SOME NEW TAXA OF *NOSTOC* VAUCHER FROM NORTH INDIAN CROP-FIELDS

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ABSTRACT

The paper describes seven new taxa belonging to the genus *Nostoc* Vaucher, found in the course of investigations on algal flora of crop-fields of North India. Of these, there is one new species, *N. wartisporum* sp. nov., one new variety, *N. paludosum* var. *majus* var. nov., three new forms, *N. calcicola* f. *variabilis* f. nov., *N. ellipsosporum* f. *minor* f. nov., and *N. aureum* f. *variabilis* f. nov., and two new form variants, *N. calcicola forma* and *N. commune forma*.

INTRODUCTION

In the course of investigations on the algal flora of North Indian crop-fields, the authors came across a number of new taxa of blue-green algae. The taxa which are being described here have been isolated from soil-water enrichment cultures of soil samples from paddy (*Oryza sativa* L.), wheat (*Triticum aestivum* L.), mustard (*Brassica campestris* L.), 'arhar' (*Cajanus cajan* (L). Mills.) gram (*Cicer arietinum* L.) and cauliflower (*Brassica oleracea* L. var. *botrytis* L.) fields, but for one taxon *N. commune forma* which was collected from a water-logged paddy field. It is intended to describe these seven new taxa belonging to genus *Nostoc* Vaucher in the present communication.

1. Nostoc wartisporum sp. nov. (Pl. 1, Figs. 1a,b; Text-figs. 6a-d)

Colonia globosa, microscopica, libera natatio, fuscosa ; colonia mucilaga indistincta, propria vagina solita indistincta ; trichomata undulata, curvata, solide implicata, 3.0—4.0 μm latae ; cellulae ellipsoidalae vel cylindricalae, 3.0—5.0 μm longae, fere longiores quam latae ; heterocystae raro, fines vel intercalares, globosa cum prona finis, 4.0 μm in diametero ; spores oblonga vel globosa, free oblonga, et in longiora catenis, tota trichoma conversae sporogenosae, 5.5—6.5 μm latae, 7.0—8.0 μm longae, epispora pallida fuscosa cum parvae verrucae.

Habitatio—Apparentus in aqua macula locupletae culturae soli exempli ex inculto agro risi.

Coll. No.—P3. Materia dsposita ex in Collectionibus Algalibus, Lucknowense Universitati, sub numero : P3

Locus—Bangla Bazar, Lucknow.

Datum—10.8.71.

Colony spherical, microscopic, free-floating, brownish ; colonial mucilage indistinct, individual sheath usually indistinct ; trichomes undulate, curved, densely entangled, 3.0—4.0 μm broad ; cells ellipsoidal, cylindrical, 3.0-5.0 μm long, generally longer than broad ; heterocysts not common, terminal or intercalary, spherical, with ends flattened, 4.0 μm in diameter ; spores ovoid or spherical, generally ovoid in long chains, entire trichomes may become sporogenous, 5.5-6.5 μm broad, 7.0-8.0 μm long, epispore with minute warts, pale brown.

Habitat—Appeared in soil-water enrichment cultures of soil samples from a paddy field.

Coll. No.—P3. The material is deposited in the Algal Collections, Lucknow University under No: P3.

Loc.—Bangla Bazar, Lucknow.

Date—10.8.71.

In cell dimensions, this species can be compared with many species of *Nostoc* but the presence of small warts on the epispore—a strikingly characteristic feature of the present alga—has not been reported so far in any species of *Nostoc* except in *N. gelatinosum* (Schousboe) *ex* Born. *et* Flah. where spines have been reported. But it differs from *N. gelatinosum* in the dimensions of vegetative cells, heterocysts and spores. Also, frequently, minute mucilage pads are seen in between two spores (Text-figs. 6c, 8b). Hence the present alga is not comparable with any known species and is a new species of the genus to be named *Nostoc wartisporum* sp. nov.

2. Nostoc paludosum Kütz. *ex* Born. *et* Flah.

Kützing, F.T. Tab. Phycologicae, 2 : 1, pl. 1, fig. 2, 1850 ; Forti, A. in De Toni, Sylloge Algarum, 5 : 390, 1907 ; Geitler, L., Kryptogamenflora, 836, fig. 528a, 1932; Desikachary, T.V., Cyanophyta, 375, pl. 69, fig. 2, 1959.

var. **majus** var. nov. (Plate 1, Fig. 2; Text-fig. 2).

Thallus punctiformus, gelatinus, levis flavus ; vagina firma vel diffluens, distincta ad peripheriam ; trichomata 4.0—6.0 μm latae ; cellulae dispositae in sufractum viarum saepe alcem rem imminentem, lividus viridis longior quam latior, 4.0—8.0 μm longae, dolium formae ; heterocystae similes vegetativis celullis in late, leve longiores quam celullae vegetativae, 4.0—6.5 μm latae, 5.0—9.0 μm longae ; spores definitae omnino fibra conversae sporegenosae subsphericae quam oblongae, 5.5—7.0 μm latae, 6.0—10.0 μm longae, episporae leves et nudae coloris.

Habitatio—Apparentus in aqua macula locupletae culturae soli exempli ex in culto agro risi.

Coll. Nos.—P43 *et* P52. Materia deposita est in collectionibus Algalibus, Lucknowense Universitati, sub numero : P43 et P52.

Locus—Telibagh *et* Faridnagar, Lucknow.

Datum—18.8.74 *et* 10.11.74.

Thallus punctiform, gelatinous, light-yellow ; sheath firm or diffluent, distinct at periphery ; trichomes 4.0—6.0 μm broad ; cells arranged in zigzag manner, often overlapping, blue-green, longer than broad, 4.0—8.0 μm long, barrel-shaped ; heterocysts similar to vegetative cells in breadth, slightly longer than vegetative cells, 4.0—6.5 μm broad, 5.0—9.0 μm long ; spores in chains, subspherical to oblong, 5.5—7.0 μm broad, entire filament turns sporogenous, 6.0—10.0 μm long, epispore smooth and colourless.

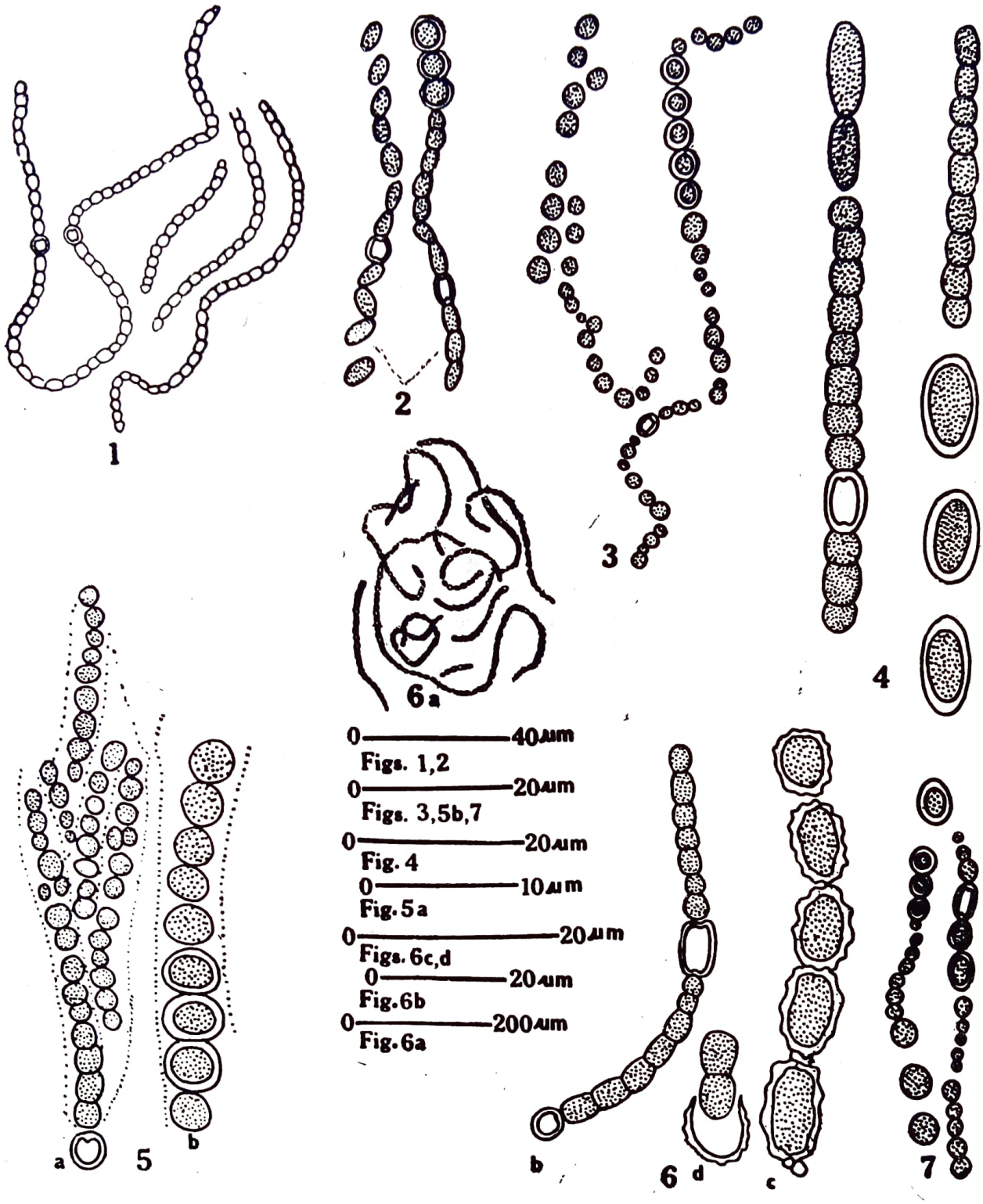
Habitat—Appeared in soil-water enrichment cultures of soil samples from paddy fields.

Coll. Nos.—P43 and P52. The material is deposited in the Algal Collections, Lucknow University under No: P43 and P52.

Loc.—Telibagh and Faridnagar, Lucknow.

Date—18.8.74 and 10.11.74.

The present variety differs from the type in possessing a light-yellow thallus, a firm sheath in the beginning which later on becomes diffluent, broader trichomes, generally barrel-shaped cells arranged in a zigzag fashion, at times overlapping, heterocysts almost similar to vegetative cells in dimensions and broader and longer sub-spherical spores.



1. *Nostoc aureum* forma *variabilis* f. nov. showing the vegetative filaments with heterocysts.
2. *Nostoc paludosum* var. *majus* var. nov. filaments with zig-zag arrangement of cells and showing spores.
3. *Nostoc calcicola forma* with vegetative cells, heterocysts and spores.
4. *Nostoc ellipsosporum* forma *minor* f. nov. filaments with vegetative cells, heterocysts and ellipsoidal spores.

5a. *Nostoc commune forma* vegetative cells with a single basal heterocyst and distinct sheath.

5b. *N. commune forma* spores in a chain.

6a. *Nostoc wartisporum* sp. nov. Habit.

6b. *N. wartisporum* sp. nov. vegetative filaments with terminal and intercalary heterocysts.

6c. *N. wartisporum* sp. nov. spores in a long chain showing warts and mucilage pad.

6d. *N. wartisporum* sp. nov. germination of akinete.

7. *N. calcicola* forma *variabilis* f. nov. filaments with varying sizes of vegetative cells and spores.

The present alga, therefore, is considered to be a new variety of *N. paludosum* to be called *Nostoc paludosum* var. *majus* var. nov.

3. Nostoc calcicola Breb. *ex* Born. *et* Flah. Geitler, L., Kryptogamenflora, 842, fig. 534, 1932 ; Desikachary, T. V., Cyanophyta, 384, pl. 68, fig. 1, 1959.

forma **variabilis** f. nov. (Pl. 1, Fig. 3; Text-fig. 7).

Thallus mucilaginus ; vagina diffluens, levem lividum-viridis, macroscopica ; proprius vagina indistincta ; trichomata 1.5—3.5 μm latae, lividum viridis ; cellulae cylindricae, oblongae, quadratio ; heterocystae longiorae et latiorae quam cellulae vegetativae, intercalares, 2.0-4.0 μm in linea media, spores subglobosi in difinitae emnine fibrae longae vel breves, 5.0-7.0 μm in linea media, episporae leves et nudae coloris.

Habitatio—Apparentus in aqua macula locupletae culturae soli exempli ex inculto agro sinopi (*Brassica campestris*).

Coll. No.—Ml. Materia deposita est in collectionibus Algalibus, Lucknowense Universitati, sub numero : Ml.

Locus—Gosainganj.

Datum—19.2.72.

Thallus mucilaginous, sheath diffluent, pale blue-green, macroscopic ; individual sheath indistinct ; trichomes 1.5—3.5 μm broad ; cells cylindrical, oblong, quadrate ; heterocysts longer and broader than the vegetative cells, intercalary, 2.0-4.0 μm in diameter ; spores subspherical, in long or short chains, 5.0-7.0 μm in diameter, epispore hyaline and smooth.

Habitat—Isolated from soil-water enrichment cultures of soil samples from a mustard field.

Coll. No.—Ml. The material is deposited in the Algal Collections, Lucknow University, under no. : Ml.

Loc.—Gosainganj.

Date—19.2.72.

The present form differs from the type specimen in possessing a distinct colonial sheath, indistinct and diffluent individual sheath, a wider range of the breadth of the trichomes, different cell-shape, spherical and shorter heterocysts and broader spores having a hyaline epispore.

Considering the above differences and variations, the present plant is regarded as a new form of the species to be named *N. calcicola* f. *variabilis* f. nov.

4. Nostoc ellipsosporum (Desm.) Rabenh. *ex* Born. *et* Flah.

Desikachary, T. V., Cyanophyta, 383, pl. 64, fig. 5, 1959.

forma **minor** f. nov. (Text-fig. 4).

Thallus mollis, mucilaginus, spatium, obscurus fulvus ; filamentae flexuosae, crinibae implicatae ; trichomatae 3.75-4.25 μm latae, levem lividum-viridis ; cellulae cylindricae, longiorae vel breviorae quam latae, vulgo breviorae quam latae ; heterocystae globosae vel oblongae terminalis vel intercalaris, 4.5-5.5 μm latae, 5.5-6.5 μm longae ; spores ellipsoides vel oblongi, 4.5-6.0 μm latae, 8.0-10 μm longae, episporae level et nudae coloris.

Habitatio—Apparentus in aqua macula locupletae culturae soli exempli ex inculto agro risi.

Coll. No.—P16. Materia deposita est in collectionibus Alga-libus, Lucknowense Universitati, sub-numero : P16.

Locus—Bani, Lucknow-Kanpur Road.

Datum—12.8.72.

Thallus soft, mucilaginous, expanded, dark brown ; filaments flexuous, loosely entangled ; trichomes 3.75-4.25 μm broad, light-blue green ; cells cylindrical, longer or shorter than broad, generally shorter than broad ; heterocysts spherical or oblong, terminal or intercalary, 4.5-5.5 μm broad, 5.5-6.5 μm long ; spores ellipsoidal or oblong, 4.5-6.0 μm broad, 8.0-10.0 μm long, epispore smooth and hyaline.

Habitat—Appeared in soil-water enrichment cultures from soil samples of a paddy field.

Coll. No.—P16. The material is deposited in the Algal Collections, Lucknow University, under no. : P16.

Loc.—Bani, Lucknow-Kanpur Road.

Date—12.8.72.

The present form differs from the type specimen in possessing a dark brown mucilaginous thallus, spherical to oblong heterocysts which are much shorter and narrower, and narrower and smaller spores.

It, however, comes close to description of the species by RAO (1938) but differs from it in possessing narrower spores.

Thus the present form does not agree with the type specimen or any of its sub-taxa and is a different form to be named *Nostoc ellipsosporum* forma *minor* f. nov.

5. Nostoc aureum Kütz.

Tab. Phyc., 2 : pl. 1, fig. 4, 1850 ; Tilden, J., Minnesota algae, 165, 1910.

forma **variabilis** f. nov. (Text-fig. 1).

Colonia parvus, discipulus, levis-viridis, mollis, mucilaginus, trichomata 3.0-4.0 μm latae, omnino brevis, valide flecterae, laxi implicata, raro erectus, cellulae globosa vel oblonga, 2.5-4.0 μm longae, lividum-viridis, heterocystae fines vel intercalares, unicus 3.0-4.0 um in diametero, globosus ; spores non observatio.

Habitatio—Apparentus in aqua macula locupletae culturae soli exempli ex inculto *Brassica oleracea* var. *botrytis*.

Coll. No.—Ca l, Materia deposita ex in collectionibus Algalibus, Lucknowense Universitati, sub numero : Ca l.

Datum—10.2.72.

Colonies small, adherent, light-green, soft, mucilaginous, trichomes 3.0-4.0 μm broad, quite short, strongly curved, loosely entangled, rarely straight ; cells globose or oblong, 2.5-4.0 μm long, blue-green ; heterocysts terminal or intercalary, single, 3.0-4.0 μm in diameter, spherical ; spores not observed.

Habitat—Appeared in soil-water enrichment cultures from soil samples of a cauliflower field.

Coll. No.—Ca l. The material is deposited in the Algal Collections, Lucknow University, under no.: Ca l.

Loc.—Barabanki.

Date—10.2.72.

The present form is similar to *N. aureum* Kütz. in overall morphological appearance of the colonies, cell-shape and nature of heterocysts. However, the present form is characterised by its broader trichomes, longer cells, strongly curved nature of the filaments and very small microscopic colonies, features which are not found in the type. Moreover, in the description of the type (TILDEN, 1910) there is no mention of the length

of the cells and a colonial sheath is present while the latter feature is absent in the present alga. Considering these characters, the present form does not agree with the type specimen. It may be mentioned that spores have never been seen in the original species or in the present form.

6. Nostoc calcicola Breb. *ex* Born. *et* Flah.

Geitler, L., Kryptogamenflora, 842, fig. 534, 1932 ; Desikachary, T. V., Cyanophyta, 384, pl. 68, fig. 1, 1959.

forma (Text-fig. 3).

Thallus mucilaginous, sheath diffluent, pale blue-green or blue-green, indistinct mucilaginous sheath ; trichomes 1.5-2.0 μm broad, blue-green ; cells cylindrical, subspherical or quadrate ; heterocysts subspherical, 2.0-2.5 μm in diameter, single, intercalary ; spores subspherical, 6.0-8.0 μm in diameter, epispore smooth and yellowish.

Habitat—Appeared in soil-water enrichment cultures from soil samples of a paddy field.

Coll. No.—P12.

Loc.—Utratia, Lucknow.

Date—18.10.71.

The present form differs from the type in possessing an indistinct sheath, cylindrical, subspherical to quadrate cells, narrower heterocysts and much bigger spores than recorded for the type. It is, therefore, a variant form of *N. calcicola.*

7. Nostoc commune Vaucher *ex* Born. *et* Flah.

Geitler, L., Kryptogamenflora, 845, figs. 537, 1932 ; Frémy, P., Cyano. cotés, d'Eur., 177, pl. 58, fig. 3, 1933 ; Desikachary, T. V., Cyanophyta, 387, pl. 68, fig. 3, 1959.

forma (Pl. 1. Figs. 4a, b, Text-fig. 5a, b).

Plant mass gelatinous, in the beginning spherical, afterward flattened, expanding, spreading out into perforated, folded and undulate sheets ; filaments flexuous, densely entangled ; sheath distinct at times, hyaline or light-brown ; trichomes 2.0-2.5 (-4.0) μm broad ; cells depressed spherical or barrel-shaped, 3.0-4.5 μm long; heterocysts terminal or intercalary, 4.0-5.0 μm in diameter, spherical, single ; spores brownish in colour, 4.0—6.0 μm in diameter, spherical, epispore with hyaline smooth wall.

Habitat—Isolated from soil-water enrichment cultures of soil samples from a wheat field.

Coll. No.—W8.

Loc.—Kakori, Lucknow.

Date—7.4.72.

The present form differs from the type in possessing a highly perforated, folded and undulate sheet-like thallus, a very distinct sheath, narrower trichomes, depressed and spherical cells, spherical and narrower heterocysts and larger spores.

Spores have been observed only once in the species so far (Desikachary, 1959 : 387) and are reported to be of the same size as vegetative cells. The present authors have observed spores for the second time and these are much bigger than the vegetative cells (Pl. 1, Fig. 4b; Text-fig. 5b).

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REFERENCES

DESIKACHARY, T. V. (1959). *Cyanophyta.* ICAR Publication, New Delhi.

FORTI, A. (1907).. Myxophyceae in De Toni, *Sylloge Algarum.* **5** : 761, Padova.

FREMY, P. (1933). Les Cyanophycees des cotes d' Eur. *Mem. Soc. nat. Sci. nat., et. Match de Cherbourg.* **41** : 1-236.

GEITLER, L. (1932). Cyanophyceae in Rabenhörst's *Kryptogamenflora.* **14** : 1196 Leipzig.

KÜTZING, F. T. (1846-1871). Tabulae Phycologicae Oder Abbildungen der Tange, I. XIX, Pls. 1-1900. Nordhausen.

RAO, C. B. (1938). The Myxophyceae of the Madras Presidency, India. *J. Indian bot. Soc.*, **17** : 81-96.

TILDEN, J. E. (1910). *Myxophyceae* in *Minnesota Algae* I. Minneapolis.

EXPLANATION OF PLATE 1

1a. *Nostoc wartisporum* sp. nov. Habit, ×300

1b. *N. wartisporum* sp. nov. part of sporogenous region magnified showing mucilage pads and warts on the spore wall × 2300.

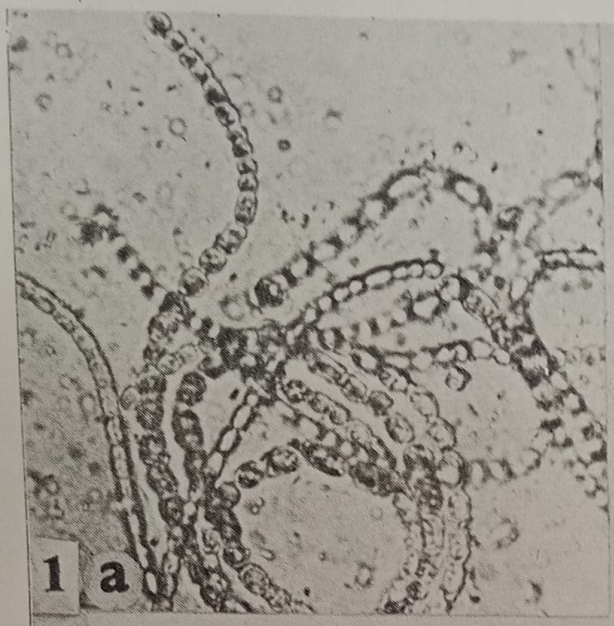
2. *N. paludosum* var. *majus* var. nov. vegetative cells and spores partly arranged in zig-zag fashion, ×300.

3. *N. calcicola* forma *variabilis* forma nov. Habit, ×300.

4a *N. commune forma* Habit, ×700

4b. *N. commune forma* spores formed in series, ×1400.

(m—mucilage pad ; w—warts.)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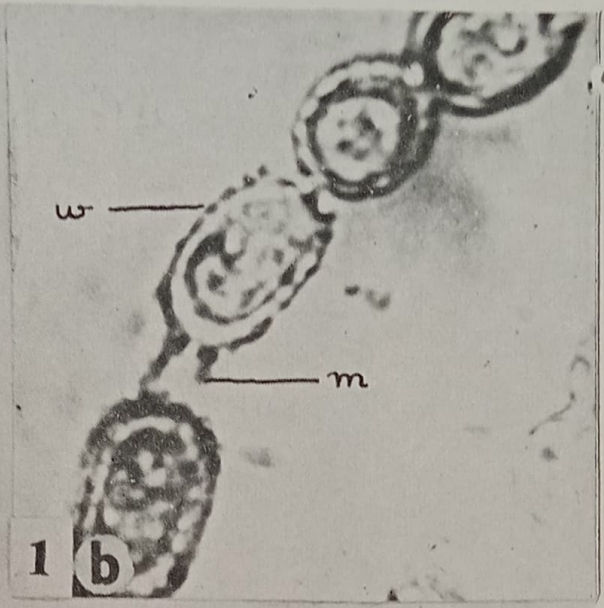
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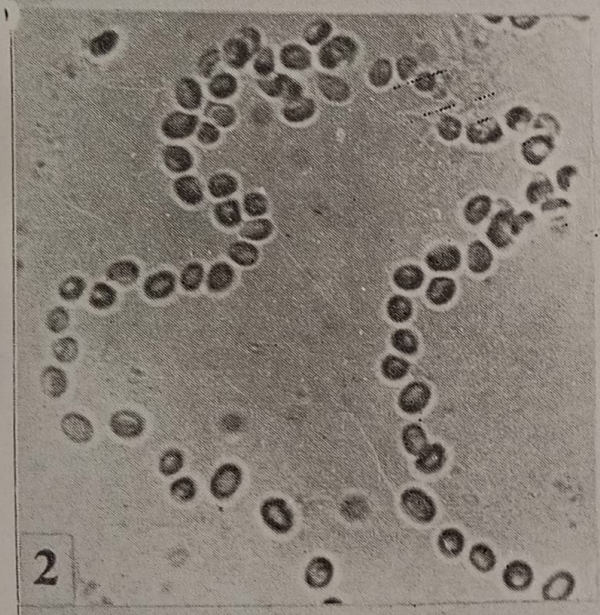
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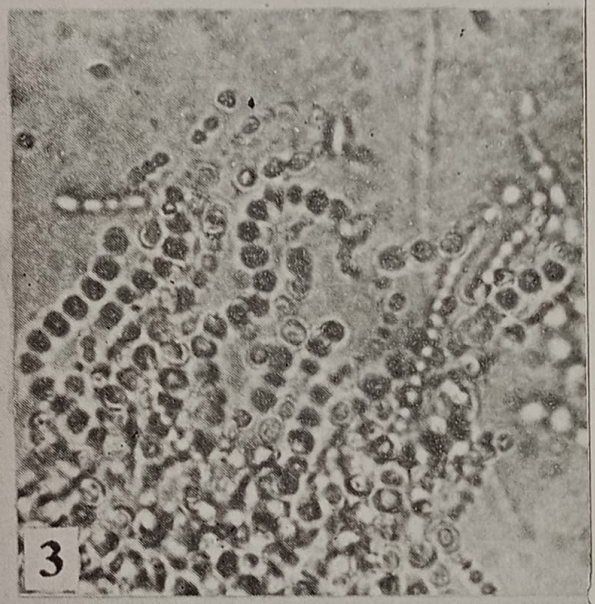
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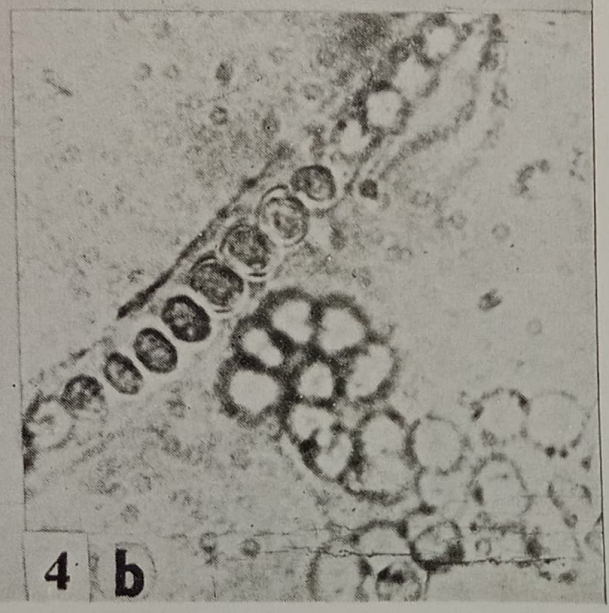
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