

# TAXONOMIC STUDIES ON THE GENUS *ZYGNEMOPSIS* (ZYGNEMOPHYCEAE SHAMEEL) FROM NORTH-EASTERN AREAS OF PAKISTAN

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**Abstract:** Six species of the genus *Zygnemopsis* (Skuja) Transeau were collected from various freshwater habitats of Gujranwala, Jhang and Sheikhpura districts of Punjab Province in Pakistan and Neelum Valley of Azad Kashmir during February to April 2004. All the species have been described for the first time from their area of collection, and most of them are first reports from Pakistan. They were found to grow in winter and spring.

**Keywords:** Algae, freshwater, Chlorophyta, *Zygnemopsis*, taxonomy, cytology, reproduction

## Introduction

*Zygnemopsis* is a comparatively recent genus of the phylum Chlorophyta, which was established by Transeau [1]. It was reported for the first time from Pakistan by Khan & Faridi [2], who described its three species from Peshawar Valley. Later on Masud-ul-Hasan [3] described its only one species from Punjab. Apart from these no other work has been done on its taxonomy from Pakistan. In a recent classification of Shameel [4], its order Zygnemales was placed together with the order Oedogoniales in the class Zygnemophyceae, which has been re-characterized [5]. During December 2003- July 2005 a large survey was made to collect algae from various freshwater habitats of the Punjab and some areas of Azad Kashmir, as a result of which several genera of the class Zygnemophyceae have been taxonomically described [6-10]. The present paper is a continuation of these studies, where a detailed taxonomic investigation of the genus *Zygnemopsis* was undertaken including several new reports from Pakistan.

## Materials and Methods

Collections were made from Gujranwala, Jhang, and Sheikhpura districts of Punjab Province in Pakistan and Neelum Valley of Azad Kashmir during February to April 2004. The specimens were obtained by hand-picking from various freshwater habitats like slow running water channels, stagnant ponds and road-side puddles. They were preserved in glass bottles containing 5 % formalin and brought to the laboratory at Karachi, where they were stained in iodine solution and examined in 10 % glycerin mounts under microscope (Zeiss, Germany). Their drawings were made with the help of camera lucida as described earlier [6]. The material was taxonomically determined with the help of authentic literature [11-13]. The voucher specimens are kept in the Phycology & Phycochemistry Lab. (Room No. 18), MAH Qadri Biological Research Centre, University of Karachi, where this research work was carried out.

## Results and Discussion

On the basis of their morphological and cytological characteristics six species of *Zygnemopsis* were identified from the collected material; the genus may be characterized as follows:

### *Zygnemopsis* (Skuja) Transeau 1934: 203

Unbranched, free floating filaments of cylindrical cells; two axial, cushion shaped or stellate chloroplasts with a central, prominent pyrenoid in each cell, sandwiching the single nucleus, embedded in the cytoplasm; conjugation scalariform or lateral; conjugating tube very wide; zygospores quadrate in shape and zygospore-wall 2-3 layered; cavity of conjugant cell surrounding the zygospores inlined with shiny colourless gel; some species produce aplanospores; mesosporium may be smooth or variously ornamented. Following six species were collected which may be distinguished as follows:

1. Reproduction by aplanospores ..... 2  
Reproduction by zygospores ..... 3
2. Aplanospores ellipsoid .....  
..... *Z. saravatiensis* (4)  
Aplanospores globose, sub-globose or quadrate ..... *Z. lahaulense* (3)
3. Zygospores cuboid with projecting corner ..... *Z. splendens* (6)  
Zygospores not as above ..... 4
4. Deposition of shiny, white, pectic lamellae in gametangia ..... *Z. indica* (2)  
No deposition of such lamellae in gametangia ..... 5
5. Zygospores up to 27  $\mu\text{m}$  in diameter .....  
..... *Z. spiralis* (5)  
Zygospores more than 27  $\mu\text{m}$  in diameter .....  
..... *Z. hesaragattense* (1)

### *Z. hesaragattense* Iyengar in Randhawa 1959: 207

*Reference:* [12: 207].

*Morphological characters:* Unbranched filaments.

*Cytological features:* Vegetative cells 11-13  $\mu\text{m}$  broad and 84-86  $\mu\text{m}$  long with two chloroplasts (Fig. 1a).

*Reproductive structures:* Conjugation scalariform; zygospores formed in very much distended conjugation canal and extending completely across both the gametangia; mesosporium granular, golden-brown; zygospores 40-42  $\mu\text{m}$  in diameter (Fig. 1b).

*Locality:* Azad Kashmir: Neelum Valley (5-4-2004).

*Geographical distribution:* Previously reported from India.

*Remarks:* It was collected in free-floating state during spring season from slow running water at Azad Kashmir. It is being reported for the first time from this area.

2. *Z. indica* Randhawa 1937: 297

*References:* [11: 55, 12: 197, 2: 75, 3: 78].

*Morphological characters:* Unbranched filaments.

*Cytological features:* Vegetative cells 14-15  $\mu\text{m}$  broad and 4-6 times longer, 90-92  $\mu\text{m}$  long; with two semi-stellate chloroplasts, each with one pyrenoid (Fig. 2a).

*Reproductive structures:* Reproduction by zygospore and aplanospore; conjugation- canal

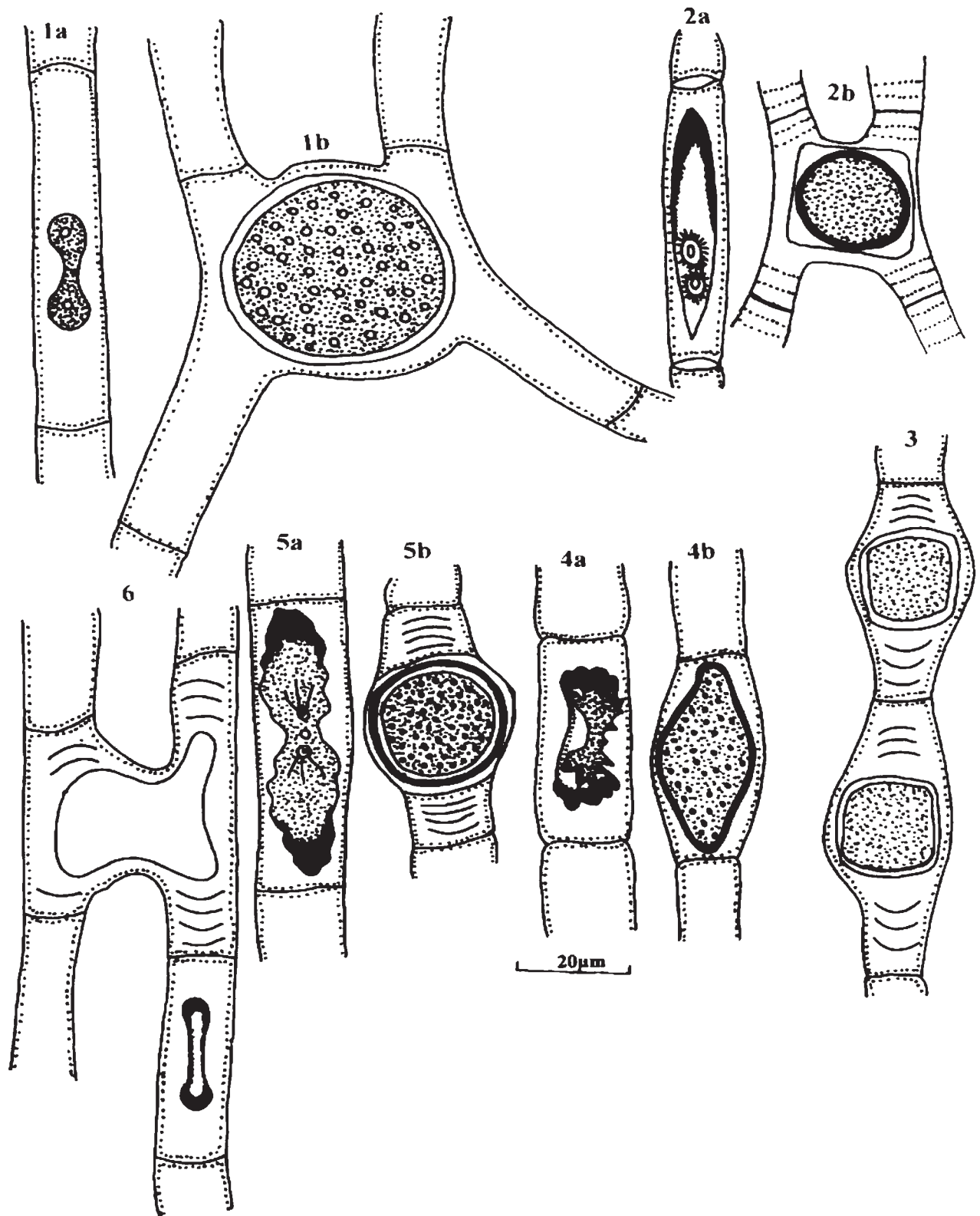


Fig. 1-6. Species of *Zygnemopsis* from Pakistan: 1. *Zygnemopsis hesaragattense*: 1a. vegetative cell, 1b. zygospore formation; 2. *Z. indica*: 2a. vegetative cell, 2b. zygospore formation; 3. *Z. lahaulense*; 4. *Z. saravatiensis*: 4a. vegetative cell, 4b. aplanospore formation; 5. *Z. spiralis*: 5a. vegetative cell, 5b. zygospore formation; 6. *Z. splendens*: zygospore formation and a vegetative cell.

wide, deposition of shiny white, pectic lamellae in gametangia; zygospores globose or quadrately-ovoid, 35-36  $\mu\text{m}$  broad and 38-40  $\mu\text{m}$  long (Fig. 2b); spore-wall verrucose; some zygospores also triangular; aplanospores smaller *i.e.* 16-17  $\mu\text{m}$  broad and 21-22  $\mu\text{m}$  long in size.

*Locality:* Gujranwala District: Nandipur (19-2-2004).

*Geographical distribution:* Previously reported from U. S. A., India and Pakistan.

*Remarks:* Collections were made in winter in free-floating state. During this period temperature remained moderate, therefore less growth appeared. It was found in vegetative as well as reproductive conditions in stagnant water ponds.

#### ***Z. lahaulense* Randhawa 1958**

*Reference:* [12: 201].

*Morphological characters:* Unbranched filaments.

*Cytological features:* Vegetative cells 13.6-16.0  $\mu\text{m}$  broad and 60-86  $\mu\text{m}$  long; with two stellate chloroplasts.

*Reproductive structures:* Reproduction entirely by aplanospores (Fig. 3); sporangia swollen on one or both sides and filled with shiny pectic material; spores globose, sub-globose or quadrate, 21-28  $\mu\text{m}$  in diameter, yellow-brown.

*Localities:* Gujranwala District: Nandipur (19-2-2004); Jhang District: Chenab near Riwaz Bridge Chund (22-2-2004).

*Geographical distribution:* Previously reported from India.

*Remarks:* Specimens were obtained from two different localities of the Punjab during winter.

They were found in stagnant water channel of Chenab River, where they occurred in limited quantity in free-floating state. In these collections conjugation stages were not observed. It is being reported for the first time from Pakistan.

#### ***Z. saravatiensis* Iyengar in Randhawa 1959: 204**

*Reference:* [12: 204].

*Morphological characters:* Unbranched filaments.

*Cytological features:* Vegetative cells 12-14  $\mu\text{m}$  broad and 68-70  $\mu\text{m}$  long (Fig. 4a); chloroplasts two, axial cushions, with a central pyrenoid.

*Reproductive structures:* Reproduction mostly by aplanospores, which are ellipsoid, 22-24  $\mu\text{m}$  broad and 33-35  $\mu\text{m}$  long (Fig. 4b).

*Locality:* Sheikhpura District: near Moranwala Village (15-3-2004).

*Geographical distribution:* Previously reported from India.

*Remarks:* The specimens were obtained from road-side puddles near a village during spring in free-floating state. The soil of Sheikhpura District is of semi-arid type. The soil at the place of collection was made of silt, clay and large proportion of sand with pH 8.0. This species is also being reported for the first time from Pakistan.

#### ***Z. spiralis* (Fritsch) Transeau 1934:214**

*References:* [11:57, 12: 199, 13: 328].

*Morphological characters:* Unbranched filaments.

*Cytological features:* Vegetative cells 16-18  $\mu\text{m}$  broad and 47-49  $\mu\text{m}$  long (Fig. 5a); each cell

contains two stellate chloroplasts.

*Reproductive structures:* Conjugation scalariform; zygospores quadrately-ovoid, 25-27  $\mu\text{m}$  broad and 46-48  $\mu\text{m}$  long (Fig. 5b).

*Locality:* Sheikhpura District: near Moranwala Village (15-3-2004).

*Geographical distribution:* U.S.A.: Wisconsin, Michigan; South Africa: Table Mountain, wet rocks on slope; India.

*Remarks:* The collection was made from roadside puddles in a village during spring season. It was found in free-floating and massive quantity in the vegetative as well as reproductive stages. It is being reported for the first time from Pakistan.

### ***Z. splendens* Randhawa 1937:297**

*References:* [11: 55, 12: 196].

*Morphological characters:* Unbranched filaments.

*Cytological features:* Vegetative cells 13-14  $\mu\text{m}$  broad and 51-53  $\mu\text{m}$  long (Fig. 6); chloroplasts two, with single pyrenoid and plane septa.

*Reproductive structures:* Conjugation scalariform; protoplasm secretes a shining white, pectic, cellulosic substance in a homogenous mass; zygospores cuboids with projecting corners, 27-29  $\mu\text{m}$  broad and 34-35  $\mu\text{m}$  long (Fig. 6).

*Locality:* Azad Kashmir: Neelum Valley (5-4-2004).

*Geographical distribution:* U.S.A.; India: Faizabad, U.P.; China.

*Remarks:* Collections have been made during spring. It occurred in massive quantity and in free-floating state in the stagnant water ponds at Azad Kashmir. This species is being reported for the first time from this area.

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