International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 01-10-2020; Accepted: 15-10-2020; Published: 05-11-2020
Volume 2; Issue 4; 2020; Page No. 322-327

Diversity of nostocaceae (Cyanophyceae) of gossaigaon subdivision, Kokrajhar District, Assam, India

Runuma Rabha Basumatary[1], Ranee Das[2]
[1] Department of Botany, University of Science and Technology, Meghalaya Kling Road, Baridua, Ri-Bhoi, Meghalaya, India
[2] Department of Botany, University of Science and Technology, Meghalaya Kling Road, Baridua, Ri-Bhoi, Meghalaya, India

Abstract
Gossaigaon is a subdivisional area of Kokrajhar district which is escaped attention of algal diversity by botanical researchers. The present studies was carried out on the diversity of family Nostocaceae, (cyanophyceae or blue green algae) during June 2017 to July 2018 (for one year) and a total 33 species were identified. However, it has attempt to explore the algal biodiversity systematically taking consideration on morphological characters. Among the identified species, *Anabaena* carried highest number (14) followed by *Nostoc (8), Cylindrospermum (6), and Anabaenopsis, Wollea, Pseudanabaena* and *Aulosira represent by single species*. Cyanophyceaen flora are sensitive to nutrient enrichment. It was found that the seasonal variation is a special character among these algae. *Anabaena azollae* is common and present in any kind of habitat water.

Keywords: morphology, nostocaceae, diversity, Gossaigaon subdivision.

1. Introduction
Blue green algae or Cyanophyceae are pioneer oxygenic phototrophic organisms on earth .They can grow well either in nutrient rich or at low nutrient concentrations (Philipose,1960; Munawar, 1970b; Fogg, 1975) [10, 9]. Nostocaceae is a family of cyanophyceae which are simple filamentous heterocystous for which they can fix nitrogen symbiotically with fungi, lichen, mosses and ferns. As nitrogen fixing organisms in the environments, they can increasing yield of many crop plant (Song *et al* 2005) [14]. Though it is simple or primitive in cellular organization, they are very important groups for soil fertilization. They can grow and survive in all kinds of terrestrial and aquatic ecosystems for their adaptability to any kind of environmental conditions and stresses (Castenholz, and Waterbury, 1989; Tandeau de Marsac and Houmard, 1993; Potts, 1999) [4, 16, 11]. PH, carbondioxide, organic matter, alkalinity, nitrates and phosphates are important factors in their distribution. Cyanophyceaen algae used as indicator of pollution and biodegrading organisms (Subramanaian and Uma, 1996) [15]. The present literature reveals that there are many workers in this field in Assam (Buragohain and Yasmin, 2014; Yasmin *et al*, 2015; Gurumayum and Senapati, 2017; Dihingia and Baruah, 2017; Barman *et al*, 2015; Sarma and Rout, 2017) [3, 7, 8, 6, 2, 13].

2. Matrials and Methods
The present study was carried out in Gossaigaon subdivision under Kokrajhar district, Assam. The area is situated at the latitude of 26. 4371 °N and longitude 89. 9767 ° E. The maximum average temperature of the area is 30.18°C and minimum is 18.94°C. The average rainfall is 297.93 mm.
The algal samples were collected from all kinds of habitat water both from polluted and non-polluted water bodies like ponds, ditches, beels,steams & rivers,rice fields during the study period covering all seasons. The samples were collected into a proper labelled vials with habitat water to its 1/3 capacity. At the same time the other important characters like, their occurrence, habitats, color and nature were noted down in note book. Identification were done with the help of the monographs of Desikachary (1959) [5]. Anand (1989) [1]. And Prescott (1962) [12].At the same time the microphotographs were taken by Nikon camera.

3. Results and discussion
A total 33 cyanophyceaen algal species belonging to 6 genera under the family Nostocaceae were identified during study periods. All of them are simple filamentous heterocystous forms**.** Maximum number of species were reported from *Anabaena* (12 species), followed by *Nostoc* (8 species), *Cylindrospermum* (6 species), Rest were carried by single species i.e *Anabaenopsis*, *Aulosira* and *Pseudanabaena*. *Anabaena* sp. was reported as dominant species. Their morphotaxonomic characters description are given below-

Division Cyanophyceae
Order Nostocales
Family Nostocaeae
Genus Anabaenopsis

1. Species: *Anabaenopsis circularis* Wolosz. Et Miller (Plate I, Fig.1) Desikachary, Cyanophyta, 354, 1959. Trichome free swimming, spirally coiled with, with 1-1 ½ spirals, 4.0-5.2 µm broad; cells spherical with granuoles; heterocysts spherical.
Habitat: Planktonic in pond; locality-Gossaigaon; collection no-29, 53

2. Species: *Cylindrospermum alatosporum* Fritsch (Plate I,Fig.2)Desikachary , Cyanophyta ,362 ,pl. 64 ,fig. 9 , 1959 Thallus thin trichome 3.2- 3.6 µ m broad ; cells barrel-shaped as long as broad ; heterocysts ellipsoidal , 4.3 µ long and 7.7-10.5sadµm long ;spores single ,sometimes in a row, 10-21 µm

broad and 20-30 µ m long . Habitat: On Deeping rocks in temporary rain water; locality-Gossaigaon; collecting no-129

3. Species: *Cylindrospermum mucicola* Kützing ex Born.et Flah. (Plate I, Fig.3) Desikachary, Cyanophyta, 366, pl. 65,fig.3,1959.Anand, Handbook of Blue-Green Algae,49, fig.149,1989. Thallus expanded, mucilaginous; trichomes 3.0-4.4µm broad, constricted at the cross-walls; cells cylindrical; heterocysts oblong; spores oval, 8.2-10.8µm broad, 10.0- 18.5µm long. Habitat: Moist soil (rice field); locality-Gossaigaon; collecting No-87

4. Species: *Cylindrospermum gorakhpurense* Singh, RN (Plate I, Fig.4) Desikachary, Cyanophyta, 363, pl. 74, fig. 4, 1959.
Trichome blue green, single, constriction at the cross walls,3.2-5 µm broad; cells cylindrical; heterocysts ellipsoidal, one at each end of the trichome; spores ellipsoidal with rounded apex 6.4-7.9µm broad, and 13.5-17.0µm long,yellowish brown, outer membrane provided with a delicate needle shaped projections.
Habitat: Paddy field, and ditches; locality-Saraibil, Gossaigaon; collecting no-93, 41

5. Species: *Cylindrospermum musicola var. kashmiriensis* Bharadwaja (Plate I, Fig.5) Desikachary, Cyanophyta, 367, pl. 64, figs. 3,5,12, 1959**.** Thallus mucilaginous ,thin ,bluish-green; trichomesslightly constricted at the joints, cells barrel shaped,2.1-2.8 µm broadand2.4-6.8 µ m long ,heterocysts one at either end,ellipsoidal,3-4.6µm broad and 5.4-10µ m long; spores adjoining to heterocysts ,5.4-8.00 µ broad and 9-12.60 µm long .
Habitat: Temporary pond; locality -Saraibil; collecting no-51

6. Species: *Cylindrospermum stagnale* (Kütz) Born.et Flah. (Plate I, Fig.6) Desikachary, Cyanophyta, 363, pl.65 fig.9.1959; Anand, Handbook of Blue-Green Algae, 49, fig. 150, 1989.
Thallus attached or free floating , trichomes 3.3-4.0µm broad , constricted at the cross walls ; cells cylindrical , heterocysts sub spherical 5.6-6.3 µm broad10.4-15.9 µm long ; spores cylindrical with rounded ends, 10.2-16.5 µm broad and 32.8-36.7 µm long.
Habitat: On moist soil (rice field); locality-Gossaigaon; collecting No-123

7. Species: *Cylindrospermum stagnale f. variabilis* Prasad (Plate I, Fig.7) Desikachary, Cyanophyta, 364, pl. 64, fig. 1, 1959**.**
Thallus mucilaginous, light blue green, forming mat; trichomes 2.6-3.8 µm broad, constricted at the cross walls; heterocyst both ends of filaments, cylindrical, spores elongate formed singly, 6.5-14.6µ broad and 10.6-24.8 µm long. Habitat: Floating in rice fields; locality- Gossaigaon; collecting No-30

Division Cyanophyceae
Order Nostocales
Family Nostocaeae
Genus Wollea

8. Species: *Wollea* bharadwajae *Singh*, RN. (Plate I, Fig.8) Desikachary, Cyanophyta, 372, pl. 73, fig .1, 1959.
Trichome 5-5.9 µ m broad ; cells barrel shaped ;heterocysts 6-7 µ m broad ; spores 10.2- 12.5 µ m broad and 12- 12.8 µ m long , formed in a rows of three on either side of the heterocyst .
Habitat: Free floating on paddy; locality- Gossaigaon; collecting no -88, 73

Division Cyanophyceae
Order Nostocales
Family Nostocaeae
Genus *Nostoc*

9. Species: *Nostoc calcicola* Brevisson ex Born. et Flah. (Plate I, Fig.9) Desikachary, Cyanophyta, 384, pl. 68, fig.1,1959; Anand, Handbook of Blue- Green Algae, 49, fig. 151,1989.
Thallus mucilaginous, filament loosely entangled; sheath indistinct ,colorless; trichome 2.7µm broad ,pale blue green ; cells barrel shaped;heterocysts subspherical, 3.4µm broad ; spores subspherical ,4.2-5µm broad . Habitat-paddy fields; locality - Gossaigaon, Grahampur, Saraibil; collecting no -6, 32, 38

10. Species: *Nostoc carneum* Ag. Ex Born. et Flah. (Plate I, Fig.10) Desikachary, Cyanophyta, 381, pl. 69, fig.6, 1959; Anand, Handbook of Blue-Green Algae, 49, fig. 152, 1989.
Thallus leathery, irregularly expanded, gelatinous; filaments loosely contorted, flexuous; sheath indistinct, colorless; trichome 3.2-3.7 µm broad; cells upto twice as long as broad; heterocysts oblong; spores oval to ellipsoidal. Habitat-on moist soil, floating in pond; locality- Gossaigaon; collecting no-28,151

11. Species: *Nostoc commune* Vaucher ex Born. et Flah**.** (Plate I, Fig.11) Desikachary, Cyanophyta, 387, pl. 68, fig.3, 1959; Anand, Handbook of Blue-Green Algae, 49, fig. 153, 1989.
Thallus gelatinous, membranous or leathery, sometimes irregularly torn,blue green; filaments entangled;sheath distinct at the periphery,; trichome 4.0-5.4µm broad,cells short barrel shaped; heterocysts spherical; spores as big as vegetative cells.
Habitats-on moist soil at the edge of beel; locality- Grahampur; collecting no-43

12. Species: *Nostoc hetei* Dixit (Plate I, Fig.12) Desikachary, Cyanophyta, 389, pl. 67, fig.2 Thallus spherical; trichomes 3.2-5.6µm broad, irregularly curved and densely entangled; heterocysts single, or in short chains, spherical; spores not seen.
Habitat-stagnant water with submerged plants in rice field; locality-Grahampur, Saraibil, Gossaigaon; collecting no-26, 46 109, 24, 19

13. Species: *Nostoc linkia* Bornet ex Born, ET Flah. (Plate I, Fig.13) Desikachary, Cyanophyta, 377, pl.69, fig.4, 1959; Anand, Handbook of Blue-Green Algae, 49, fig. 157, 1989.
Thallus varying in size; filaments densely entangled, flexuous or highly coiled; sheath colourless; trichomes 3.2-3.8 µm broad; cells short barrel shaped; heterocysts subspherical; spores subspherical. Habitat-attached with other algae and submerged plant in rice fields; locality - Grahampur, Gossaigaon; collecting no- 56, 141

14. Species: *Nostoc linkia var. arvense* Rao, C.B. (Plate I, Fig.14) Desikachary, Cyanophyta, 377, pl. 67, fig. 1, 1959.
Thallus gelatinous, filaments numerous ;trichomes 4-4.8 µm broad , cells spherical or barrel shaped , 4.4-5.2 µm long ; heterocysts spherical 4.9-7 µm broad ; spores in long chains .
Habitat-on moist soil in rice fields; locality- Gossaigaon; collecting no- 27, 61

15. Species: *Nostoc muscorum* Ag. Ex Born. ET Flah. (Plate I, Fig.15) Desikachary, Cyanophyta, 385, pl. 70, fig. 2, 1959.
Thallus irregularly expanded, filaments densely entangled; trichomes with no definite mode of arrangement, cell 4.3 µm broad, 3.4 µm long; heterocysts spherical, 4.2-5.6 µm broad and 5.5-6.8 µm long; spores oblong, many in series. Habitat-free floating in rice fields; locality -Gossaigaon, Saraibil, Grahampur; collecting no-116, 33, 63,

16. Species: *Nostoc punctiforme* (Kütz) *Geitler* Hariot. (Plate I, Fig.16) Desikachary, Cyanophyta, 374, pl. 69, fig. 1, 1959.
Thallus globose, attached, densely entangled; sheath hyaline; trichome 3.2- 3.8 µm broad, cells barrel shaped, blue green, heterocysts 4- 6 µm broad. Habitat -on moist soil of rice field; locality-Grahampur; collecting no-203

Division Cyanophyceae
Order Nostocales
Family Nostocaeae
Genus *Anabaena*

17. Species: *Anabaena ambigua* Rao, C. B. (Plate II, Fig.17) Anand, Handbook of Blue-Green Algae, 45, fig.129, 1989.
Trichomes completely enclosed in mucilaginous envelope or sheath ; ensheathed trichomes free floating ,generally occurring single,occasionally in dense clusters, 10.8- 48.8 µm broad ;trichomes straight;cells barrel shaped with deep contrictionat the joints 4.2-6 00µm broad and 3.2-4.9µm long heterocysts spherical broader than normel cell; spores ellipsoidal .
Habitat-free floating on paddy field; locality-Grahampur, Gossaigaon; collecting no -60,208

18. Species: *Anabaena anomala* Fritsch. (Plate II, Fig.18) Desikachary, Cyanophyta,398, pl. 73, fig. 2, 1959; Anand, Handbook of Blue-Green Algae,45, fig. 130, 1989.
Trichomes moniliform; apical cell rounded, obtuse apex; cells 3.0-3.4µm broad; heterocysts rare, intercalary, single, spherical, 3.5-5.7µm broad; endospore thin.
Habitat-floating in rice fields; locality-Grahampur, Gossaigaon; colecting no-11,212

19. Species: *Anabaena azollae* Strasburger. (Plate II, Fig.33) Prescott, Algae of Western Great Lakes, 515, pl. 115, fig. 12,13, 1982. Trichome endophytic, inhabiting inside the tissues of *Azolla pinnata* Wiled; cells spherical to sub globose, 3.6-4.2µm broad and 4.7-5.8µm long; heterocysts ovate, 4.0-4.6µm broad and 6.2-6.4-µm long; akinates ellipsoidal.
Habitat-endophytic in the leaf of *Azolla pinnata* on rice fields and common in any other water body; locality-Gossaigaon, Saraibil, Grahampur; colecting no-67, 120, 75, 23,185

20. Species: *Anabaena circinalis Rabenhorst* ex Born. et Flah. (Plate II, Fig.19) Desikachary, Cyanophyta, 414, 1959.
Trichomes circinate, seldom straight; cells barrel-shaped or spherical; heterocysts subspherical, 7.6-8.8µm broad; spores cylindrical, ends rounded, 16.2-18.5µ broad and 30.4µm long, away from the heterocysts.
Habitat-planktonic in ditches; locality-Gossaigaon, Grahampur; collecting no-188, 55

21. Species: *Anabaena doliolum* Bharadwaja. (Plate II, Fig.20) Desikachary,Cyanophyta,410, pl. 78 fig. 3, 1959; Anand, Handb ook of Blue-Green Algae, 45, fig. 131, 1989.
Trichome single , straight , curved , 3.6- 4 µ m broad ; cells barrel shaped , heterocysts barrel- shaped , 5.3- 6.0µ m broad and 6.4-8.5 µ long ; spores ellipsoidal ,with pointed apices in long chains ,adjoining the heterocysts .
Habitat-ditches, pond; locality -Gossaigaon; collecting no-54, 24

22. Species: *Anabaena fertilissima* Rao, C. B. (Plate II, Fig.21) Desikachary, Cyanophyta, 398, pl. 74, fig. 1 ,1959; Anand, Handbook of Blue-Green Algae, 45, fig. 132, 1989.
Trichome single, with round end cells ; cells barrel shaped, trichome 4.6-5.8 µm broad ;heterocyst rare , intercalary ,6-7.6 µbroad ; spores in long chain , often making the whole trichome sporogenous, adjoining the heterocyst,4.6-7.6 µm broad and 3.4-7.8 µm long . Habitat -on moist soil (Ditches); locality - Gossaigaon; collecting no - 64

23. Species: *Anabaena fuellebornii* Schmidle. (Plate II, Fig.22) Desikachary, Cyanophyta, 401, pls. 71, fig. 11 and pl. 75 , figs. 1,3 , 1959. ; Anand, Handbook of Blue-Green Algae, 45, fig.133, 1989. Trichome straight or coiled ; cells cylindrical with rounded ends , 4-5 µm broad ,up to 10 µ m long ,end cell round ; heterocyst barrel shaped with round ends , 4.5-6.8 µ m broad and 10.3- 11.6 µm long ; spores on one side of the heterocyst , single or in pairs ,ellipsoidal about 9.8-14.8 µ m broad and up to 19.8 µ m long with fine spiny or papillate wall. Habitat-free floating on rain paddels, paddy field; locality- Gossaigaon; collecting No: 72, 8

24. Species: *Anabaena iyengarii* Rao.C.B. (Plate II, Fig.24) Desikachary, Cyanophyta, 408, pl. 76, fig. 5, 1959; Anand, Handbook of Blue-Green Algae,45,fig.133,1989.
Trichome single, 3.8-4.0µm broad, tapering at the ends; cells barrel shaped, as long as broad; heterocysts barrel shaped; spores ellipsoidal both sides of the heterocysts, 8.0-10.0 µm broad and 10.6-18.8µm long. Habitat-present in ponds, beel; locality: Gossaigaon, Saraibil; collecting no- 22, 66, 59

25. Species: *Anabaena iyengarii var. tenuis* Rao, CB. (Plate II, Fig.23) Desikachary, Cyanophyta, 408, pl. 76, fig.1, 1959.
Thallus free floating, pale blue green; trichomes straight,3.7-4.5µm broad; end cell conical with rounded apices; cells barrel shaped, as long as broad; heterocysts spherical, 4.9-6.8µm broad and 5.6-10.5µm long; spores ellipsoidal with rounded ends single or in pairs on either side of heterocysts, 7.8-9.5 µm broad and 9.0-19.8µm long. Habitat-present in beel, pool; locality-Gossaigaon, Saraibil; collecting no-198, 40

26. Species: *Anabaena oscillarioides* Bory ex Born.et Flah. (Pla te II, Fig.26) Desikachary, Cyanophyta, 417, pl.71, fig.7, 1959; Anand, Handbook of Blue-Green Algae, 45, fig. 137, 1989.
Thallus gelatinous; trichome 4.0-5.6µm broad; cells barrel shaped as long as broad; heterocysts spherical; spores on both sides of the heterocysts; single or 2-3, cylindrical, 6.8-8.2µm broad, 18.9-35.0µm long. Habitat-on rice fields; locality-Gossaigaon, Grahampur, Kachugaon; collecting no-7,111, 25

27. Species: *Anabaena spiroides* Klebahn. (Plate II, Fig.30) Desikachary, Cyanophyta, 395, pl. 71, fig. 9, 1959.
Ttichome single, free floating, regular spirally coiled; cells spherical; heterocyst subspherical; spores elongate, next to heterocyst. Habitat-free floating in tank; locality-Grahampur; collecting no-7, 121, 24.

28. Species: *Anabaena spiroides var. contracta* Klebahn. (Plate II, Fig.27) Desikachary, Cyanophyta, 396, 1959.
Trichome free floating , single, spiral 18.9-23.7 µm broad and 10-15.4 µm distant; cells spherical 6.2-7.6 broad, mostly shorter than broad.
Habitat-free floating on pond, ditches; locality-Gossaigaon, Grhampur, Saraibil; collecting no -11, 133, 35

29. Species: *Anabaena unispora* Gardner. (Plate II, Fig.28)
Desikachary, 403, pl. 77, fig. 1, 1959. Thallus thin; trichome intermixed with other algae, cells 3.6-4.0µm broad, and 4.4-4.8µm long ,constricted at the cross walls; heterocysts larger in size; akainetes single,ellipsoidal, developed in one side of the heterocysts, the size of the spores is variable ,12.4-13.8µm broad,and 18.9-24.7µm long. Habitat- in temporary rain water with other algaeand in pond; locality-Gossaigaon, Grahampur, Saraibil; collecting no- 44, 37, 20

30. Species: *Anabaena utermöhlii* Geitler. (Plate II, Fig.25)
Desikachary, Cyanophyta, 415, pl. 74, fig.2, 1959. Trichomes single, free floating, often regularly , sometimes irregularly spirally coiled; spirals 17-28.7µm broad; sometimes uncoiled; cells 3.5-4.2 µm broad,4.2-5.4µm long; heterocysts elongate; spores bent, on both sides of the heterocysts, 7.2-8.0µm broad, 18.2-19.8µm long. Habitat-free floating on pond; locality-Gossaigaon; collecting no-79, 13

31. Species: *Anabaena variabilis* Kützing ex Born. ET Flah. **(**Plate II, Fig.29) Desikachary, Cyanophyta, 410, pl. 71, fig.5, 1959.
Thallus thin, gelatinous; trichome 3.0-4.5 µm broad, constricted at the cross walls, end cell conical; cells barrel- shaped; heterocysts spherical; spores formed centrifugally in catenate series, away from heterocysts,oblong ,yellowish brown in colour. Habitat- attached on damp walls; locality- Gossaigaon; collecting no-70, 12

Division Cyanophyceae
Order Nostocales
Family Nostocaeae
Genus Pseudanabaen

32. Species: *Pseudanabaena schmidlei* Jaag.O. (Plate II, Figs.31 32) Desikachary, Cyanophyta, 219, pl. 75, fig. 4, 1959. Thallus free floating , blue green; trichomes 5.6- 7.0µm broad, up to 300 µm long; cells more or less as long as broad . Habitat-free floating in any stagnant water, beel, rice field; Locality-Grahampur, Gossaigaon; collecting no-201,208,113

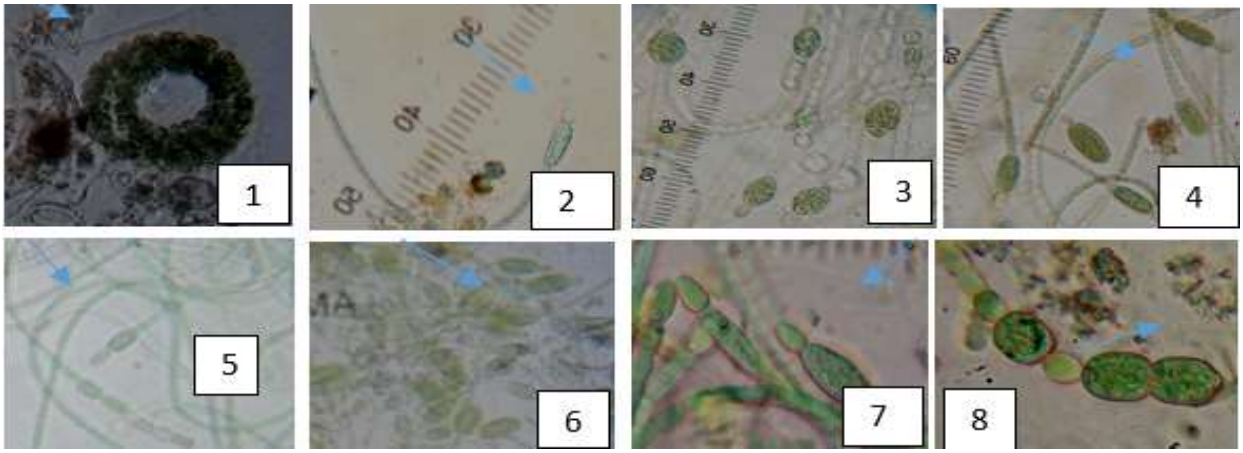
Division Cyanophyceae
Order Nostocales
Family Nostocaeae
Genus Aulosira

33. Species: *Aulosira fritschii* Bharadw. (Plate II, Fig. 34)
Desikachary, Cyanophyta, 432, pl. 80, figs. 7-12, 1959. Filaments unbranched, 19.5-15.8 µm broad, straight; sheath hyaline; trichome constricted at the cross walls; cells longer than broad; heterocyst single and intercalary, cylindrical; spores in long chains formed centrifugally interrupted by vegetative cells.
Habitat -in pond with other submerged plants; locality –Saraibil; collecting no- 58

4. Conclusions

The present study has identified a total 34 cyanophycean species from different habitat water of Gossaigaon subdivision. All species were heterocystous filamentous and belongs to 7 genera. Among these taxa *Anabaena* carried highest no (13), followed by *Nostoc* (9), *Cylindrospermum* (6) and *Anabaenopsis*, *Wollea*, *Aulosira* and *Pseudanbaena* represent by single species.
The study has reported that the area is rich in cyanobacterial population which are veryimportant for the growth and yields of rice crop particularly in this area.
Lastly it can be concluded that these heterocystous filamentous algae increase the soil fertility by adding N_2 into the soil naturally.

Photographic Plate I



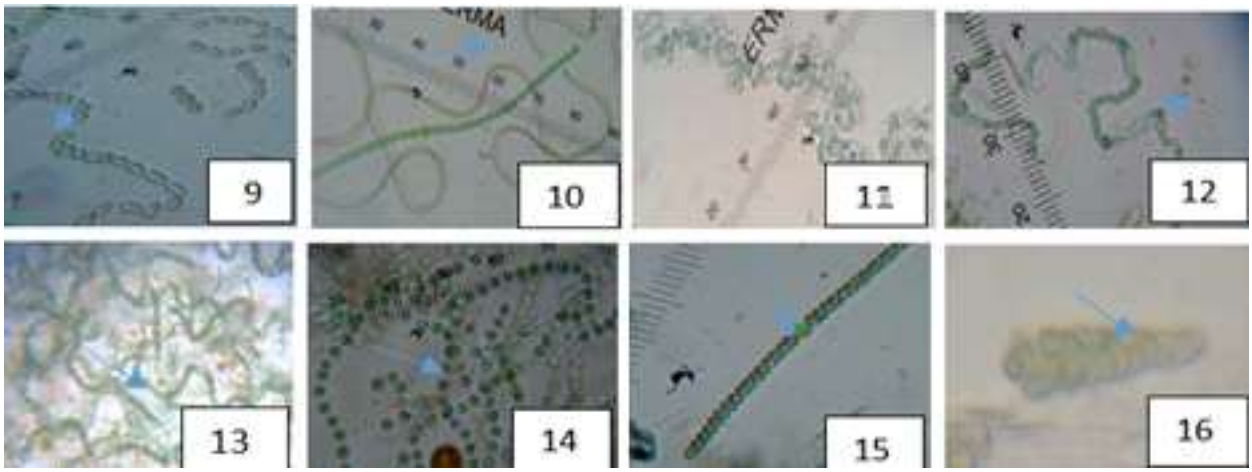


Fig 1: *Anabaenopsis circularis* Wolosz. Et Mille, 2) *Cylindrospermum alatosporum* Fritsch , 3) *Cylindrospermum muscicola* Kützing ex Born et Flah,4} *Cylindrospermum gorakhpurense* Sing, R.N., 5) *Cylindrospermum muscicola var. kasmiriensis* Bharadw, 6) *Cylindrospermum stagnale*(Kütz) Born et Flah, 7) *Cylindrospermum stagnale f. variabilis* Prasad , 8) *Wollea bharadwajae* Sing,R. N.,9) *Nostoc calcicola* Breb.,10) *Nostoc carneum* Ag., 11) *Nostoc commune* Vaucher ex Born. ET Flah, 12) *Nostoc hatei* Dixit, 13) *Nostoc linckia* (Roth) Bornet ex Born. ET Flah, 14) *Nostoc linckia v. arvense* Rao, CB, 15) *Nostoc muscorum* Ag. Ex Born. ET Flah., 16) *Nostoc punctiforme* (Kütz) Hariot.

Photographic Plate II

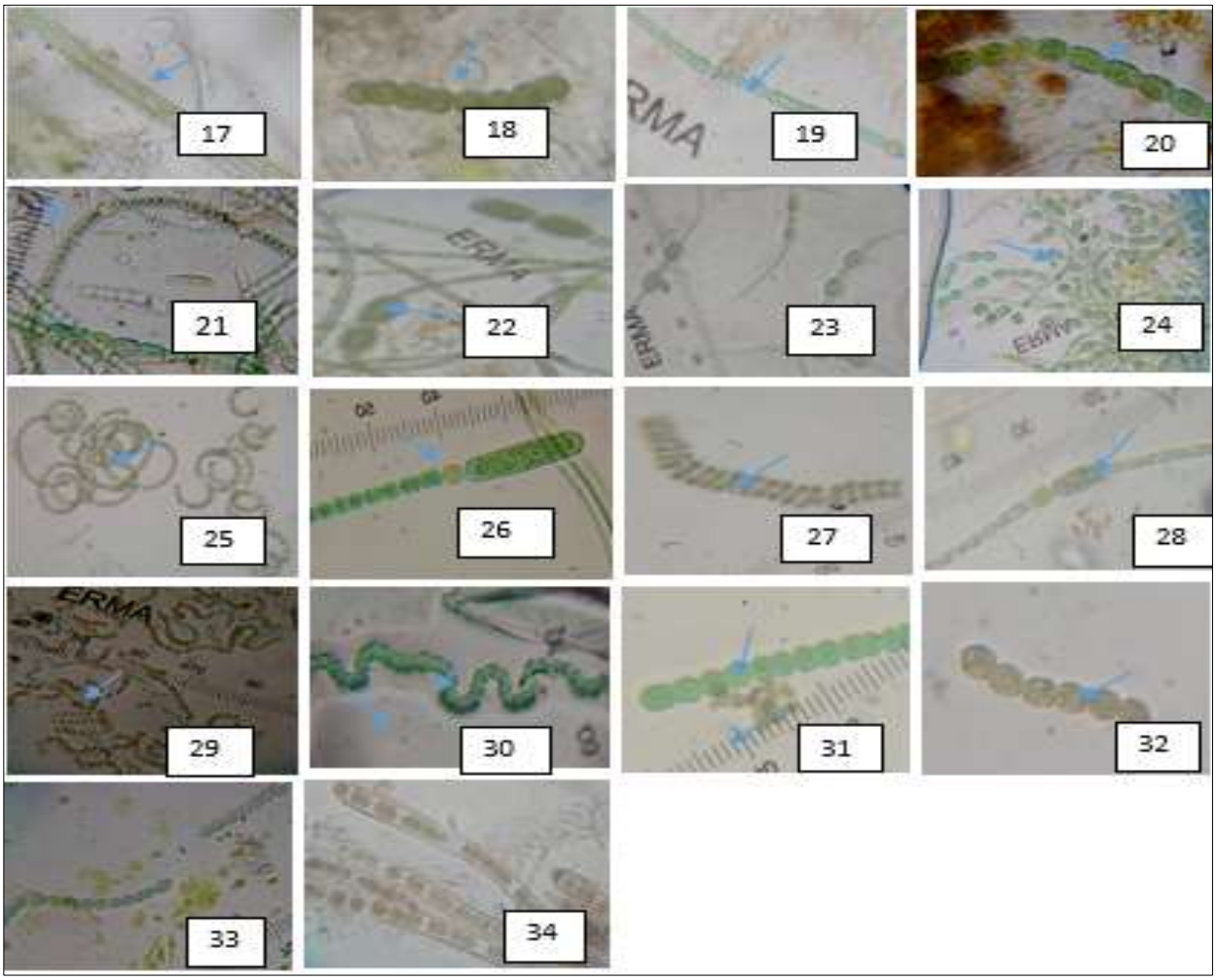


Fig 2: *Anabaena circinalis* Rabenh, 20) *Anabaena doliolum* Bharadwaja, 21) *Anabaena fertilissima* Rao, CB, 22) *Anabaena fuellebornii* Schmidle, 23) *Anabaena iyengarii var. tenuis* Rao, C.B. 24) *Anabaena iyengarii* Rao, CB, 25) *Anabaena utermöhlii* Geitler, 26) *Anabaena oscillarioides* Bory ex Born ET Flah, 27) *Anabaena spiroides var. contracta* Klebahn 28) *Anabaena unispora* Gardner, 29) Anabaena variabilis Kützing ex Born. ET Flah. 30) Anabaena spiroides Klebahn, 31&32) *Pseudoanabaena schmidlei* Jaag. O., 33) *Anabaena azollae* 34) *Aulosira fritschii* Bharadw

5. References

1. Anand N. Handbook of Blue-Green Algae (of rice fields of South India), 1989.
2. Barman D, Deka SJ, Barma B. Seasonal Diversity and Habitat characteristics of Algae of Wetlands in the West Garo Hills, Meghalaya, India. Research Journal of Recent Sciences. 2015; 4:274-279.
3. Buragohain BB, Yasmin F. Biomonitoring of Pollution by Microalgae Community in Aqutic System with Special Reference to Water Quality of River Kolong, Nagaon , Assam, India. Int J Appl Sci Biotechnol. 2014; 2(1):45-49.
4. Castenholz RW, Waterbury JB. Oxygenic photosynthetic bacteria, group E. Cyanobacteria. In Bergey's Manual of Systematic Bacteriology (Eds Staley, J. N.*et al*.)Williams and Wilkins Co, Baltimore, 1989, 1710-1728.
5. Desikachary TV. Cyanophyta. ICAR. New Delhi, 1959.
6. Dihingia J, Baruah PP. Studies on N2-fixing cyanobacterial diversity and its seasonal variation in the rice fields soils of Brahmaputra floodplain of Kamrup District Assam. Journal of Algal Biomass Utilization. 2017; (3):40-49.
7. Yasmin F, Buragohain BB, Sarma R. Aquatic Algae from Kaziranga National Park, Assam, India. International Journal of Current Microbiology and Applied Sciences. 2015; 4(12):297-302.
8. Gurumayum S, Senapati SS. Exploration of Algal Varieties from Panikhaiti Area of Guwahati using Winogradsky Column. International Journal of Current Microbiology and Applied Sciences. 2017; 6(3):1195-1204.
9. Munawar M. Limnological studies on freshwater ponds of Hyderabad India.II. The biocoenose-distribution of unicellular and colonial phytoplankton in polluted and unpolluted environments. *Hydrobiologia*. 1970; 36(1):105-128.
10. Philipose MT. Freshwater phytoplankton of inland fisheries, Proc. Symp. Algalogy. ICAR.New Delhi, 1960, 272-291
11. Potts M. Mechanisms of desiccation tolerance in cyanobacteria. Eur. J. Phycol. 1999; 34:319-328.
12. Prescott GW. Algae of the Western Great Lakes Area. 2nd WmC. Brown Company Publishers, Dubuque, Lowa, IA, 1962.
13. Sarma P, Rout J. Colonisation of Oscillatoria on submerged polythene in domestic sewage water of Silchar town, Assam (India). Journal of Algal Biomass Utilization. 2017; 8(4):135-144.
14. Song T, Martensson L, Eriksson T, Zheng W, Rasmussen U. The Federation of European Materials Societies. *Microbiology Ecology*. 2005; 54:131-140.
15. Subramanaian G, Uma L. Cyanobacteria in pollution control Journal of Science. Industrial research. 1996; 55:685-692.
16. Tandeau de Marsac, Houmard NJ. Adaptation of cyanobacteria to environmental stimuli: New steps towards molecular mechanisms. FEMS Microbiol. Rev. 1993; 104:119-190.