

SEASONAL VARIATION AND DISTRIBUTION OF EUGLENOPHYCOTA IN THE PUNJAB

SYED TARIQ-ALI¹, A. ZARINA¹ AND MUSTAFA SHAMEEL²

¹Department of Botany, Federal Urdu University of Arts, Science & Technology, Gulshan-e-Iqbal Campus, Karachi-75300
²Department of Botany, University of Karachi, Karachi-75270, Pakistan

Abstract

A long survey of different freshwater habitats was made during December 2003-July 2006 in the districts of Gujranwala, Jhang, Lahore, Rawalpindi, Sargodha, Sheikhupura and Sialkot in the Punjab Province of Pakistan. As a result of that distribution and diversity of 55 species belonging to three genera viz., *Euglena*, *Phacus* and *Trachelomonas* of the phylum Euglenophycota were observed. Most of the collected species were found to grow in summer (39.13%), they slightly decreased in autumn (27.53%) and their occurrence diminished in winter (15.94%). Largest number of species was collected from Lahore City and its neighboring areas (42.85%), which was followed by the district of Rawalpindi (35.71%), the other five districts exhibited a poor distribution of species (2.85-5.71%). *Euglena* Ehrenberg with its 42 species occurred most commonly (76.36%), followed by *Phacus* Dujardin with 11 species (20%), and *Trachelomonas* Ehrenberg with 2 species was the least common (3.63%). It was further observed that a vast majority of the species occurred simultaneously in planktic and benthic conditions (56.36%), while 27.27% of them were growing in purely planktic and 16.36% in epiphytic conditions.

Introduction

Punjab is the largest province of Pakistan and is rich in a variety of water bodies such as rivers, canals, irrigation channels, rice fields, lakes and rain pools. A large survey was made during 2003-2006 to collect the species of unicellular algae belonging to the phylum Euglenophycota which were taxonomically investigated (Tariq-Ali *et al.*, 2005, 2006). They were found to exhibit a great diversity of occurrence (Tariq-Ali *et al.*, 2009a). This initiated the present study, where seasonal variation and distribution of the phylum and its collected genera are being presented.

Materials and Methods

Species of the euglenoid algae were collected from various freshwater habitats in the districts of Gujranwala, Jhang, Lahore, Rawalpindi, Sargodha, Sheikhupura and Sialkot in the Punjab Province of Pakistan (Fig. 1) during December 2003 and July 2006. The types of water bodies from where collection was made, the procedure adopted for the collection, the methods used for preservation, microscopic investigation and taxonomic identification of the collected material have already been described recently (Tariq-Ali *et al.*, 2009a). They remained the same in the present study.

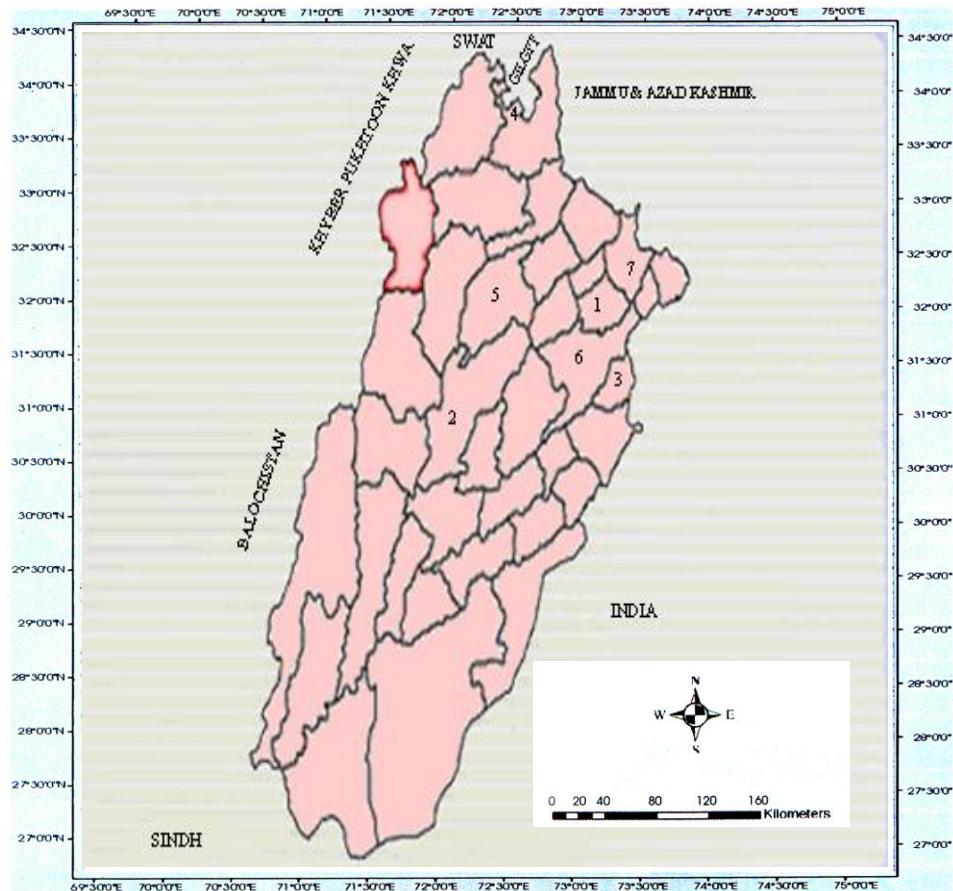


Fig. 1. Districts of the province of Punjab from where collections were made: 1. Gujranwala, 2. Jhang, 3. Lahore, 4. Rawalpindi, 5. Sargodha, 6. Sheikhupura and 7. Sialkot.

Results and Discussion

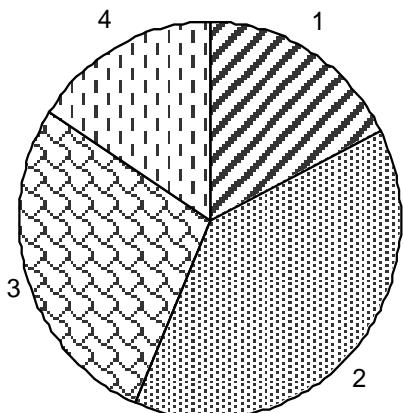
The name of the phylum as Euglenophycota has recently been developed for a group of unicellular algae (Shameel, 2008). The euglenophycotes are worldwide organisms occurring mainly in freshwater habitats, their communities are well known in small water bodies rich in organic matter. The growth rate of their biomass is only lower than those of the phyla Cyanophycota, Vovophycota, Cryptophycota and Bacillarophycota (Soylu & Gönülol, 2003; Poniewozik, 2005; Tas & Gönülol, 2007; Wolowski & Grabowska, 2007). In the present study 55 species of euglenophycotes were collected belonging to three genera: *Euglena* Ehrenberg, *Phacus* Dujardin and *Trachelomonas* Ehrenberg and were taxonomically identified. Their details have already been given previously (Tariq-Ali *et al.*, 2009a).

Seasonal variation: Most of the species were collected in summer (39.13%), the frequency of their occurrence was low during autumn (27.53%) which decreased in spring (17.39%). During winter their occurrence diminished as 15.94% (Fig 2a). *Euglena*

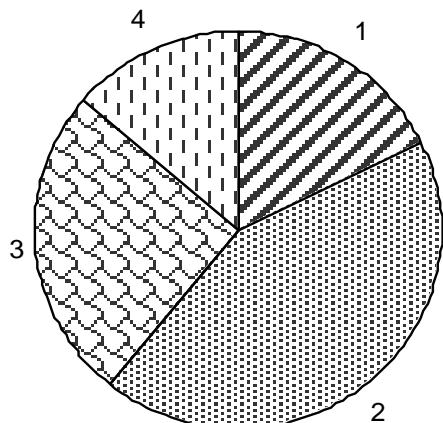
followed exactly the same pattern of seasonal variation (Fig. 2b), as was shown by the phylum in general. *Phacus* slightly differed from this plan, which occurred in the largest proportion in autumn (37.5%) and was found in a lower proportion in summer (31.25%). Its frequency of occurrence in winter and spring (Fig. 2c) was similar to that of the phylum *Trachelomonas* was only collected during winter (Fig. 2d). It was also found to grow abundantly in winter in the Suriyar Dam Reservoir of Turkey (Atici, 2002) and the Siemianówka Reservoir of Poland (Wolowski & Grabowska, 2007). Species of *Euglena* were more spread and abundant during summer than those of *Phacus* and *Trachelomonas* in the rivers of Karasu (Firat) and Yeşhrmak (Tokat) of Turkey (Soylu & Gönülol, 2003). But in Lake Cernek of Turkey, *Euglena* was very prevalent in summer and *Trachelomonas* in autumn (Tas & Gönülol, 2007). The euglenophycotes dominated the phytoplankton population during summer in the lake of Licheńskie and Ślesińskie of Poland (Napiórkowska-Krzbietke, 2009). They were more abundant in the dry season than the wet one in Minichinda Stream of Nigeria (Davies *et al.*, 2009). Their diversity and composition in the Niger Delta water bodies was found to vary seasonally with peak in dry season (Yakubu *et al.*, 2000). It appears that they exhibit different pattern of seasonal variation in different water bodies, depending on their ecological conditions.

Locality distribution: The species of Euglenophycota were collected from 7 different districts of the Punjab, among them the greatest proportion of the collections (42.85%) was made from Lahore City and its neighboring areas (Fig. 3a). In other studies also the largest collections of algae were obtained from this district regarding members of the phyla Cyanophycota (Naz *et al.*, 2009), Bacillarophycota (Tariq-Ali *et al.*, 2009b), Chlorophycota, Charophycota and Vaucherophycota (Zarina *et al.*, 2009). It is due to several water bodies such as canals, tubewells, reservoirs and fountain-displaying areas at Lahore (Husna *et al.*, 2005; Shahnaz *et al.*, 2007). The smallest portions of the collection were found in the districts of Jhang and Sargodha (2.55% each). In some previous studies also the poor growth of algae was recorded in these districts (Masud-ul-Hasan & Batool, 1987; Zarina *et al.*, 2010). *Euglena* followed the same pattern of locality distribution (Fig. 3b) as was exhibited by the phylum. *Phacus* was collected only from 3 districts (Fig. 3c) and *Trachelomonas* was found in one district only (Fig. 3d). These three genera showed great variation in the locality distribution at River Yeşhrmak in Turkey (Soylu & Gönülol, 2003).

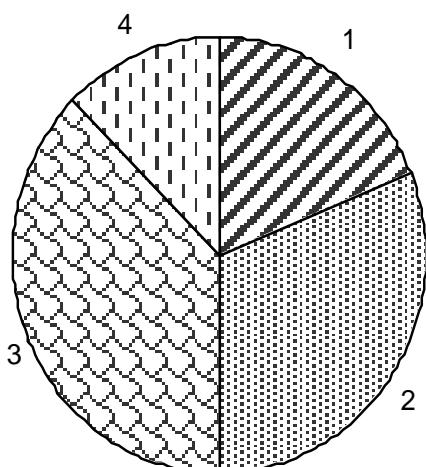
Species distribution: *Euglena* with its 42 species was found most commonly (76.36%), *Phacus* occurred with 11 species (20%) and *Trachelomonas* with 2 species was least common (3.63%) in the Punjab (Tariq-Ali *et al.*, 2009a). Euglenophycotes are very tolerant to pollution, quickly respond to environmental changes of organic pollution level (Wolowski & Grabowska, 2007). Several taxa have been collected which showed that they are largely restricted to eutrophic and hypertrophic conditions (Cooper, 2001; Visitación *et al.*, 2009). Among them *Euglena* occurred most commonly in several water bodies, such as Arkansas (Meyer *et al.*, 1970), River Yeşhrmak in Turkey (Soylu & Gönülol, 2003), Lake Cernek of Turkey (Tas & Gönülol, 2007), Minichinda Stream of Nigeria (Davies *et al.*, 2009) and Rodriguez Stream in Argentina (Visitación *et al.*, 2009) *etc.* In some other water bodies the species of *Trachelomonas* were found as most prevalent *e.g.* Saryar Dam Reservoir in Turkey (Atici, 2002), Siemianówka Reservoir in Poland (Wolowski & Grabowska, 2007) and lakes of Licheńskie and Ślesińskie of Poland (Napiórkowska-Krzbietke, 2009). It appears that different genera behave differently in their species distribution depending on the localities and ecological conditions.

a. *Euglenophycota*

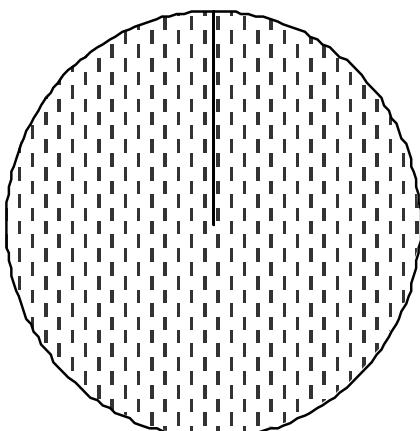
1= Spring (17.39%), 2= Summer (39.13%)
 3= Autumn (27.53%), 4= Winter (15.94%)

b. *Euglena*

1= Spring (17.64%), 2= Summer (43.13%)
 3= Autumn (25.49%), 4= Winter (13.72%)

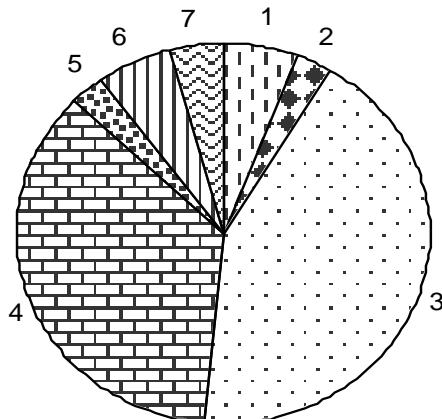
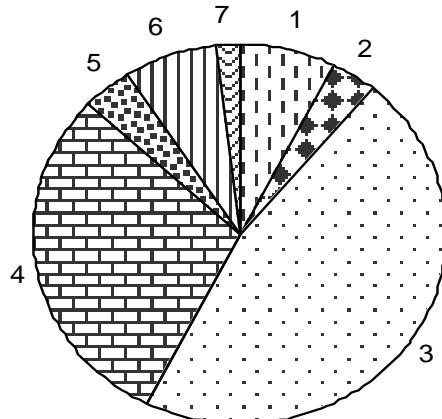
c. *Phacus*

1= Spring (18.75%), 2= Summer (31.25%)
 3= Autumn (37.50%), 4= Winter (12.50%)

d. *Trachelomonas*

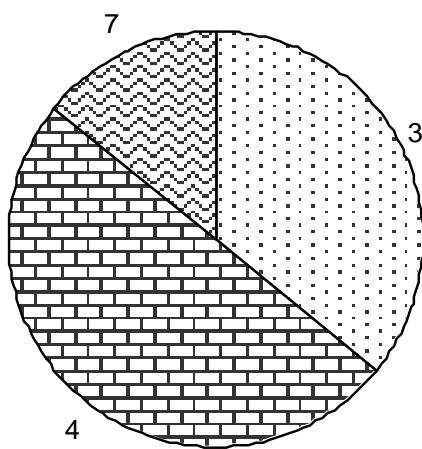
1= Spring (---), 2= Summer (---)
 3= Autumn (---), 4= Winter (100%)

Fig. 2. Seasonal variations of the *Euglenophycota* and its component genera in the Punjab.

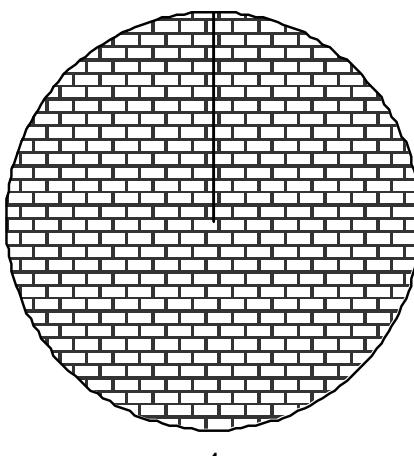
a. *Euglenophycota*b. *Euglena*

1= Gujranwala (5.71 %), 2= Jhang (2.85 %),
 3= Lahore (42.85 %), 4= Rawalpindi (35.71 %),
 5= Sargodha (2.85 %), 6= Sheikhupura (5.71 %),
 7= Sialkot (4.28 %)

1= Gujranwala (7.4 %), 2= Jhang (3.7 %),
 3= Lahore (46.3 %), 4= Rawalpindi (29.6 %),
 5= Sargodha (3.7 %), 6= Sheikhupura (7.4 %)
 7= Sialkot (1.9 %)

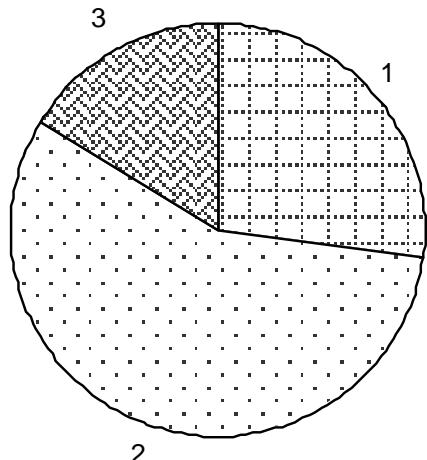
c. *Euglenophycota*

1= Gujranwala (---), 2= Jhang (---),
 3= Lahore (35.7 %), 4= Rawalpindi (50%), 5= Sargodha (---), 6= Sheikhupura (-),
 7= Sialkot (14.3 %)

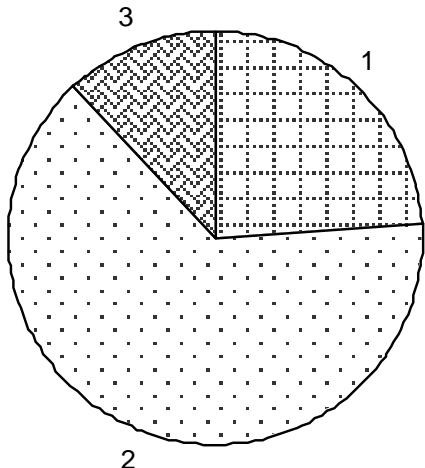
d. *Trachelomonas*

1= Gujranwala (---), 2= Jhang (---),
 3= Lahore (---), 4= Rawalpindi (100 %),
 5= Sargodha (---), 6= Sheikhupura (---)
 7= Sialkot (---)

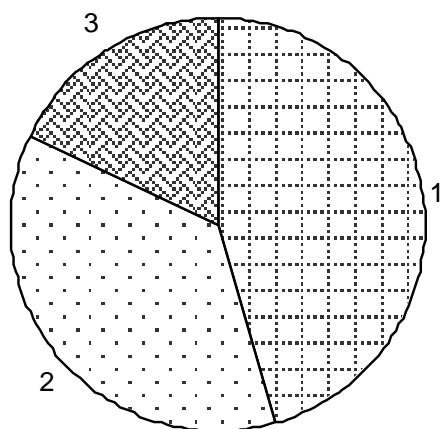
Fig. 3. Locality distribution of the Euglenophycota and its component genera in the districts of Punjab.

**a. *Euglenophycota***

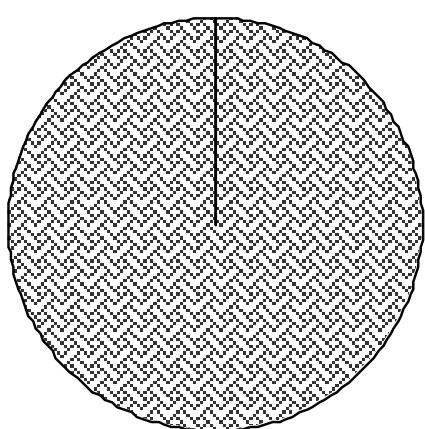
1= Planktic (27.27 %),
 2= Planktic & Benthic (56.36 %),
 3= Epiphytic (16.36 %)

**b. *Euglena***

= Planktic (23.80%),
 2= Planktic & Benthic (64.28%),
 3= Epiphytic (11.90 %)

**c. *Phacus***

1= Planktic (45.45%),
 2= Planktic & Benthic (36.36 %),
 3= Epiphytic (18.18%)

**d. *Trachelomonas***

= Planktic (---),
 2= Planktic & Benthic (---),
 3= Epiphytic (100%)

Fig. 4. Habitat distribution of the Euglenophycota and its component genera in the Punjab.

Habitat distribution: Greatest proportion of the species of Euglenophycota occurred as planktic & benthic both (56.36%) *i.e.* sometimes they were free-floating and sometimes attached with hard substrata (Fig. 4a) while 27.27% of them were purely planktic and 16.36% were epiphytic *i.e.* they were attached with macroalgae or water plants. *Euglena* followed the same proportion of distribution as that of the phylum in general (Fig. 4b), but *Phacus* contained more planktic species (45.45%) than planktic & benthic both (36.36%) and least proportion (18.18%) of epiphytic species (Fig. 4c). The species of *Trachelomonas* occurred only in epiphytic condition (Fig. 4d). *Heteronema* Dujardin and others are colourless genera, being phagotrophs with special ingestion apparatus (Poniewozik, 2005), they could not be collected in the present studies. In most of the water bodies the euglenophycotes were found to occur in the planktic condition (Cooper, 2001; Atici, 2002; Tas & Gönülol, 2007; Visitación *et al.*, 2009). They are source of food and oxygen for heterotrophs in aquatic habitats and affect directly the primary productivity by forming first circle of food chain. They also play a role in determining water pollution and cleaning waste water (Soylu & Gönülol, 2003). But inspite of their potential use as indicators of environmental conditions, little is known about their communities in large water bodies such as lakes and huge reservoirs. Being planktic, their growth and distribution depends on the carrying capacity of the environmental and on the nutrient concentration both intracellular and extracellular (Ezra & Nwankwo, 2001; Davies *et al.*, 2009).

Acknowledgement

Asstt. Professor, Department of Botany, Federal Urdu University, Karachi. We are grateful to Miss Sehar Zaidi for her kind help in composing the pie diagrams.

References

Atici, T. 2002. Nineteen new records from Sariyar Dam Reservoir phytoplankton for Turkish freshwater algae. *Turk. J. Bot.*, 26: 485-490.

Cooper, V.C. 2001. Recent name changes in eukaryotic freshwater algae. *New Zeal. J. Bot.*, 39: 601-616.

Davies, O.A., J.F.N. Abowei and B.B. Otene. 2009. Seasonal abundance and distribution of plankton of Minichinda Stream, Niger Delta, Nigeria. *Amer. J. Sci. Res.*, 2: 20-30.

Ezra, A.G. and D.I. Nwankwo. 2001. Composition of phytoplankton algae in Gubi Reservoir, Bauchi, Nigeria. *J. Aquat. Sci.*, 16: 115-118.

Husna, R., A. Zarina, Masud-ul-Hasan and M. Shameel. 2005. Taxonomic study of Cyanophyta from Lahore, Pakistan: I. Class Chroocophyceae Shameel. *Int. J. Phycol. Phycochem.*, 1: 143-150.

Masud-ul-Hasan and I. Batool. 1987. A taxonomic study of some freshwater algae from Attock and Sargodha districts. *Biologia*, 33: 345-366.

Meyer, R.L., J.H. Wheeler and J.R. Brewer. 1970. The freshwater algae of Arkansas. *Arkan. Acad. Sci. Proceed.*, 24: 32-35.

Napiórkowska-Krzelbietke, A. 2009. Diversity and dynamics of phytoplankton in lakes Licheńskie and Ślesińskie in 2004-2005. *Arch. Pol. Fish.*, 17: 253-265.

Naz, S., A. Zarina, Masud-ul-Hasan and M. Shameel. 2009. Diversity of Cyanophycota in the north-eastern areas of Pakistan. *Proc. Pak. Acad. Sci.*, 46: 29-40.

Poniewozik, M. 2005. Some *Heteronema* species (Euglenophyta) occurring in Lęczna-Włodawa Lakeland (eastern Poland). *Act. Soc. Bot. Pol.*, 74: 323-327.

Shahnaz, A., A. Zarina, Masud-ul-Hasan and M. Shameel. 2007. Survey of some Volvocophyta Shameel from Lahore, Pakistan. *Int. J. Phycol. Phycochem.*, 3: 205-212.

Shameel, M. 2008. Change of divisional nomenclature in the Shameelian Classification of algae. *Int. J. Phycol. Phycochem.*, 4: 225-232.

Soylu, E.N. and A.G. Gönülol. 2003. Phytoplankton and seasonal variations of the River Yeşihrmak, Amasya, Turkey. *Turk. J. Fish. Aquat. Sci.*, 3: 17-24.

Tariq-Ali, S., Masud-ul-Hasan and M. Shameel. 2005. Taxonomic study of the genus *Phacus* Dujardin (Euglenophyta) from Lahore and Sialkot districts of Pakistan. *Int. J. Phycol. Phycochem.*, 1: 173-176.

Tariq-Ali, S., A. Zarina, Masud-ul-Hasan and M. Shameel. 2006. Diversity of the genus *Euglena* Ehrenberg from certain areas of the Punjab, Pakistan. *Int. J. Phycol. Phycochem.*, 2: 17-32.

Tariq-Ali, S., Masud-ul-Hasan and M. Shameel. 2009a. Diversity of Euglenophycota in the Punjab, Pakistan. *Int. J. Phycol. Phycochem.*, 5: 183-190.

Tariq-Ali, S., Masud-ul-Hasan and M. Shameel. 2009b. Diversity of the genera of pinnate diatoms in the Punjab, Pakistan. *Pak. J. Bot.*, 41: 2551-2561.

Tas, B. and A. Gönülol 2007. An ecological and taxonomic study on phytoplankton of shallow lake, Turkey. *J. Environ. Biol.*, 28: 439-445.

Visitación, C., E. Ohira and N. Gómez 2009. Euglenophyta from a stream of Pamoean plain subjected to anthropic effects: A Rodriguez, Buenos Aires, Argentina. *Algol. Stud.*, 131: 63-86.

Wolowski, K. and M. Grabowska. 2007. *Trachelomonas* species as the main component of the euglenophyte community in the Siemianówka Reservoir (Narew River, Poland). *Ann. Limnol. -Int. J. Lim.*, 43: 207-218.

Yakubu, A.F., F.D. Sikoki, J.F.N. Abowei and S.A. Hart. 2000. A comparative study of phytoplankton communities of some rivers, creeks and borrow pits in the Niger Delta Area. *J. Appl. Sci. Environ. Manag.*, 4: 41-46.

Zarina, A., Masud-ul-Hasan and M. Shameel. 2009. Diversity of freshwater green macro-algae in the Punjab and neighboring areas of Pakistan. *Pak. J. Bot.*, 41: 271-291.

Zarina, A., S. Naz, and M. Shameel. 2010. Distribution of freshwater blue-green algae (Cyanophyta) in northeastern Pakistan. *Int. J. Algae*, 12: 257-270.

(Received for publication 17 January 2010)