CHAPTER I

INTRODUCTION
The term soil refers to the outer, loose materials of earth's surface, a layer distinctly different from the underlying bedrock. It can be defined as the weathered upper surface of the earth's crust which is mixed with the living organisms and product of their decay. But this conservative definition does not speak all about the nature of the soil which is a much more complex and dynamic system and is governed by a "constellation" of factors. These factors are usually grouped under such heads as climatic, geological, biological, physical, chemical etc.

In almost every soil, in samples obtained from each continent and from the most remote islands, one finds the presence of algae, yet their position as indigenous soil inhabitants has often been the subject of considerable controversy. For the microbiologist, the soil environment is unique in several ways: it contains a vast population of bacteria, actinomycetes, fungi, algae and protozoa. It may be considered as the most active of biological interactions in nature. The biochemical reactions concerned with the decomposition of organic matter, weathering of rocks, and the nutrition of agricultural crops occur here. Algae are never as numerous as bacteria, actinomycetes or fungi. The lack of sufficient appreciation of this group can be attributed in part
to the small population.

Ecologically the algae are a world wide group occurring on the land surface, on all types of soil, on permanent ice and snowfields, but having their major centre of distribution in the waters which cover 70% of the earth's surface. Under natural conditions, algae grow as mixed communities which may include many species and genera.

Algae are photo-autotrophic micro-organisms and the occurrence of these has been recorded in soils throughout the world, but no definite geographical localization of families, genera or species has yet been presented. As a group, the algae are moderately adaptable to environmental changes, persisting in unfavourable circumstances such as in alkaline and desert soils.

Soil algae refers to the various ecological groups, viz. terrestrial algae growing abundantly on the soil surface as crusts or films (Saprophytes); aquatic terrestrial forms growing on the surface of permanently damp soil, and soil algae proper, found below the soil surface (Cryptophytes).

The tropical soils have a greater preponderance of the blue-green algae than the green ones, presumably because of high temperature and humidity. The algal growth is generally rich at the surface, their abundance decreasing rapidly with depth. The origin of the subterranean algae may be air-borne
water-borne, biotic or all three.

Soil algae have been investigated from the standpoint of nitrogen nutrition in desert (Fogg, 1947) and semidesert soils (Robbins, 1912; Fletcher and Martin, 1948), as a source of oxygen (Harrison and Aiyer, 1913) and nitrogen (Watanabe et al., 1951) in rice fields.

Soil algae contribute significantly to soil formation in a variety of ecological habitats. They have been investigated with respect to their possible value as pioneer vegetation in volcanic deposits (Treub, 1888). They are acknowledged as an initial stage in succession (Stokes, 1940-41) and are usually the first colonizers of bare areas of rocks and soils (Booth, 1941; Schwabe, 1970).

Soil algae play an important part in various soil processes. They help in soil aggregation and thus bind the soil particles together. Surface forms like Protosiphon, Chlorococcom, Nostoc, Scytonema, Microcoleus etc. help in soil conservation and building up soil fertility. Presence of blue-green algae also improves the texture of the soil due to the aggregation brought about by the polysaccharides of their cellwalls. These soil algae also add a large quantity of organic matter to the soil (Fuller and Rogers, 1952) which may be responsible for this soil aggregation.

Soil algae are also recognised as an important agency
in stabilizing surface crust in areas denuded of macro-
vegetation by drought (Piercy, 1917; Drouet, 1937) or
erosion (Elwell et al., 1939; Osborn, 1950) and in improving
water infiltration (Booth, 1941). They act as a water
conserving stratum in semidesert areas (Elwell, Slosser and
Daniel, 1939) and as a continuous source of organic matter
and nitrogen (Fogg, 1947).

The soil aggregating effects of algae do not appear to
be ephemeral, as in the case of fungi (Waksman, 1952) because
their sheaths, microbial products and the organic matter added
to the soil by them remain in the soil for quite a long time
even after their death. As organic material and humus is
continuously being added to the soil by their growth and decay,
the aggregating effects of these algae in the soil are of a
greater significance than bacteria and fungi.

Soil algae grow abundantly in tropical fields due to
waterlogging, high temperature and high humidity and about
75% of them are blue-green algae (Pandey, 1965). These blue-
green algae are procaryotic micro-organisms and some of them
can fix molecular nitrogen. These possess the enigmatical
structures known as heterocysts, which are known as the sites
of nitrogen fixation.

Among 30 species of class Cyanophyta which are capable
of nitrogen fixation, 38 species were found in the soils
excluding rice fields. The nitrogen, which these algae fix
during the growth excreted into the soil in form of peptides, free amino acids and other nitrogenous compounds which becomes subsequently available to the associated rice plants. Thus blue-green algae as a nitrogenous fertiliser in the rice field help to increase the yield of rice plants (Waksman, 1932). Apart from nitrogen, these algae supply, to the crop plants, a variety of biologically important substances like vitamins, auxin and gibberelline like substances and some other growth promoting substances which help in increasing the yield. It has also been observed that certain algae produce antibiotics or toxins that inhibit the growth of other algae and decrease root development of higher plants (Flint, 1947). It is not inconceivable that algae affect the development and severity of plant diseases by producing substances inhibitory or stimulatory to root parasites or substances that predispose plants to attack by root parasites. Surface living algal forms by their photosynthetic activity produce organic substances which remain in the soil and become available for the next crop. Thus they play a great role in natural economy of plant nutrients and function as a living green manure. Many workers after conducting experiments have reported that a little application of algae give a better yield in comparison to nitrogenous compound used as ammonium sulphate. Venkataraman and his coworkers (1974)
have convincingly shown that in tropical soils, particularly in the rice fields, these algae can be advantageously used to supplement the inorganic nitrogen fertilizers for rice cultivation. These organisms can fix in rice field 15 to 43 Kg nitrogen per hectare per season. Artificial inoculation of the rice field soils with blue green algal strains results in an increased yield of the crop by about 10 to 15 percent. Besides rice crop, algal inoculation has also been shown to be beneficial to vegetables and other crops. Blue-green algal extracts were found to improve growth and development of rice plants and also the protein content of the grains (Shukla and Gupta, 1967).

Due to a wide range of tolerance to a variety of fungicides, insecticides, herbicides and nematicides, these algae can be safely used with the modern pest control measures. So it is evidently clear that these nitrogen fixing soil algae help to the soil and also the crop plants in a variety of ways.

Algae also serve as raw materials for many industrial products. In many countries, particularly in South East Asian countries, algae are used as human food because of their high protein and vitamin content. Some algae have medicinal properties, although no antibiotics are produced from algae commercially.