Comparative Algological Studies in Rice Fields in Kerala State

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Rice fields constitute artificial biotopes of a peculiar character. The biocoenosis in them is the association of two micro-organizations, that of the water and of the soil, although they are not independent of each other. Biocoer.otic life in the water of rice fields is, however, of a short duration extending over four to six months in all. After harvest, the overwhelming part of the aquatic microorganisms either perishes or forms spores to tide over the unfavourable conditions for existence. Such forms that can successfully perennate constitute, in general, the basic algal population of the soils and a study of the nature and types of these forms is important to understand their ecological and agricultural importance.

The present communication compares the indigenous algal flora of the rice fields from seven districts of Kerala State, a predominantly rice growing region. The most northerly parts of the area studied were the fields from South Wyanad and Tirur Taluks in Kozhikode district growing rice on sandy loam and laterite soils. The southernmost part of the area in question included the rice fields from Chirayinkil taluk in Trivandrum district, all having sandy loam soils. In addition the algal flora in the five different districts, viz. Quilon (Kunnathur taluk), Kottayam (Kottayam and Meenachil taluks), Ernakulam (Muvattupuzha taluk), Trichur (Thalapally taluk) and Palghat (Chittur taluk) were also examined.

Materials and Methods

The details regarding the soil samples and their chemical analysis are shown in Table I. Attention to depths of sampling of the soils was not given since the fields are under regular cultivation and the only treatment given to the soil was desiccation.

The algal population in the soil was studied by means of enrichment cultures which were prepared with modified Bristol's medium containing per liter: 0.25 g KNO_3, 0.01 g. $CaCl_2$, 0.075 g $MgSO_4 . 7H_2O$, 0.075 g. K_2HPO_4, 0.025 g. NaCl, 0.02 g. FeSO4 and 1 ml. of A_5 micro-nutrient solution. Cultures inoculated with five grams of soil were set up in milk bottles containing 100 ml. of the medium and were

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maintained under identical conditions of temperature and illumination. In one set of cultures the pH was uniformly adjusted to 7.5 and in the other the respective original pH of the soils was maintained. The cultures were examined at fortnightly intervals.

For optical density measurements an 80 percent aqueous acetone extract of the cultures was read at 490 mμ in an Unicamp Spectrophotometer.

Nitrogen estimations were done by the conventional micro-Kjeldhal method.

Observations

All the soils were acidic, their pH varying from 3.5 to 6.5. The percentage of organic carbon ranged from 0.3 to 4.25 and the available phosphorus and potassium from 22.7 to 45.4 kg/ha and from traces to 3495 kg/ha respectively. The total soluble salts varied between 0.0 to 4.5 m. mhos/cm². (Table I).

TABLE I

Place of collection, texture and chemical analysis of the soils.

District	Taluk	Nature of soils	Serial number	pH.	Organic carbon %	Av P. Kg./ hect.	Av.K Kg's'/ hect.	Total S.S. (mm hos/ cm²)
Trivandrum	Chirayinkil	Sandy loam	5412	5.5	0.62	36.3	181.6	0.50
	,,	,,	5414	5.0	0.60	24.9	227.0	0.05
	,,	,,	5753	4.5	0 65	31.7	31.7	0.50
	,,	,,	5754	4.1	0.67	27 2	45.4	0 50
Quilon	Kunnathur	Sandy loam	5862	5.6	0 43	35.1	31.7	0.35
	,,	,,	5861	5 0	0.76	124	22.7	0 60
	,,	Laterite	5839	4.3	1 05	11 3	18.1	0.70
Kottayam	Kottayam	,,	4799	5 0	1.28	34.0	349.5	2,10
	Meenachil	,,	5249	4.1	0.95	4.5	90.8	0.20
	,,	,,	5762	3.5	4.25	11.3	204.3	1.40
Ernakulam	Muvattupuzha	Sandy loam	4869	3.6	0.96	36.3	45.4	0.00
	,,	Laterite	4866	4.0	1.20	18.1	54.4	0,20
	,,	,,	4876	4.7	0.83	19.2	Trace	0.00
Trichur	Talapally	,,	5773	6 0	0 65	4.5	136.2	0 10
	,,	Sandy loam	5774	5.0	0 30	2.2	22.7	0.25
	,,	Laterite	5787	4 5	0 60	136	31.7	0.30
Palghat	Chittur	Sandy loam	5977	4.0	0.42	22.7	68.1	0.10
	,,	,,	5974	4.3	0 40	45.4	95.3	0.10
	,,	,,	5968	5,5	0.45	20.4	111.3	0 30
	,,	Laterite	5955	5 1	0.16	20.4	111.3	0 00
Kozhikode	South Wynad	Sandy loam	5814	5.7	0 58	9.0	295.1	0 90
	,,	,,	5815	5 0	0 52	32.9	147.5	4,50
	,,	,,	5807	6.5	0 30	24 9	81.7	0 30
	Tirur	Laterite	5735	4.2	0.75	9.0	Trace	0.35

The present investigation indicated that the rice fields in the different districts of the State harboured algal vegetations which in respect of their composition stood fairly near to one another. Forms like *Chlamydomonas elliptica*, *Chlorococcum humicola*, *Uronematerrestris*, *Plectonema nostocorum*, *Calothrix brevissima* and *Aulosira fertilissima* were encountered in the soils from all the seven districts. On the other hand, there were forms which were restricted to one or other of the districts: *Charcium ornithocephalum* in Trivandrum, Quilon, Trichur, Palghat and Kozhikode districts; *C. debaryanum* in Trivandrum, Kottayam, Palghat and Kozhikode districts; *Coelastrum glabrum* in Palghat district; *Glococystis ampla* in Kottayam district; *G. verruculosa* in Palghat district; *Chlorosarcina consociata* in Trivandrum and Quilon districts; *Closterium acerosum* in Kozhikode district; *Oocystisgigas* in Trivandrum, Quilon and Palghat districts; *Ophiocytium bicuspidatum* in Quilon District; *Nitzschia palea* in Triv. andrum district; *Chlorococcus minor*, *Synechococcus cedrorum* and *Spirulina subtilissima* in Quilon district; *Oscillatoria subbrevis* in Quilon and Kozhikode districts; *Os. sancta* in Trivandrum, Ernakulam and Trichur districts; *Os. tereberiformis* in Ernakulam district *Os. princeps* in Trivandrum district; *Lyngbya aesturaii* in Trivandrum, Quilon Ernakulam and Kozhikode districts; *L.conferveides* in Kottayam district; *Anabaena cylindrica* in Quilon and Palghat districts; *Cylinderospermummusicola* in Trivandrum and Trichur districts; *Nostoc muscomum* in Quilon and Ernakulam districts *N.paludosum* in Palghat district and *N. punctiforme* in all districts except Ernakulam.

Comparing the algal diagrams of, all the rice fields (Fig. 1), it could be seen that Myxophyceae varied in proportion from 20 to 76 percent and that they were the highest in number in the soils from Chirayinkil taluk in Trivandrum district and lowest in those from Kottayam and Meenachil taluk in Kottayam district. The proportion of Chlorophyceae members varied from 25 to 100 percent and was lowest in some fields in Muvattupuzha taluk in Ernakulam district and highest in Meenachil taluk in Kottayam district, in two fields in Muvattupuzha taluk in Ernakulam district and in one field in South Wynad taluk in Kozhikode district. Xanthophyta constituted only 10% in one field in Kunnathur taluk in Quilon district and in another field in Chittur taluk in Palghat district. The optical density of the cultures at 490 mμ also corresponds closely with the proportion of the Myxophyceae. (Fig. 2)

There are many genera occurring in these fields which have been described from other parts of India, as well as, from other countries, although there are specific differences in their compositions. (Singh 1939, 1942, Mitra, 1951; Dutta and Venkataraman, 1958, Gonzalves and Gangla 1949, Kol, 1956). Of special interest is the abundant occurrence of the blue green algae in the present soils the pH of which vary between 3. 5 and 6. 5. Of the 19 forms recorded, 7 were reported to be capable of nitrogen fixation, viz. *Aulosira fertilissima* (Singh, 1942); *Calthri brivissima* (Watenabe, 1951, 1959) *Anabaena cylindrica* (Bortels 1940), Fogg, 1942); *Nostoc muscorm* (Allison *et al*, 1937, Burries *et al*, 1942; Williams and Burries, 1952); *Nostoc puntiforme* (Bortels, 1940; Drewes, 1928; Winter, 1935); *Nostoc pasudosum* (Bortels, 1940)

Table II shows the addition of nitrogen o the soil due to the growth of *Aulosira fertillssima.*

Pot culture experiments with this alga have shown a significant increase in the yield of rice (N. P 130) (Sundara Rao *et al,* 1963). Particularly significant is the obiquitious occurrence of this alga in most of the rice fields studied so far (Singh, 1960) and it seems that this alga has a great affinity for rice field conditions. With its capacity to fix nitrogen this alga under such conditions may play a significant role in rice production.

TABLE II

Nitrogen added to the soil due to the growth *of Aulosira fertilissima*
(Incubation 30 days; N. in mg/100 g soil)

Control (A)	Alga (B)	Alga NO_3 (C)	Alga P_2O_5 (D)
0.0933	3.710	3.360	2.846

Significant at 1% level
Se———————0.2492
C. D at 1% 0.937
C. D at 5% 0.704

Summary

A comparative algological study of the rice fields of seven districts of Kerala was made. All the soils were acidic in nature, the pH ranging from 3.5 to 6.5. The distinct composition of the algal association in the various fields shows that the proportion of Myxophycea members varied from 20 to 76 percent and that of Chlorophycean ones from 25 to 100 percent.

It was found that the rice fields in the different districts harboured vegetations which in respect to their composition were fairly similar. Certain algal forms like *Aulosira fertilissima* and *Calothrix brevissima* were encountered in all the rice fields, while the occurrence of some forms was localised.

Of the 19 forms of blue-green algae recorded 7 were already known to be nitrogen fixers.

The activity of *Aulosira fertilissima* towards the nitrogen economy of the soils was studied and its beneficial role in the rice fields is indicated.

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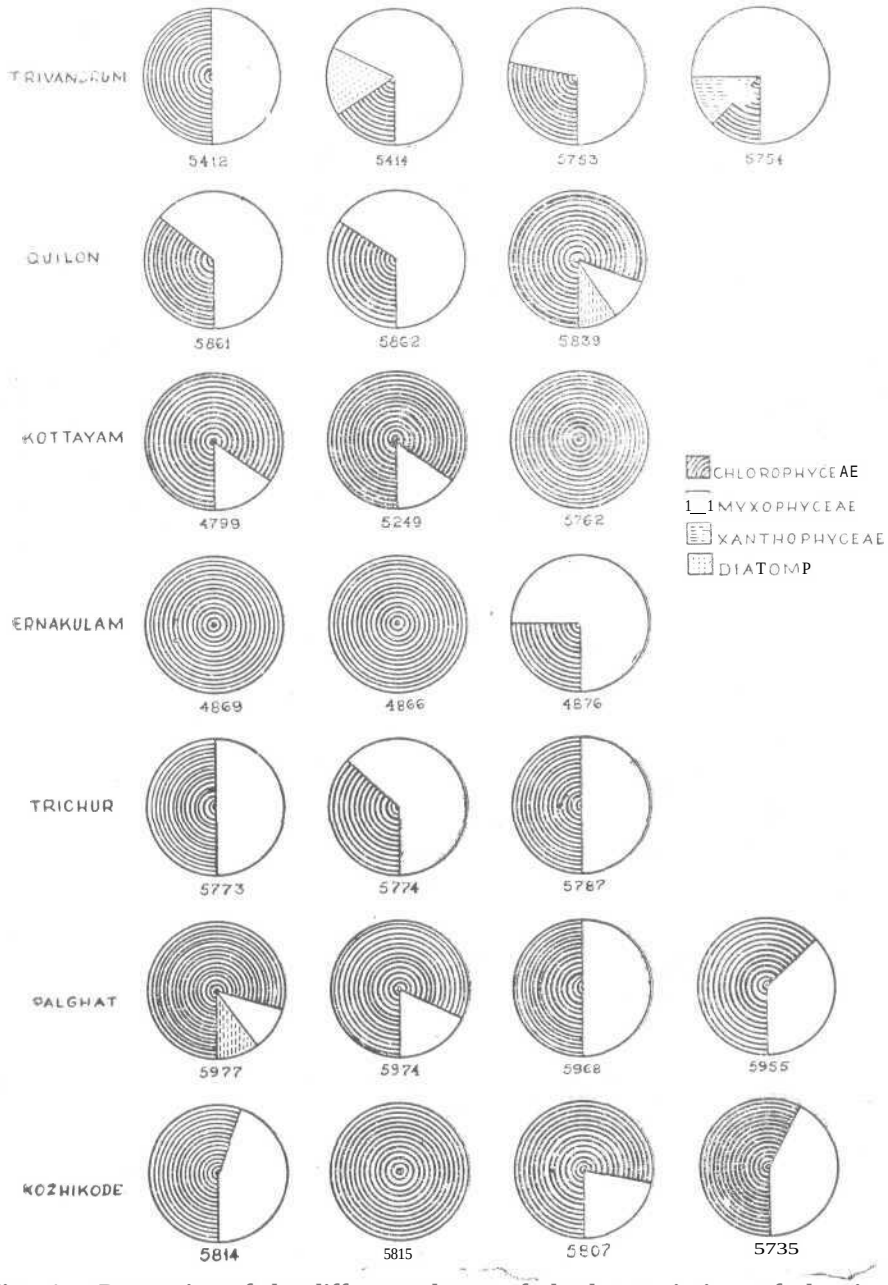

Fig. 1. Proportion of the different classes of algal associations of the rice fields in Kerala. (For soil numbers refer Table I)

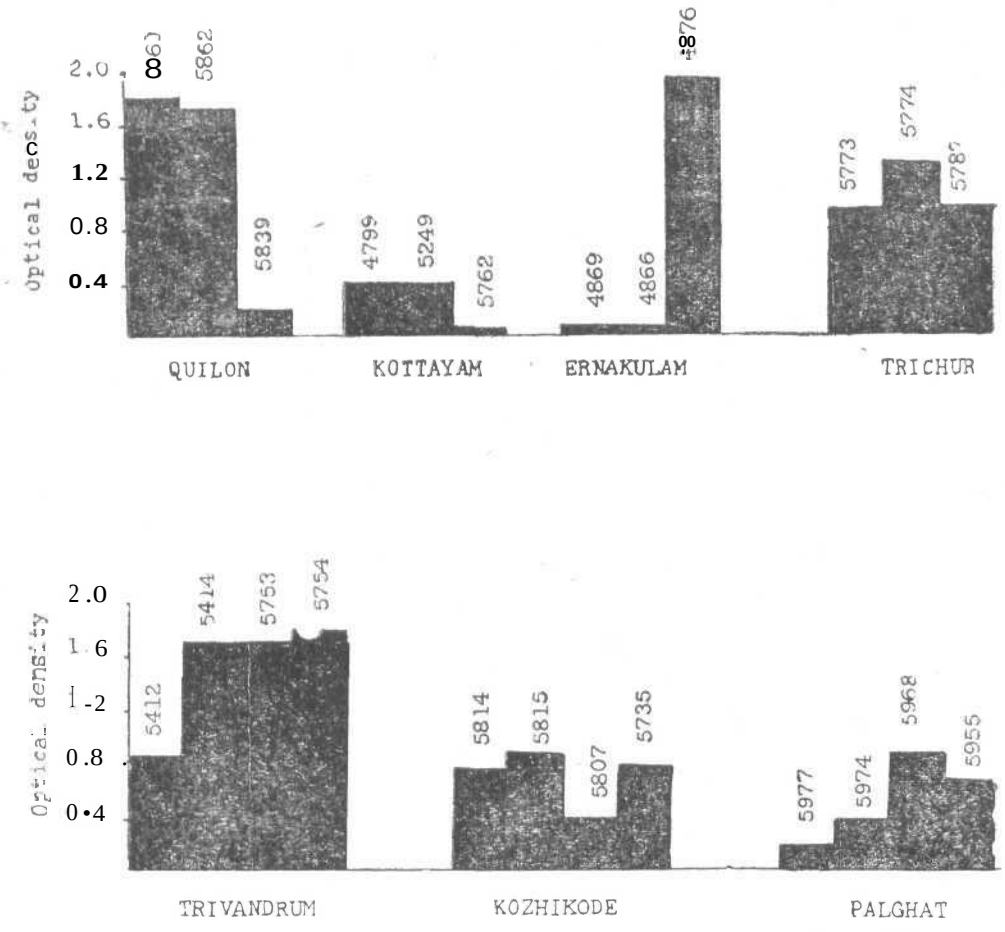

Fig. 2. Optical density of the acetone extracts of the various soils at 490 m.μ. (For soil numbers refer Table I)

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