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Abundance of Cyanobacteria from Partially Flooded Sugarcane Fields of Shirol Taluka, District Kolhapur

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Abstract: *Sugarcane is major cash crop of Shirol taluka. Huger works on Cyanobacteria that involve in recycling of nutrients makes major role the economy of soil and growth of crop. Algae play an important role in the economy of soil. The result of the present study shows satisfactory algal diversity found in partially flooded sugarcane fields in all regions. Algae nowadays are exploited to tackle the major problems such as food, fuel, soil fertility, sanitation, pharmaceutical and health problems (Prasad, 2008). Number of researcher's works about roles of blue green algae on growth of various crops. Every year more or less occurrence of heavy rainfall especially in Kolhapur, Sangli and Satara districts in the month of July & August creates intense flood situations in study area. Floods have extremely long durations so heavy losses of life, properties & crops were noteworthy. The study area faces more or less flood situations creates three sugarcane agronomic zones as completely flooded (CFLD) ,partially flooded (PFLD) and non-flooded (NFLD) fields are effecting on flora and fauna of the field responsible for productivity of the crop plants. During the investigations an average cyanobacteria encountered in partially flooded fields from Shirol taluka than flooded and non-flooded fields. It revealed the presence of four groups consisting of 122 species belonging to 58 genera of microalgae.*

Keywords: Sugarcane, Cyanobacteria, Food soil fertility, Shirol

I. INTRODUCTION

1.1 Shirol Taluka Location and Extent

Sugarcane crop dominated Shirol taluka located at 48 km away from Kolhapur, Maharashtra. It extends between 16.37° and 16.52 north latitudes and 74.27°and 74.42°east longitudes. It has 503.0 sq. km. land situated in Warna, Krishna, Dudhganga and Panchganga river basin.

1.2 A Review of Sugarcane

Sugarcane has several species of tall perennial true grasses *Saccharum,* tribe Andropogoneae, belongs to the grass family Poaceae. Sugarcane is a monocotyledon crop, native to the warm temperate to tropical South, Southeast Asia, and New Guinea, used for sugar production. Sugarcane cultivated in different environments (Irvine, 1983). It has two to six meters tall, jointed, fibrous stalks and sucrose accumulation in the stalk of internodes.

Sugarcane is an important commercial crop that contributed significantly to the growth of India. Uttar Pradesh will be the largest producer of sugar in India followed by Maharashtra. In 2017-2018, Maharashtra accounted for 17.73 per cent (9.2 lakh hectares) of the total area under sugarcane cultivation in India (52.00 lakh hectare). The sugarcane crop varieties are mainly produced in well-known breeding centers as 'Sugarcane Breeding Society' at Coimbatore and in Maharashtra at Padegaon. Sugar industry has helped in improving the per capita income of the rural areas. However at present, sugarcane farming is affected due to several natural as well as manmade over activities. Everyone is worried that the average production of sugarcane is 120 tons per hectare and the average sugar yield is 12.5 %. Nearly 70% of the sugar is produced from a species of sugarcane *Saccharum officinarum* and hybrids of this species. Sucrose is a prime product extracted from sugarcane in factories. Ethanol is a fermented product of sugarcane juice used in preparation of various medicines,

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beverages and laboratory work. Falernum, molasses, bagasses are also other products derived from sugarcane. A number of people use sugar cane reeds to make pens, mats, screens, and thatch.

1.3 Need and Importance of Cyanobacterial Study

Present investigation includes exact discussion about the diversity of algal flora of cyanobacteria and correlation with crop productivity. Cyanobacteria play a significant role in growth and developing crop plants because of its diazotrophic nature. Globally spreadover and potential to symbiotic nature in many ways useful to mankind so ultimately creating interest makes them attractive research.Cyanobacteria are lower state gram-negative prokaryotic organisms popularly known as blue green algae. They have a lot of potential to enjoy well under all possible a variety of aquatic and terrestrial environments exhibiting a wide range of temperature, salinity, water potential, pH and irradiance. Number of photosynthetic bacteria are rich in chlorophyll, performing oxygenic photosynthesis very close to eukaryotic algae and higher plants referred to as cyanophyta.

Cyanobacteria are eco-friendly, accelerate solubilization and mobility of nutrients, improves texture of soils and diverts towards the fertility, reclamation of alkaline and saline waste land. Dravid *et al.* (2005) states that cyanobacteria inhabit oxygen rich environments which implies that early photosynthetic organisms would have lived in an atmosphere that was rich in CO_2 and poor O_2. Worldwide survival ability of cyanobacteria play a significant role through various mechanisms lies in their agronomic importance as biofertilizers due to their N2-fixing ability that helps them to grow successfully in habitats where little or no combined sites of nitrogen fixation. They are naturally found in most paddy soils and improve the fertility and textures of soil at any cost (Prasanna *et al.*, 2013b). Nitrogen is a significant macronutrient required for agricultural productivity. Nitrogen available in the atmosphere is unable to be utilized by plants due to its chemical inertia (except those in symbiotic associations with N2 fixers).

Prasanna *et al.* (2013b) states that by the activity of heterocyst's few free -living and symbiotic cyanobacteria are potential of utilizing atmospheric nitrogen through the process of biological nitrogen fixation. Investigation by Venkatraman (1969) using Nitrogen-15 (15N) tracing technique to study the nitrogen cycle, the amount of nitrogen fixed by cyanobacteria, some of them utilized for growth and remaining released in soil and again assimilated by plants. Cyanobacteria show independent vigorous growth and development and organic components contribute to the natural fertility of the soils. Thajuddin and Subramanian (2005) studied that utilization of these biofertilizers have been reported in lettuce, tomato, radish, cotton barley, oats, maize, chili and also in sugarcane.

Enormous diversity of nitrogen fixing forms were found in completely and partially flooded fields of shirol taluka. According to Prasad and Prasad (2001) most common nitrogen fixing forms in paddy fields are *Nostoc linkia, Anabaena variabilis, Aulosira fertilisima, Calothrix* sp., *Tolypothrix* sp., *and Scytonema* sp. Moore (1969) realized that species of Anabaena and Nostoc dominated in soil and fixed up to 20–25 kg/ha atmospheric nitrogen. Anabaena nearly fix 60 kgseason of nitrogen per season and also improve soils with rich organic matter. Vaishampayan *et al.* (2001) states that a number of investigators studied cyanobacteria nitrogen fixing efficiency and proved that it provides biomass approximately 4 kg N ha-1 to the paddy fields.

Recently it was reported that some species of cyanobacteria have important sources of proteinaceous rich food for animals as well as human beings. *Spirulina platensis* has been collected for food and dried in the sun since ancient times. Nowadays *Spirulina* tablets are prescribed by physicians for protein deficient patients. Most of the cyanobacterial association with plants are known to involve mutual exchange of nutrients specially related to the fixation of carbon and nitrogen (Rai Bergman, 2002 and Jaiswal *et al.*, 2008). According to Patterson, (1996) cyanobacteria include their use as in bioremediation of toxic compounds in bio control of pest's production for commercial, laboratory chemicals, restriction enzymes, and pharmacological tools. Everyone is worried about crop yield so many fields applying careless and over use of chemical fertilizers is leading to serious air, water as well as soil pollution. According to Singh *et al* (2013b); Thatoi *et al.* (2013) realized that directly and indirectly cyanobacteria provide bio fertilizers, economically cheaper and environment friendly alternatives to chemical fertilizers which increase the soil productivity.

II. MATERIAL AND METHODS

2.1 Source of Materials

During cropping period August 2018 to December 2019 and cropping period August 2019 to December 2020 the algal flora were investigated. Samples were collected from 48 sugarcane (Co 86032 variety) fields from 12 villages of three agronomic zones of completely flooded (CFLD) sugarcane fields of **Arjunwad, Danwad, Ghalwad-Kanwad, Khidrapur** villages, partially flooded (PFLD) sugarcane fields of **Dattawad, Herwad, Shirol, Udagoan** villages and non-flooded (NFLD) sugarcane fields of **Chipri, Jainapur-Jambhali, Takali, Tamdagale** villages by standard procedure.

2.2 Algal Sampling

The Primary goal of research work was study of algal diversity of sugarcane fields. Soil samples were collected and cultured at least once in a month from the sugarcane fields of Shirol taluka during the cropping period from August 2018 to December 2019 and August 2019 to December 2020 by standard procedure. All the experiments were organized, maintaining five replicates and repeated thrice.

2.3 Culturing and Isolation of Algae from Soil Samples

Culturing and isolation algae from soil samples is done by using various culturing medium as BG 11 ± medium (Rippka et al 1979), Fogg's nitrogen free medium (Fogg et al. 1973), chu's 10 medium (Chu, S.1942) and Allen and Arnon's medium (Allen and Arnon 1955); fine result found in BG 11 ± medium, so prefer BG 11 ± medium for culturing. We take sterile petri dishes containing sterilized soil samples and then add BG 11 ± medium with PH: 7.1. The petri dishes incubated in the culture chamber for two weeks at 25°c with 12/12 light and dark cycle artificial illumination under 5 K lux intensity of white fluorescent light. After formation colonies were purified, multiplied and identified, by using loops a part of each colony separated then transferred into another plate. After purification of taxa, taxonomic determination takes place with the help of standard literature (Dasikachary 1959, Santra 1993, Anand 1980, Anagostidis and Komarek 1985 and Guiry and Guiry 2012). Photographs were taken by digital camera after algae were viewed under light microscope.Micrometric measurements of the algae were taken by ocular of 10 x, 45 x and 100 x objectives with 10 x eyepiece. By using ocular and stage micrometers, morphometric studies were carried out. Algal Cultures were maintained in chemically defined nitrogen free BG 11 media (Stainer et al. 1971).

IV. RESULT AND DISCUSSION

Cultured samples were taken for microscopic observation. A drop of sample was taken on a slide and observed under light microscope. Microphotographs were taken on a Nikon L-20 digital camera. Identification of algal flora was done by using source books i.e. Prescott (1982), Fritsch (1965), Biswas (1980), Desikachary (1951) and Sarode and Kamat (1984).Algal diversity was found maximum in partially flooded fields of sugarcane during cropping period year of 2018 -2019 as well as 2019-2020 than the completely-flooded and non-flooded sugarcane field in almost all the region. An average microscopic observation of phytoplankton from Shirol taluka during flooded and non-flooded time revealed the presence of four groups consisting of 122 species belonging to 58 genera of microalgae. The group wise distribution revealed Cyanophyceae (46) Chlorophyceae (50), Euglenophyceae (04) and Bacillariophyceae (22). The number of species recorded was more or less similar at different sites during study time. Cyanophyceae members i.e. *Aphanocapsa, Aphanothece, Chroococcus, Nostoc, Scytonema, Spirullina* and *Oscillatoria*, significantly found in partially flooded regions.Species of Bacillariophyceae viz. *Nitzschia, Hantzschia, Navicula* and *Gyrosigma;* from Chlorophyceae *Closterium, Spirogyra* and *Mougeotia;* and from cyanophyceae *Chroococcus, Oscillatoria* and *Microcystis* were common to most of the sites during study time.

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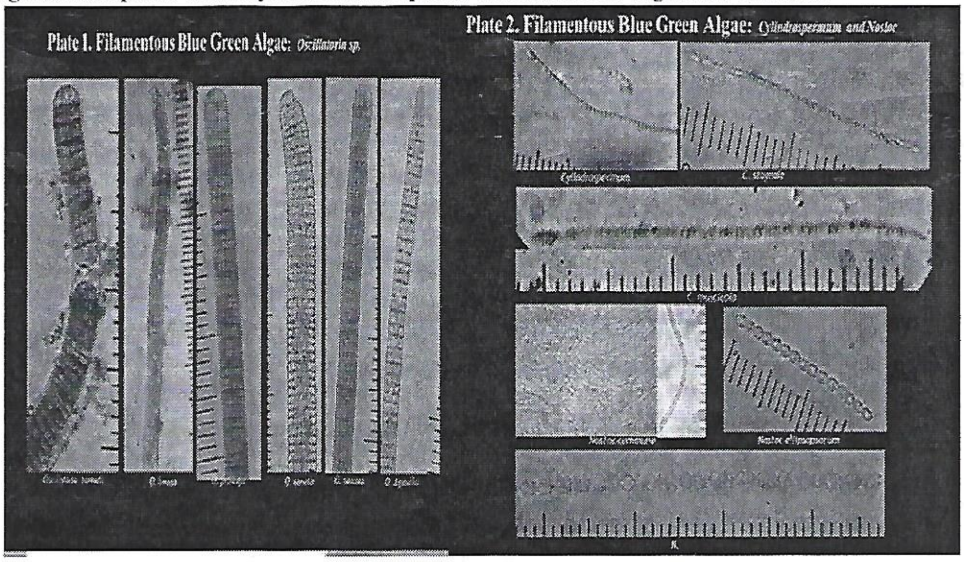
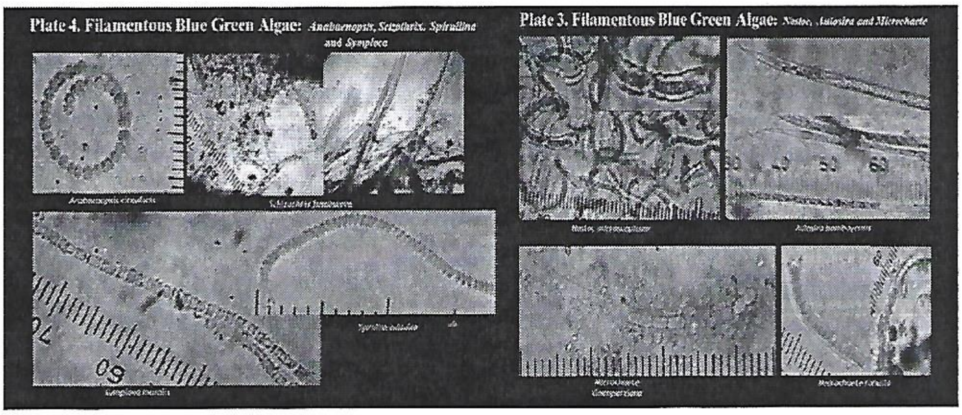
Following are some plates of the cyanobacterial species encountered in sugarcane field soil.





V. CONCLUSION

At present investigation of during sugarcane cropping period of 2018-2019 and 2019-2020 of Shirol taluka particularized that enormous cyanobacterial diversity enjoying in partially flooded sugarcane fields, creditable yield percentage of sugarcane was also found in partially flooded sugarcane fields. It concludes that cyanobacteria play an important role in various ways as improving soil fertility, ultimately soil nutrients accelerate the population of cyanobacteria and there are subsequent increases in sugarcane yield due to cyanobacteria production.

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