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"STUDIES ON
NITROGEN FIXING
BLUE-GREEN ALGAE
IN RICE SOILS OF
CENTRAL SRI LANKA"

A thesis submitted by

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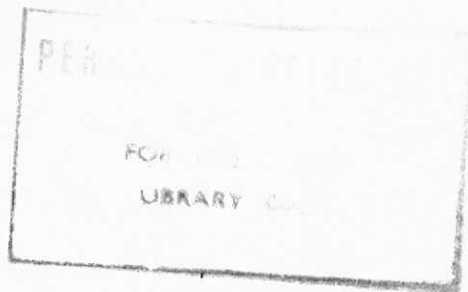
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ABSTRACT

The blue-green algal flora in rice soils of Central Sri Lanka was surveyed by microscopic observations and culturing of soil samples collected from different agro-climatic zones in liquid algal media. Seventy-three taxa of heterocystous (nitrogen fixing) algae were recorded, out of which 46 were isolated into unialgal cultures. The culture collection raised includes 200 nitrogen fixing algal strains isolated from the different sampling sites.

Among the heterocystous algae observed, the following taxa are recorded for the first time in Sri Lanka: Nostoc carneum, N. ellipso sporum, N. ellipso sporum var. violacea, N. rivulare, N. paludosum, N. punctiforme var. populorum, N. passerinianum, N. commune, N. spongiaeforme, N. spongiaeforme var. tenuis, N. sphaeroides, N. minutissimum, N. linckia var. arvense, N. sphaericum, N. calcicola, Anabaena bergii, A. aphanizomenoides var. ellipso spora, A. viguieri, A. variabilis, A. variabilis var. kashiensis, A. hieronymusii, A. cylindrica, A. doliolum, A. oscillarioides, Cylindrospermum gorakhpurense, Cy. majus, Cy. muscicola, Nodularia spumigena, Calothrix membranacea, C. parietina, C. elenkinii, C. ghosei, Dichothrix fusca, Gloeotrichia pilgeri, G. intermedia var. kanwaense, Rivularia hansgirgi, R. aquatica, Mastigocladus laminosus, Hapalosiphon aureus, H. hibernicus, H. welwitschii, Fischerella muscicola, Westiellopsis prolifica and Stigonema minutissimum. Besides these,

eight more taxa appear to be either new species or new varieties of blue-green algae.

The presence-absence data of the most widely distributed 46 taxa of heterocystous blue-green algae was analysed using multivariate techniques (i.e. classification and ordination methods) of vegetation analysis, and then examined in relation to ecological parameters. Regression analytical models (simple linear, simple polynomial and multiple linear) were used to investigate the environmental factors affecting the quantitative distribution (population densities) of heterocystous algae and the nitrogen fixing potential of the soil. pH, available phosphorus and C/N ratio were the important pedological factors influencing algal distribution and the nitrogen fixing potential. Altitude and rainfall were also found to have some effect. Water holding capacity of the soil was observed to affect the qualitative distribution (species composition), while the effect of Kjeldahl nitrogen and organic matter content was only on the quantitative distribution of heterocystous algae. It was apparent that the ecological factors which largely determine the blue-green algal flora and its nitrogen fixing activity were pH, status and availability of nutrients and water in the soil, intensity of insolation and temperature.

The isolated blue-green algae were observed to fix nitrogen during laboratory incubations, under conditions

comparable to those that may occur naturally in Sri Lankan rice fields. Some of the algae with dark pigmentation and having membranous growth habit could fix nitrogen under strong mid-day sunlight of nearly 120 klx intensity. The pH range within which nitrogen fixation occurred in some algae was directly influenced by the incubation temperature; and a widening of its range was observed with increase in temperature. In Nostoc carneum, the optimum pH for nitrogen fixation was seen to shift from alkaline to neutral conditions as the incubation temperature was increased.

Low levels of pH and available phosphorus in the soil were found to limit the successful colonization of rice soils by blue-green algae, and the removal of these limitations by liming and adding phosphates enhanced colonization. Some of the isolates obtained from the rice soils of Central Sri Lanka established and colonized well on soils of the other regions of the country.

Certain taxa of the isolated heterocystous blue-green algae showed tolerance to low pH and low levels of available phosphorus in soil. Such algae may have a considerable agronomic potential in acidic and phosphorus deficient rice soils. The high adaptive versatility exhibited by Nostoc carneum, Calothrix membranacea and Mastigocladus laminosus to a wide range of environmental conditions makes them attractive as potential algal bio-fertilizers for most rice soils.

On the basis of characterization of some of the isolates in relation to certain environmental factors, the potential use of such algae as biofertilizers for different rice soils of Sri Lanka are discussed in this study.

This investigation revealed that some of the investigated algae have a potential for making a positive contribution to the nitrogen economy of rice soils and could perhaps be used as biological nitrogen fertilizers in rice cultivation in Sri Lanka.