

DIVERSITY OF THE GENERA OF CHLOROPHYTA IN FRESH WATERS OF DISTRICT SWAT N.W.F.P PAKISTAN

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Abstract

Fifty six genera of green algae were collected from ten different localities of District Swat, belonging to 25 families and 9 genera of Chlorophyta from December 2006 August 2008. Family Oocystaceae with 39 species was most commonly found, next to it were families Scenedesmaceae with 18 species and Desmidiaceae with 14 species. The genera Oocystis and Tetraedron were represented by 10 species and Cosmarium with 7 species occurred most commonly. Among the recorded genera 13 (23.2%) were Unicellular, 25 (44.6%) were Colonial, 9 (16.7%) were Unbranched filamentous, 4 (7.1%) were branched filamentous, 1 (1.7%) was Pseudofilamentous, 1 (1.7%) was Mesh-like, 2 (3.5%) were Heterotrichous and 1 (1.7%) was with Irregular amorphous thallus. Highest proportion of Chlorophycean members was recorded from Kanju area 89 and lowest was recorded from Kalam 69.

Introduction

The Valley of Swat a part of Malakand Division covers 5737 square kilometers (estimated). The elevation of the valley is 630 to 3000m above sea level. Swat is located at a distance of 170 km from Peshawar and 270 km from Federal capital of Islamabad. Faridi (1971) recorded some genera of fresh water algae from Pakistan and Azad Kashmir. Leghari *et al.*, (2001) reported 46 species of Chlorophycean members belonging to order Chlorococcales from Sindh. Reshmi (2004) conducted a detailed study on Chlorophycean biodiversity in Wet lands on Satna (M.P.) India. The study reviewed 32 genera and 52 species belonging to 18 families and 7 orders of Chlorophyceae, which were recorded from different wet lands of Satna. Kumar & Rai (2005) recorded 13 taxa of Chlorophyceae from Namchi, Sikkim-Himalayas. Misra *et al.*, (2005) worked on some fresh water algae of Eastern Uttar Pradesh, India. Their communication deals with morpho-taxonomic description of 11 fresh water algae belonging to class Chlorophyceae and Bacillariophyceae. Sarim and Zaman (2005) carried an extensive study and a total of 89 species belonging to 31 genera of Chlorophyceae, Bacillariophyceae, Xanthophyceae and Cyanophyceae, were recorded from various localities of District Charsadda. Zarina *et al.*, (2005) worked on Green algae and made large collections from various Districts of Punjab. Tiwari and Chauhan (2006) studied the seasonal phytoplanktonic diversity of Kitham Lake, Agra. There collections were dominated with Chlorophycean members. Zarina *et al.*, (2009) described 22 genera and 127 species of Green algae from Punjab and neighboring areas of Pakistan. The recent report of algal species diversity was reported in Swat by Ali *et al.*, 2010 and 2010a.

Materials and Methods

Algal collections were made during December 2006 to August 2008 from various localities of District Swat. The specimens were identified with the help of authentic literature (Smith, 1950; Prescott, 1961; Siddiqi & Faridi, 1964; Tiffany & Britton, 1971; Akiyama & Yamagishi, 1981).

Results and Discussion

Fifty six genera containing 138 species belonging to 25 families and 9 orders have been collected from various fresh water habitats. Collected algal members were identified up to species level. (Tables 1-2).

1. Taxonomic diversity: Chlorophyta was represented by 9 orders, 25 families, 56 genera and 138 species. Family Oocystaceae was represented by 12 genera, Palmellaceae and Volvocaceae by 5 genera each, Scenedesmaceae, Cladophoraceae and Zygnemataceae by 3 genera each, Dictyosphaeriaceae, Hydrodictyaceae, Oedogoniaceae, Tetrasporaceae, Ulothrixaceae and Cosmariae by 2 genera each, while Chlorococcaceae, Characiaceae, Chaetophoraceae, Chaetosphaeridiaceae, Coleochaetaceae, Sphaeropleaceae, Cocomaxaceae, Microsporaceae, Cylindrocapsaceae, Haematococcaceae and Desmidiaceae/Closteriaceae were represented by 1 genera each.

2. Thallus diversity: Among the recorded 56 Chlorophycean genera 13 (23.21%) were Unicellular forms, 25 (44.64%) were belonging to Colonial types, 9 (16.07%) were Unbranched Filamentous forms, 4 (7.14%) were Branched Filamentous thalli, 2 (3.57%) were those belonging to Heterotrichous thalli, while Pseudofilamentous, Mesh-Like thallus and Anastomosing thallus were recorded as 1 (1.78%) genera each.

3. Diversity of localities: Collections were made from 10 different localities of Swat District. During present study highest proportion of Chlorophycean members was recorded from Kanju 89 (64.49%). It was followed by Kabal 86 (62.31%), Aligrama 85 (61.59%), Matta 74 (53.62%), Khwaza Khela 73 (52.89%), Madian and Bahrain 70 (50.72%) each. Lowest number was that of Kalam 69 (50.00%).

4. Seasonal variation: Collections were made during all seasons, i.e., summer, autumn, winter and spring. Highest number of Chlorophycean members was recorded during summers and autumn. Winters displayed comparatively low Chlorophycean diversity. As we know that winters are a bit harsh in upper Swat region and are accompanied with heavy snowfall and hail storms so most of the Green algal members form resistant spores and parenting bodies to tide over the winters.

Table 1. Thallus Diversity exhibited by Chlorophycean Genera from fresh waters of District Swat.

S.No.	Algal taxa	1Uni		2Colo		3UBF		4BF		5PsF		6ML		7HT		8IRR	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
	Division Chlorophyta																
	Class Chlorophyceae																
	Order Chlorococcales																
	Family Oocystaceae																
1.	Ankistrodesmus Corda	5	3.6														
2.	Chlorella Beyerinck	2	1.4														
3.	Dactylococcus Naegeli											1	0.7				
4.	Gloetaenium Hansgirg			1	0.7												
5.	Kirchneriella Schmidle											2	1.4				
6.	Nephrocytium Naegeli			2	1.4												
7.	Oocystis Naegeli <i>in</i> A. Braun			10	7.2												
8.	Quadrigula Printz			1	0.7												
9.	Selenastrum Reinsch			1	0.7												
10.	Tetraedron Kuetzing	10	7.2														
11.	Trochiscia Kuetzing	3	2.2														
12.	Westella de Wildemann			1	0.7												
	Family Chlorococcaceae																
13.	Chlorococcum Fries	1	0.7														
14.	Dictyosphaerium Naegeli			2	1.4												
15.	Dimorphococcus A. Braun			1	0.7												
	Family Characiaceae																
16.	Characium A. Braun <i>in</i> Kuetzing	3	2.2														
	Family Coelastraceae																
17.	Coelastrum Naegeli <i>in</i> Kuetzing			4	2.9												
	Family Hydrodictyaceae																
18.	Hydrodictyon Roth											1	0.7				
19.	Pediastrum Meyen			5	3.6												
	Family Scenedesmaceae																
20.	Actinastrum Lagerheim			1	0.7												
21.	Crucigenia Morren			7	5												
22.	Scenedesmus Meyen			10	7.2												
	Order Cladophorales																
	Family Cladophoraceae																
23.	Basicladia Hoffman & Tilden									1	0.7						
24.	Cladophora Kuetzing									1	0.7						
25.	Pithophora Wittrock									2	1.4						
	Order Chaetophorales																
	Family Chaetophoraceae																
26.	Chaetophora Schrank									1	0.7						
	Family Chaetosphaeridiaceae																
27.	Chaetosphaeridium Klebahn			1	0.7												
	Family Coleochaetaceae																
28.	Coleochaete de Brebisson														1	0.7	
	Order Sphaeropleales																
	Family Sphaeroplaceae																
29.	Sphaeroplea C. A. Agardh									1	0.7						

Table 1. (Cont'd.).

S.No.	Algal taxa	1Uni		2Colo		3UBF		4BF		5PsF		6ML		7HT		8IRR		
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	
Order Oedogoniales																		
Family Oedogoniaceae																		
30.	Oedogonium Link					1	0.7											
31.	Bulbochaete C. A. Agardh							1	0.7									
Order Tetrasporales																		
Family Palmellaceae																		
32.	Asterococcus Scherffel	1	0.7															
33.	Gloeocystis Naegeli			3	2.2													
34.	Palmella Lyngbye														1	0.7		
35.	Palmodictyon Kuetzing														1	0.7		
36.	Sphaerocystis Chodat	1	0.7															
Family Cocomaxaceae																		
37.	Elakothrix Wille	2	1.4															
Family Tetrasporaceae																		
38.	Tetraspora Link														3	2.2		
39.	Schizochlamys Braun <i>in</i> Kuetzing														2	1.4		
Order Ulotrichales																		
Family Ulotrichaceae																		
40.	Geminella Turpin	2	1.4															
41.	Ulothrix Kuetzing	4	2.1															
Family Microsporaceae																		
42.	Microspora Thuret	1	0.7															
Family Cylindrocapsaceae																		
43.	Cylindrocapsa Reinsch	1	0.7															
Order Volvocales																		
Family Chlamydomonadaceae																		
44.	Chlamydomonas Ehrenberg	4	2.1															
Family Haematococcaceae																		
45.	Haematococcus C.A. Agardh Icon Algar	1	0.7															
Family Volvocaceae																		
46.	Gonium Mueller, Silva % Wade	1	0.7															
47.	Eudorina Ehrenberg	1	0.7															
48.	Pandorina Bory	1	0.7															
49.	Pleodorina Shaw	1	0.7															
50.	Volvox Linnaeus	2	1.4															
Order Zygnematales																		
Family Desmidiaceae/Closterieae																		
51.	Closterium Nitzsch	5	3.6															
Sub-family Cosmarieae																		
52.	Cosmarium Corda	7	5															
53.	Staurastrum Meyen	2	1.4															
Family Zygnemataceae																		
54.	Spirogyra Link	2	1.4															
55.	Mougeotia (C.A. Agardh) Wittrock	4	2.1															
56.	Zygnuma C. A. Agardh	1	0.7															

(Uni- Unicellular Colo- Colonial UBF- Unbranched Filamentous BF- Branched Filamentous PsF- Pseudofilamentous ML- Mesh like thallus HT- Heterotrichous IRR- Irregular thallus)

Table 2. Diversity of Chlorophycean Genera from different localities of Swat.

Algal taxa	Saidu Sharif		Kalam		Aligrama		Kabal		Ningolai		Matta		Khwaza Khela		Madian		Bahrain		Kalam		
	No:	%	No:	%	No:	%	No:	%	No:	%	No:	%	No:	%	No:	%	No:	%	No:	%	
Division Chlorophyta																					
Class Chlorophyceae	73		89		85		86		71		74		73		70		70		70		69
Order Chlorococcales																					
Family Oocystaceae																					
1. Ankistrodesmus Corda	4	5.4	-	-	5	5.8	5		-	-	5		-	-	4		3		3		
2. Chlorella Beyerinck	2	2.7	2	2.2	2	2.3	2		2		2		1		1		-	-	-		
3. Dactylococcus Naegeli	-	-	1	1.1	1	1.1	-	-	-	-	1		-	-	-	-	-	-	-		
4. Gloetaenium Hansgirg	-	-	1	1.1	1	1.1	-	-	-	-	-	-	1		-	-	-	-	-		
5. Kirchneriella Schmidle	1	1.3	2	2.2	2	2.3	1		1		1		-	-	2		1		1		
6. Nephrocystium Naegeli	2	2.7	2	2.2	2	2.3	1		-	-	1		2		-	-	-	-	-		
7. Oocystis Naegeli in A. Braun	6	8.2	5	5.6	3	3.5	8		5		3		-	-	5		4		3		
8. Quadrigula Printz	-	-	-	-	-	-	-	-	1		1		1		-	-	-	-	-		
9. Selenastrum Reinsch	-	-	1	1.1	1	1.1	1		1		1		1		-	-	1		-		
10. Tetraedron Kuetzing	2	2.7	3	3.3	4	4.7	5		3		7		6		9		8		3		
11. Trochiscia Kuetzing	-	-	3	3.3	-	-	-	-	-	-	1		1		-	-	-	-	-		
12. Westella de Wildemann	-	-	-	-	-	-	-	-	1		1		1		-	-	-	-	-		
Family Chlorococcaceae																					
13. Chlorococcum Fries																					
14. Dictyosphaerium Naegeli	2	2.7	2	2.2	2	2.3	-	-	-	-	-	-	2		-	-	1		1		
15. Dimorphococcus A. Braun	1	1.3	1	1.1	1	1.1	-	-	1		1		-	-	-	-	1		1		
Family Characiaceae																					
16. Characium A. Braun in Kuetzing	1	1.3	2	2.2	3	3.5	2		2		1		1		1		2		1		
Family Coelastraceae																					
17. Coelastrum Naegeli in Kuetzing	3	4.1	2	2.2	2	2.3	2		2		-	-	2		1		2		2		
Family Hydrodictyaceae																					
18. Hydrodictyon Roth	1	1.3	1	1.1	1	1.1	1		1		1		1		1		1		1		
19. Pediastrum Meyen	4	5.4	5	5.6	4	4.7	4		4		4		4		5		4		4		
Family Scenedesmaceae																					
20. Actinastrum Lagerheim	-	-	-	-	-	-	-	-	1		1		1		1		-	-	-		
21. Crucigenia Morren	6	8.2	5	5.6	5	5.8	4		-	-	4		4		1		-	-	2		
22. Scenedesmus Meyen	1	1.3	10	11.2	3	3.5	8		7		1		-	-	-	-	9		1		
Order Cladophorales																					
Family Cladophoraceae																					
23. Basicladia Hoffman & Tilden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		1	-	-	-	
24. Cladophora Kuetzing	1	1.3	1	1.1	1	1.1	1		1		1		1		1		1		1		
25. Pithophora Wittrock	1	1.3	2	2.2	2	2.3	2		-	-	2		2		2		2		1		
Order Chaetophorales																					
Family Chaetophoraceae																					
26. Chaetophora Schrank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		1		1		
Family Chaetosphaeridiaceae																					
27. Chaetosphaeridium Klebahn	-	-	-	-	-	-	-	-	1		1		1		1		-	-	-		
Family Coleochaetaceae																					
28. Coleochaete de Brebisson	1	1.3	1	1.1	1	1.1	-	-	1		1		1		1		1		-		
Order Sphaeropleales																					
Family Sphaeroplaceae																					
29. Sphaeroplea C. A. Agardh	1	1.3	-	-	-	-	-	-	1		1		1		-	-	-	-	-		

Table 2. (Cont'd.).

Simpson's Diversity Index (D): The Simpson's Index (D) measures the probability that two individual randomly selected from a sample will belong to the same species. The Simpson's Index (D) is defined as:

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

where n = Total number of organism of a particular species and N = total number of organism of all species

The value D will always lie between 0 and 1

0 represent infinite diversity & 1 represent no diversity

The larger the value of D the lower will be diversity

Table: Diversity index for families of Chlorophyta in District Swat.

Order	Family	D
Chlorococcales	Oocystaceae	0.0420
	Chlorococcaceae	0.0022
	Dictyosphariaceae	0.0044
	Characiaceae	0.0047
	Coelastraceace	0.0038
	Hydrodictyaceae	0.021
	Scenedesmaceae	0.014
Cladophorales	Cladophoraceae	0.011
Chaetophorales	Chaetophoraceae	0.0006
	Chaetosphaeridiaceae	0.0006
	Coleochaetaceae	0.0022
Sphaeropleales	Sphaeropleaceae	0.0006
Oedogoniales	Oedogoniaceae	0.0077
Tetrasporales	Palmellaceae	0.008
	Cocomaxaceae	0.0022
	Tetrasporaceae	0.0066
Ulotrichales	Ulotrichaceae	0.0157
	Microsporaceae	0.0001
	Cylindrocapsaceae	0.0006
Volvocales	Chlamydomonadaceae	0.0090
	Haematococcaceae	0.0001
	Volvocaceae	0.0081
Zygnematales	Desmidiaceae/ Closterieae	0.0122
	Cosmarieae	0.0145
	Zygnemataceae	0.0161

CONVOLVULUS SCINDICUS: CONSERVATION ASSESSMENT AVOIDING EXTIRPATION

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