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Distribution Pattern of Four Genera of Chroococcales (Blue Green Algae) in Cultivated Soils of Karnataka State

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Data on the occurence of algal genera with reference to soil physico-chemical properties, soil types and cultivation types are presented. The genera *Chroococcus* and *Gloeocapsa* were recorded from the soils with significantly higher sodium and nitrogen content respectively. Occurence of *Gloeothece* and *Aphanothece* was influenced by a number of factors. *Aphanothece* and *Gloeothece* which exhibited preferential distribution in certain soil groups were more environmental specific while *Chroococcus* and *Gloeocapsa* were adaptable and were distributed more uniformly in different soil types and cultivation types.

Key Words - Algae Distribution Nitrogen Phosphorus Sodium Soil

Algae are important contributors to soil fertility and there are a number of reports on soil algal floristics (Shields & Durrell 1964, Subba Raju 1972, Metting 1981 and Bongale & Bharati 1985). However, most reports do not include any data on the distributional patterns of specific algal taxa in relation to soil properties. Our observation on the occurrence of *Chroococcus, Gloeocapsa, Gloeothece* and *Aphanothece* in relation to different soil groups and soil components is included in this communication.

MATERIALS & METHODS Samples of cultivated soils (numbering 144) were studied for the algal flora by enrichment cultures following the methods of Singh (1961). Details on the methods of soil collection and study are according to Bongale (1981) and the list of algal species recorded from these soil samples is reported (Bongale & Bharati 1980). Among the Chroococcales members 4 genera under study i.e. *Chroococcus* (16 spp.), *Gloeocapsa* (14 spp.), *Gloeothece* (8 spp.) and *Aphanothece* (5 spp.) which were present in 58%, 39%, 26% and 25% of soil samples studied respectively, were common.

Soil samples were analysed for pH in a Beckman pH meter using 1:2 soil:water suspension (Piper 1947), available P by Bray's method for soils with pH less than 6.5 and by Olsen's method for those with higher pH (Perur *et al.* 1973), available K and Na by Systronics Flame Photometer using ammonium acetate extract of soil (Perur *et al.*, 1973), carbonates by acid neutralisation method (Black 1965), Organic carbon by Walkley & Black's rapid titration method (Piper 1947), chloride by siver nitrate titration method (Black 1965), total nitrogen by Kjeldahl method (Jackson 1973), and calcium and magnesium by disodium EDTA method (Black 1965).

Soil samples were grouped according to the presence or absence of the respective algal genera. The data on physico-chemical composition with respect to the two soil groups were statistically analysed following 'One Criterion of Classification' (Croxton & Cowden 1955). The soils were also grouped according to the soil types (25, 17, 32, 58 and 12 samples respcetively of laterites, red loams, red sandy loams, medium black sandy and black clay soils), the types of cultivation i.e., 77 samples from dry lands (Jowar, cotton, wheat) and 67 samples from wet land (paddy), and irrigation i.e., 61 irrigated fields and 83 rainfed fields. Distribution of algal genera in relation to soil physico-chemical properties in these soil groups also is given.

RESULTS The genera *Chroococcus* and *Gloeocapsa* were recorded from the soils with significantly higher sodium and higher nitrogen content respectively *Gloeothece* was present in the soils with significantly higher pH and PO_4, Cl and Ca content while *Aphanothece* preferred the soils with significantly higher pH and CO_3, Cl, Org.C, Na, Ca and lower PO_4 content. Differences of other soil components studied between the soils with and without the respective genera were non-significant (Table. 1).

Observations on distribution frequency of algal genera in different soil groups (Table 2) revealed that *Aphanothece* was commonly recorded in irrigated field soils compared with rainfed field soils (42% and

Table 1 Algal Genera and Soil Physico-chemical Composition (Chemical Component as % of Dry Soil Sample)

Source	pH	CO_3	PO_4	Cl	Org.C	K	Na	N	Ca	Mg
Chroococcus										
Present	7.7	0.49	0.003	0.030	0.59	0.023	0.021	1.101	0.014	0.0007
Absent	7.4	0.44	0.003	0.028	0.61	0.027	0.017	0.093	0.014	0.0007
F value	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	***	N.S.	N.S.	N.S.
Gloeocapsa										
Present	7.6	0.45	0.003	0.028	0.61	0.025	0.018	0.099	0.014	0.0008
Absent	7.5	0.51	0.002	0.030	0.59	0.025	0.020	0.077	0.014	0.0006
F value	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.	N.S.
Gloeothece										
Present	7.9	0.55	0.003	0.035	0.65	0.024	0.025	0.088	0.015	0.0010
Absent	7.5	0.44	0.002	0.027	0.57	0.018	0.018	0.099	0.010	0.0006
F value	*	N.S.	*	*	N.S.	N.S.	N.S.	N.S.	***	N.S.
Aphanothece										
Present	7.9	0.64	0.004	0.036	0.68	0.026	0.023	0.089	0.016	0.0011
Absent	7.5	0.41	0.006	0.027	0.57	0.028	0.017	0.100	0.013	0.0005
F value	*	*	***	**	*	N.S.	*	N.S.	**	N.S.

*, **, *** : Significant at 5%, 1% and 0.1% levels respectively; N.S. : Non-Significant

Table 2 Distribution of Algal Genera in Different Soil Groups

Soil Groups	Algal genera (% occurence)				pH	Percentage of dry soil sample						
	Apt.	Glt.	Glc.	Chr.		CO_3	PO_4	Cl	Org.C	Na	N	Ca
I. *Irrigation :*												
Rainfed	13	14	36	55	7.2	0.36	0.0019	0.024	0.52	0.010	0.102	0.013
Irrigated	42	25	43	60	8.1	0.62	0.0033	0.036	0.73	0.033	0.091	0.015
II. *Cultivation Type:*												
Dry-lands	18	23	38	57	8.0	0.60	0.0023	0.025	0.54	0.018	0.093	0.014
Rice fields	33	28	36	58	7.2	0.29	0.0027	0.034	0.68	0.022	0.103	0.014
III. *Soil Type:*												
Laterites	12	8	20	44	6.8	0.17	0.0017	0.034	0.60	0.004	0.114	0.015
Red loams	18	12	47	47	6.3	0.04	0.0021	0.023	0.62	0.006	0.105	0.010
Red sandy loams	25	19	41	84	7.7	0.31	0.0025	0.033	0.53	0.024	0.085	0.014
Med.black sandy	36	43	45	59	8.1	0.77	0.0031	0.030	0.63	0.026	0.100	0.014
Black clays	8	8	42	42	8.2	0.72	0.0016	0.021	0.49	0.023	0.071	0.015

Apt. - *Aphanothece*, Glt.- *Gloeothece*, Glc.- *Gloeocapsa* Chr.- *Chroococcus*

13% respectively of the samples studied recorded the alga). Accordingly, irrigated field soils had high pH and CO_3, Cl organic, Na and Ca which correspond with the physico-chemical requirements of the genus (Table 1) phosphate content alone however, did not agree with the requirement of the genus. Among the two types of cultivation, rice fields favoured the occurrence of the genus to a greater extent when compared with dry-land field soils, and the former group of samples had high Cl, Organic C and Na content.

Dry land field soils did not favour the occurrence of *Aphanothece* in spite of high pH and CO_3 and low PO_4 content apart from high Ca content (0.014% in both the groups). The alga possibly could not withstand the prolonged desiccation prevailing in such soils. Among the soil types studied, *Aphanothece* was more common in medium black sandy soils followed by red sandy loams. Accordingly these soils had high pH and CO_3, Cl, organic C and Na while Ca did not differ much among the soil types. *Aphanothece* was poorly represented in laterites, red loams and black clay soils while physico-chemical composition of these soil types varied considerably possibly indicating that the alga is not adaptable to these soils.

Higher percentage of irrigated field soils, when compared with rainfed field soils, contained the genus *Gloeothece*. Former group of soils had high pH and PO_4, Cl, and Ca content in accordance with the requirement of the genus (Table 1). Rice field soils which had higher frequency occurrence of *Gloeothece* had high PO_4 and Cl content. The pH of these soils, however, did not agree with the requirement of the genus, and Ca content did not differ between the two soil groups. Among the soil types studied, medium black sandy soils, when compared with other soil types, recorded maximum frequency occurrence of *Gloeothece*, and accordingly these soils had higher values of pH, PO_4, and Cl while Ca content did not much differ among the soil types. Other soil types were not much favourable to the genus.

Gloeocapsa was more frequently recorded from irrigated field soils in spite of their low nitrogen content than the rainfed soils. The alga was more uniformly distributed in both the cultivated soils and all the soil types except, however, the laterites which did not much favour the genus.

Chroococcus was more common in red sandy loams, followed by medium black sandy soils, which had high sodium content. Other soil types did not much restrict the occurrence of the alga (84%, 59%, 47%, 44%, and 42% of red sandy loams, medium black sandy soils, red loams, laterites and black clay soils respectively, recorded the genus). The alga was more uniformly distributed in dry-lands and rice fields as also in rainfed and irrigated field soils.

DISCUSSION *Aphanothece* and *Gloeothece* exhibit greater environmental specificity while *Gloeocapsa* and *Chroococcus* are more adaptable to the soil habitats. *Aphanothece* and *Gloeothece* were more common in rice field soils than in dry-land crop field soils indicating their preference for water logged condition compared to the moist and dry environment prevailing in the latter group of soils. The other two genera under study were more uniformly distributed in the two cultivation groups of soils, possibly suggesting their adaptability to environmental variation. Irrigated field soils recorded higher frequency of all the 4 genera; *Chroococcus* was most adaptable, since it was more uniformly recorded from the two soil groups. Data on soil types also supported the above observation on greater environmental specificity of *Aphanothece* and *Gloeothece* and adaptability of *Gloeocapsa* and *Chroococcus*. This was evident from the restricted occurrence of *Aphanothece* and *Gloeothece* in medium black sandy soils, and more common occurrence of *Gloeocapsa* and *Chroococcus* in different soil types, except for the lesser frequency occurrence of *Gloeocapsa* in laterites.

Soils present a peculiar habitat especially for algae, which generally occur more commonly in aquatic environment. Literature reveals that many algae are restricted to certain habitats like soils, paddy fields etc. (Shields & Durrell 1964). However, information on the aspects related to the ecology and factors governing such characteristic distribution is meagre. Our observations reveal that the algal genera under report differ considerably among themselves with regard to their habitat and physico-chemical requirements. Information on preferential distribution of a few other algal genera is also available (Bongale 1984, 1985, 1986a, b). Similar studies with specific algal taxa, particularly those belonging to Cyanophyceae, would further help in understanding their ecology and in ascertaining the establishment of algal inoculum strains in the fields.

It is concluded that *Aphanothece* and *Gloeothece*

exhibited greater environmental specificity since they were more commonly recorded from wet-land field soils (rice fields and irrigated field soil groups) when compared with dry-lands (dry-land crop field and rainfed field soils); the two genera also had specificity requirements with regard to a number of physico-chemical parameters. *Gloeocapsa* and *Chroococcus* showed their adaptability to different soil groups; in addition, occurrence of the two genera was not affected by a majority of the physico-chemical components.

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