

# STUDIES ON SOIL MICROBIAL POPULATION OF JHUM FALLOWS OF DIFFERENT AGES

BY

HIRANYA KUMAR DEKA

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DEPARTMENT OF BOTANY  
NORTH-EASTERN HILL UNIVERSITY  
SHILLONG - 793014  
INDIA

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North - Eastern



Hill University

DEPARTMENT OF BOTANY  
SCHOOL OF LIFE SCIENCES  
SHILLONG-793014

I certify that the thesis entitled "Studies on soil Microbial Population of Jhum-fallows of Different Ages" submitted by Mr Hiranya Kumar Deka for the Degree of Doctor of Philosophy of the North-Eastern Hill University, Shillong embodies the record of original investigation carried out by him under my supervision. He has been duly registered and the thesis presented is worthy of being considered for the award of the Ph.D. Degree. This work has not been submitted for any Degree of any other university.

Shillong

Signature of the Supervisor

August 17, 1981

Forwarded  
R.R. Misra  
17-8-81

Department of Botany  
School of Life Sciences  
North-Eastern Hill University  
Shillong, Meghalaya.

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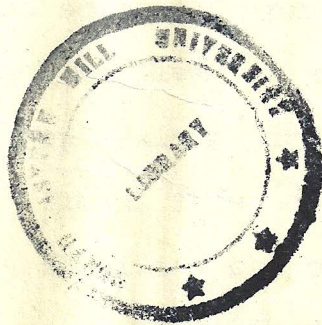
*Hiranya Kr. Deka.*  
( Hiranya Kumar Deka )

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## GENERAL INTRODUCTION



The natural vegetation at lower elevations of the hills of Meghalaya (Khasi, Garo and Jaintia Hills) is a typical humid sub-tropical moist forest with species like Shorea robusta, S. assamica, Artocarpus chaplasha, Eugenia sp., Mesua ferrea, Sterculia alata, Dipterocarpus sp., and Garuga pinnata. Besides these, forests also have a profuse undergrowth of many shrubs and herbaceous species often forming impenetrable thickets. At higher elevations the hills have tropical wet temperate pine forests, characteristic tree species being Pinus kesiya. The entire vegetation in the area is attuned to heavy rainfall, high humidity, and highly leached soil profile. However, it is almost impossible to locate a virgin forest because of the practice of "Jhum" or shifting cultivation, practised by the local tribal population resulting in the destruction of the natural forest cover.

The agricultural practices among the hill tribes of the north-eastern region is often primitive and is not based upon sound scientific principles. From the time immemorial they have lived in a hand to mouth existence with a view to get maximum yield with minimum labour. The rough and ready fields lying on the slopes often get worn out in its fertility compelling them to look for fresh lands to raise their food crops. Thus the tribal often resort to a kind of shifting cultivation, commonly known as "Jhumming".

In many parts of the world different terms are used for shifting cultivation. Some of the very common terms used in certain regions are as follows:

<u>Country</u>	<u>Terms used for shifting cultivation</u>
1. Indonesia and Malaya	Ladang
2. Java	Jumah; Humah
3. Vietnam	Ray
4. Thailand	Tam - ray; Rai
5. Laos	Hay
6. Phillippines	Hanunoo; caingin
7. Sri Lanka	Chena
8. Japan, Korea and Taiwan	Karen
9. Burma	Taungya
10. India	Bewar; Dhya; Dullee; Dippa; Erka; Jhum; Kumri; Penda; Pothu and Podu
11. Mexico and Central America	Milpa
12. Guedaloupe	Ichali
13. Brazil	Roca
14. Zaire	Masole
15. Madagascar	Tavy
16. Rhodesia; Tanzania	Chitimene; citimene
17. Ghana	Proka

But, the land use systems in relation to different terms used in different regions were not phenomena specifically to the regions of tropical and sub-tropical. It was thought by several workers that the fire used in shifting cultivation is important economically as well as in the development of social life.

Ruthenberg (1965) stated that depending upon the nature of vegetation of a particular area, and on the length of the abandoned fallows or regenerative period, the rotation of crop and forest (e.g. in rain forests); crop and bush (e.g. in the wet savannas) or crop and pasture (e.g. in dry savannas), can develop.

Dobby (1950) estimated that in south east Asia, about one-third of the total agricultural area was under shifting cultivation.

It has been calculated out that the total geographical area of Meghalaya is about 2253 hectares and out of which 821 hectares are covered by forest only. It has been estimated that about 416 hectares of the total agricultural area of Meghalaya is under jhum only.

"Jhumming" or shifting cultivation as is practised by the tribal people of north-eastern hill region of India, is the most primitive of the agricultural practices. Generally the lands in Meghalaya are under the custody

of a "Nokma" in Garo Hills, or under a "Syiem" in Khasi Hills. After paying a nominal sum, the acquired land is cleared and after keeping the felled trees for a reasonable time to dry, the area is burned. The system consists essentially of cutting and burning of forest. The burning is generally done during the months of March and April of the year. After burning, certain unwanted debris are removed, the ashes being allowed to remain on the ground. Just before the rains set in, the crops are planted by dibbling. The rapid exhaustion of the soil fertility and its erosion from the slopes, often too steep to hold soil particles, moisture and mineral nutrients, compel the farmers to discard the land under cultivation, and to seek out far more fertile area. They, therefore, discard the depleted land under cultivation and turn to areas which are covered by forests and are enriched due to forest litter decomposition over many years. They cut down the forests and burn the dried vegetation. After cultivation, for a year or two the land may be abandoned. The fertility that was built into the soil over many years due to successive forest litter decomposition and also due to the left-over ash due to burning of the cut down vegetation is soon exhausted. Unfortunately, much of the fertility is lost due to steepness of the slope along with the surface run off of rain water. Probably only a small fraction of the soil fertility is utilized by the agricultural crop subsequently raised on this soil.

"Jhumming" has always been a way of life with tribal people of the region. It was evolved by them as a reflex to the physiographical feature of the hilly tract they inhabit. This method of cultivation was probably the only method feasible in the past due to its simplicity and also due to the fact that more modern methods of agriculture were unknown in those days. The crop land was provided with natural fertility due to this practice. Further, the population pressure was not great and consequently, the jhum cycle was stretched over a period of 20-25 years or more. Such a long period provided enough scope for the natural regeneration of the forest after the land was abandoned after cultivation. Above all this method was in complete harmony with nature. However, the increasing pressure of population, in recent times, has upset the equilibrium which was maintained between man and nature in the past. The jhum cycle period has become considerably shorter and is as short as 4-5 years due to increasing population pressure on the limited available land.

Debris from primary producers accumulate on the soil surface and also within the mineral horizon along the network of roots and rhizomes. Besides this a secondary addition of organic matter comprises microbial remains, bacterial cells, fungal hyphae and mineral corpses and faeces which have in the main been produced during the

decomposition process in the litter layer. The substances that are added to the soil are continuously being exposed to various microbial activities which ultimately release the nutrients locked up in the debris through decomposition. The microorganisms in the soil are also essential for their participation in the soil formation, work conservation and sometimes biological control of certain pathogens.

Burning of plant in the forest whereas has catastrophic effect on forest wealth, it also affects the microbial community of the ecosystem. ~~Thinning~~ burning also causes a marked disturbance in the aerial environment in addition to its effect on physico-chemical characteristics of the soil. Depending upon the degree of burning the microbial population is completely or partially destroyed. In the sterile soil environment thus exposed for the colonization, the nature of microflora appearing therein will depend upon the physico-chemical status of the habitat. The soil being devoid of microbes in the beginning, no resistance is offered for the new colonizers. In this process a number of forms from different sources will try to colonise the substrate available without competition. The possibility sometimes exists for the introduction and establishment of certain pathogenic forms which may prove hazardous for the plant species growing in the area. Elimination of certain, otherwise, useful saprophytes may also be expected.

The present investigation deals mainly with the different aspects of soil microbiology of jhum land. The whole study has been categorized into the following parameters:

- (1) Studies on distribution of species and seasonal variation in the microflora of soil of different aged jhum-fallows.
- (2) Analysis of soil nutrients, viz., C, N, and P, and their relationship with growth behaviour of soil microflora.
- (3) Role of fungi in the litter decomposition.
- (4) Survey of the fungi for mycorrhizal association with certain dominant plants of the area.
- (5) Role of mycorrhizal fungi on the growth and development of a few plant species.