

## THE SOIL ALGAE OF CIBODAS FOREST RESERVE

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### SUMMARY

Three species of green algae and one blue-green alga were recorded from eight samples of soil found associated with bryophytes in the Cibodas Forest Reserve. Chemical analysis of the soil showed severe leaching of soluble mineral substances associated with a low pH. The low light intensity under forest conditions and the low pH may account for the limited algal flora.

Small samples of epiterranean and epiphytic soil from Cibodas Forest Reserve, Indonesia were received together with bryophytes collected by the Botany Honours Students (University of Singapore) taking part in the first BIOTROP Training Course in Ecological Plant Taxonomy in August 1969. The samples which were stored in polythene bags were received a few weeks after collection. The soil was carefully separated from the bryophytes and liquid cultures were set up following the method of John (1942). In this method small quantities of soil were introduced into a nutritive solution in conical flasks under sterile conditions. The nutritive solution was modified Knop's solution (Pringsheim, 1946) at full strength. The cultures were exposed to daylight in a window at approximately 26°C. The day-length was about 12 hours.

In three of the samples where sufficient soil was available, an analysis was made of nitrate, phosphate, calcium, ammonium, nitrite, magnesium, iron, aluminium, manganese, chloride, potassium, sulphate and hydrogen ion (pH), using Simplex soil-test methods supplied by Nasco Industries Incorporated, Fort Atkinson, Wisconsin, U.S.A.

### RESULTS

After about ten days the liquid cultures showed the appearance of algal growth and this continued until staling set in after six months. The pH of the cultures remained at 5.6 for two months and were adjusted to this value where the pH started to rise. The algae appearing in the various samples are listed below.

*Cibodas Locality 1*, epiterranean, 1400—1500 m, collected 20.8.69.

*Apatococcus lobatus* (Chod.) Boye Petersen.

*Cibodas Locality 2*, epiterranean, ground covered with rocks and tree roots, abundant organic matter, 1500 m, collected 21.8. 69.

*Apatococcus lobatus* (Chod.) Boye Petersen.

*Cibodas Locality 4*, on ground in the shade, 1400 m, collected 16.8.69.

*Apatococcus lobatus* (Chod.) Boye Petersen.

*Desmococcus vulgaris* Brand.

*Cibodas Locality 5*, epiterranean, 1500 m, collected 19.8.69.

*Apatococcus lobatus* (Chod.) Boye Petersen.

*Chlamydomonas (Chlamydomonas)* sp.

*Cibodas Locality 6*, epiterranean, rocky, shaded, 1400 — 1600 m, collected 18.8.69.

*Apatococcus lobatus* (Chod.) Boye Petersen.

*Cibodas Locality 7*, on ground, in shade, 1600 m, collected 22.8.69.

*Apatococcus lobatus* (Chod.) Boye Petersen.

*Cibodas Locality 8*, epiphytic on bark of trees, 1500 m, collected 21.8.69.

*Apatococcus lobatus* (Chod.) Boye Petersen.

*Desmococcus vulgaris* Brand.

*Anabaena anomala* Fritsch.

*Cibodas Locality 30*, waterfall at 1600 m, rocky ground, collected 14.8.69.

*Apatococcus lobatus* (Chod.) Boye Petersen.

*Anafoaena anomala* Fritsch.

The soil from localities 1, 2, 4, 5, 6, and 7 (all epiterranean) was of a richly organic nature and very dark in colour. The soil from locality 8 (epiphytic) was also dark coloured with only very fine particles of organic debris. This soil had accumulated beneath a cover of moss. The soil from locality 30 was a paler coloured alluvial clay with less organic matter. The chemical analysis of localities 7, 8 and 30 is given below.

*Chemical analysis of three samples of soil*

	Cibodas 7 (epiterranean)	Cibodas 8 (epiphytic)	Cibodas 30 (waterfall)
Nitrate	10 p.p.m.	10 p.p.m.	10 p.p.m.
Phosphate	½ p.p.m.	½ p.p.m.	¼ p.p.m.
Calcium	trace	trace	trace
Ammonium	10 p.p.m.	2 p.p.m.	10 p.p.m.
Nitrite	absent	absent	trace
Magnesium	2 p.p.m.	6 p.p.m.	6 p.p.m.

Ferric	2 p.p.m.	<2 p.p.m.	trace
Aluminium	15 p.p.m.	absent	3 p.p.m.
Manganese	absent	absent	2.5 p.p.m.
Chloride	absent	absent	trace
Potassium	ca 30 p.p.m.	ca 40 p.p.m.	absent-trace
Sulphate	absent	absent	trace
pH	4.0	4.0	4.0
Acid status	very strongly acid	very strongly acid	very strongly acid

### DISCUSSION

The results above show two outstanding features: (i) the extreme poverty of algal flora in the localities examined, and (ii) the very acid nature of the soil which shows signs of severe leaching of soluble mineral elements despite the high organic content. In this investigation only the extreme top soil was examined.

As was expected *Apatococcus lobatus* was ubiquitous. This species or a close relative is to be found in an active or dormant state in nearly all soil samples of whatever origin. *Desmococcus vulgaris* was found in one of the epiterranean localities (4) and as an epiphyte (8). These two species are closely related and both form cubical clusters of cells. In *Apatococcus lobatus* there is no pyrenoid and the division is less regular. This species may develop parenchymatous outgrowths in culture. In *Desmococcus vulgaris* a pyrenoid is present, although this may be difficult to see. Division is regular and outgrowths are uniseriate. It is most readily identified by the verrucose aporocysts which have the appearance of *Trochiscia* (Bourelly, 1966). An unidentified species of *Chlamydomonas* was abundant in culture from locality 5. The nitrogen fixing blue-green alga, *Anabaena anomala* was found in the epiphytic soil and in the waterfall. This grew exceedingly well in culture forming a thin gelatinous matrix of contorted filaments (Desikachary, 1959). This species has been found in rice-field soils in India (Fritsch, 1939) and Sumatra (De, 1939). Its taxonomic position is obscure since it resembles *Nostoc* in some features. Fritsch suggested it be placed in *Isocystis*.

A tropical forest reserve with continuous canopy cover is not a favourable locality for terrestrial algae due to the extremely low light intensity at level. The soil examined here was found in association with bryophytes which would further reduce the light available. Previous results in Singapore (Johnson, 1962) showed the absence of pigmented algae in

Mac Ritchie Reservoir Forest under heavy shade conditions. In this forest the pH of the top-soil was 5.7. The top-soil in Cibodas is extremely acid (pH 4.0) which would limit the species in lighted areas to acid-tolerant species.

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