higher altitude maximum dehydrogenase activity was recorded in January while during this month the activity at lower altitude was more. At lower altitude, the urease activity showed two peaks, one in May and another one in September while at higher altitude the maximum activity was recorded in July. The phosphatase activity showed two peaks at higher altitude.

The seedlings of Toona ciliata responded positively to VAM inoculation at an intermediate level of litter amendment.

The VAM infection, however, improved the growth significantly than nonmycorrhizal plants at all the levels of litter amendment. The nonmycorrhizal plants showed an increasing trend with the increasing gradient of litter dozes. But the growth of test plants was suppressed at the highest litter doze. The mycorrhizal plants had less root-shoot ratio than their non-mycorrhizal counterparts.

The difference in the efficiency of two mycorrhizal fungi, tested in terms of growth of test plant, was insignificant. Both the mycorrhizal infection as well as endogonaceous spores increased with time. The test plants growing on partially decomposed litter amended soil were more mycotrophic compared to those growing on fresh litter amended soil. Roots were highly mycotrophic at low litter dozes which decreased with increase of litter doze.

In terms of nutrient allocation in different plant tissues the shoot N, P and K was more compared to root. The concentration of these nutrients in different plant tissues also increased with time.

The effect of plant associates on root colonization and seedlings development was also studied. The mycorrhizal plants grown in association with the weed species A. conizoides, grew optimally only at density of A. conizoides (1:2::test plant: A. conizoides). Plants growing in monoculture condition showed an improved growth than those growing in mixed culture. The roots of test plants growing in association with high

density of weedy associate, were more mycotrophic than those growing comparatively with sparse population.

The growth characteristics of mycorrhizal test plants (T. ciliata) were improved when low levels of soluble and insoluble phosphorus sources were added to soil. Even in case of nitrogen amended soils, only the low doze could improve the root colonization which ultimately ameliorated the growth of test plant. Nevertheless, the growth of mycorrhizal plants was more compared to non-mycorrhizal ones at all the levels of nitrogen and phosphorus. While the growth of mycorrhizal plants was minimum at highest N and P dozes, the nonmycorrhizal counterparts showed maximum growth at that doze. Plants grown on unavailable P- source had an edge in terms of mycotrophy over those grown on available P-source.

The mycorrhizal plants had low root-shoot ratio than their nonmycorrhizal counterparts. The root-shoot ratio of nonmycorrhizal plants was high at high nutrient level of soil compared to the mycorrhizal counterparts same source level. The root-shoot ratio of nonmycorrhizal plants decreased with increased soil nutrient concentration.

In case of mycorrhizal plants, the response of both available and unavailable P-source was almost same. But in case of nonmycorrhizal plants the effect of available P-source was more pronounced. The nonmycorrhizal plants grown on available P-source showed an ameliorated growth response compared to those grown on the same level of unavailable P-source.

The mycorrhizal plants contained more of N,P and K at the 30kg h⁻¹ doze of both phosphorus and nitrogen compared to nonmycorrhizal ones. It decreased with increased level of N and P. However, it was always more than their non-mycorrhizal counterparts.

The acid phosphatase activity was more than alkaline phosphatase. The mycorrhizal roots showed an improved phosphatase compared to non-mycorrhizal ones. It was more at low P-dozes.

The effect of mycorrhizal infection on nodulation and nitrogenase activity was also studied. The tripartite association (test plant, mycorrhizae and Frankia) ameliorated both nodulation and nitrogenase activity. Both nodulation and nitrogenase activity was high in mycorrhizae and Frankia infected plants compared to only nonmycorrhizal nodulated plants. In terms of applied P dozes, the intermediate doze i.e. 120kg h⁻¹ could improve the nodulation, nodule dry weight and nitrogenase activity while plant growth was maximum at lowest P-doze i.e. 30kg ha⁻¹. The difference in growth response of test plant grown on available and unavailable P-sources was not apparent.

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