6. Alfermann, A. W., Schuller, I., Reinhard, E., *Plant. Med.* 1980, **40**, 218.
7. Rajpoot, N. C. and Govindarajan, V. S., *J. Assoc. Anal. Chem.*, 1981, **64**, 311.
8. Lindsey, K. and Yeoman, M. M., *Planta*, 1984, **162**, 495.
9. Amorim, H. V., Dougall, D. K. and Sharp, W. R., *Physiol. Plant.*, 1977, **39**, 91.
10. Knoblach, K. H., Beutnagel, G. and Berlin, J., *Planta*, 1981, **153**, 582.
11. Lindsey, K. and Yeoman, M. M., In: *Primary and secondary metabolism of plant cell cultures*, (ed.) K. H Neumann, Springer-Verlag, Berlin, 1985, p. 304.

DIATOM ABUNDANCE IN THE ESTUARIES

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THE Cooum and the Adyar river estuaries in Madras are bar protected at their bay mouths and are substantially influenced by freshwater inputs only during monsoon seasons. During summer, shallow bars formed at the bay mouths prevent free flow of water and evaporation can then increase their salinity by as much as 60‰. One may reasonably expect and, in fact, laboratory studies have generally confirmed that diatoms in such biotopes are well adapted to live under fluctuating salinity conditions[1].

Cyclotella meneghiniana Kütz. and *Amphora coffeaeformis* (Agardh) Kütz. occur in the Cooum and the Adyar estuaries where salinity varies from almost freshwater to very near that of the sea[2,3]. We have isolated a number of clones of the two diatoms from upstream of the estuaries, where there is no tidal influence; from the estuaries themselves; and also from several places in the Bay off Madras. The behaviour of these clones in relation to salinity of the medium has been studied in the laboratory. For comparison, clones isolated from a garden pond have also been included in the study.

Cyclotella meneghiniana Kütz.

Isolates of *Cyclotella meneghiniana* Kütz. when grown in different NaCl (1–30 g/l) amended Reimann medium[4] grew well at all salinities and there was no need to 'train' the diatom to tolerate different levels of NaCl. The typical behaviour of a single isolate is illustrated in figure 1. Cells were

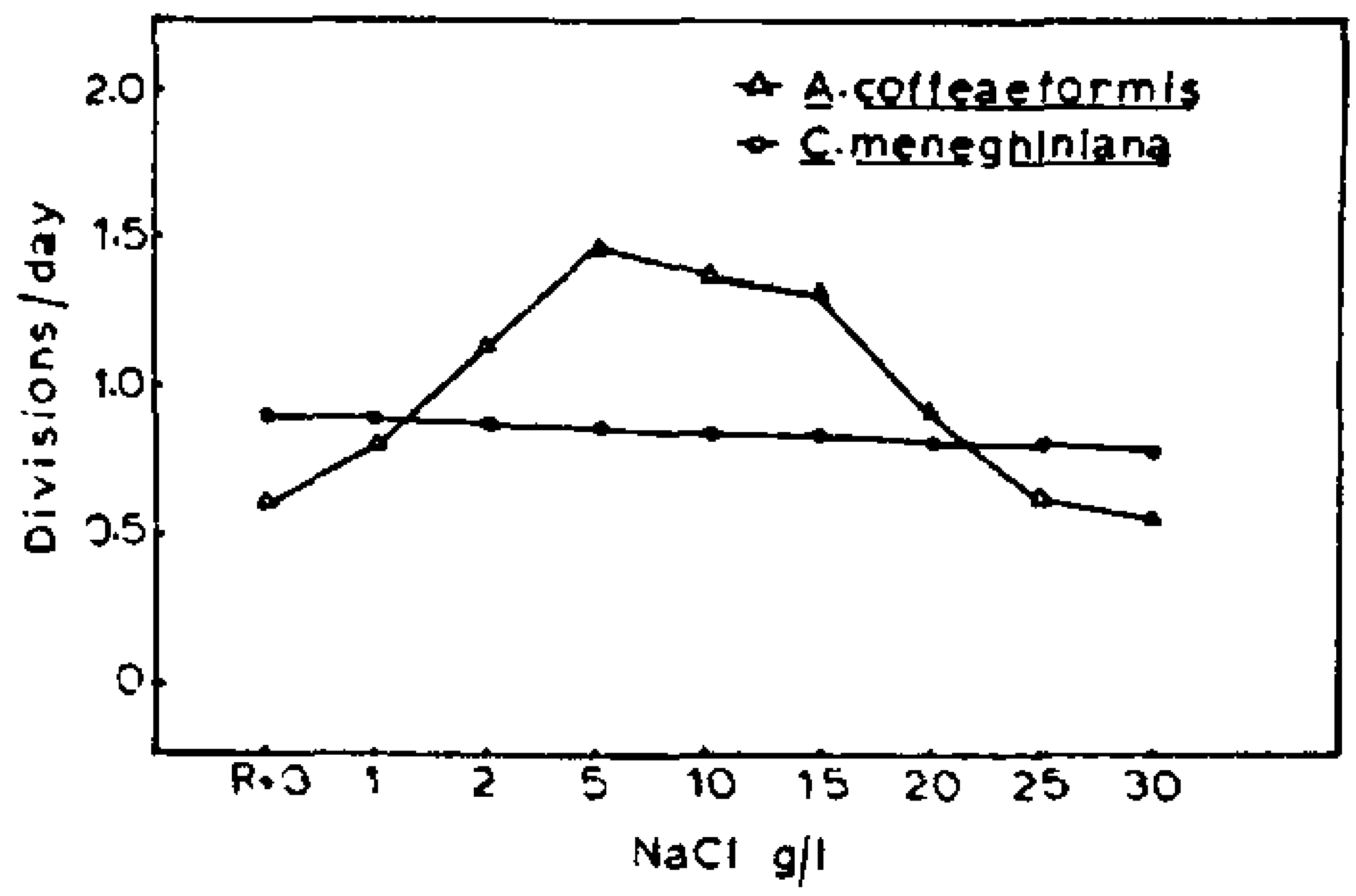

Figure 1. Division rates of *A. coffeaeformis* (Agardh) Kütz. and *C. meneghiniana* Kütz. in media of different salinities.

transferred from freshwater Reimann medium to different salinities (1–30 g/l) NaCl added to Reimann medium and again from media of high to low salinity. Transfer of cells from either Reimann medium to low salinity ranges or from high to low salinity increased their dimensions due to auxospore formation. The increase of average cell diameter obtained in different salinities of one isolate is shown in table 1.

In the Cooum and the Adyar estuaries there are two periods of auxospore formation: once during monsoon months, when there is large freshwater influx from the river; and again on the return of saline conditions when freshwater inflow stops and the estuary becomes tidal. The observations of Iyengar and Venkataraman[2] on abundance of *C. meneghiniana* Kütz. in the Cooum estuary are relevant: *C. meneghiniana* Kütz. becomes abundant during two periods of the year when heavy rain decreases the salinity of waters lending support to our laboratory studies.

In our opinion, the ability of *Cyclotella meneghiniana* Kütz. to grow in estuaries involves efficient maintenance of a small inoculum throughout the year in various places in the river and the sea and

Table 1 *Percentage increase in average cell diameter of C. meneghiniana Kütz. in Reimann medium amended with different NaCl concentrations*

Inoculum	NaCl concentration in g/l R	1	2	5	10
From Reimann	0	71	124	166	78
From Reimann + 25 g/l NaCl	7	11	47	85	11

effective use of changes in salinity to trigger auxospore formation: in short, synchronizing its life cycle to changes in the hydrology of the habitat.

Amphora coffeaeformis (Agardh.) Kütz. isolated from a particular salinity grew best only at that salinity and differences in their behaviour seem to be related to the place of origin (cf figure 1 showing the typical behaviour of the diatom isolated from mid salinity range). Thus, there seem to be races differing in their salinity responses, as indicated for other species[5,6]. Cells when transferred from freshwater to very low salinity or from high to low salinity did show significant increase in length of apical axis of valves showing a response similar to *C. meneghiniana* Kütz.

Studies on salinity tolerance of diatom species isolated from freshwater, brackish water and marine environments confirmed the existence of races in many diatoms exhibiting optimum growth at low, mid or high salinity ranges, although the species as a whole may be classified as euryhaline. These can be conveniently called micro-, meso- and macro-euryvalent species. Occurrence and abundance of individual species may depend on conditions most favourable for their optimum development (figure 2).

In nearshore waters that are influenced by rivers, phytoplankton blooms often follow marked decreases in salinity. Dominant diatoms of such blooms, are in many cases, estuarine. During monsoon seasons both the Cooum and the Adyar estuaries deliver an influx of nutrients into the sea along with euryhaline diatoms, which play an important role in phytoplankton abundance both in estuaries and in nearshore waters. When phytoplankton from the sea are inoculated into the media of low salinities/freshwater, euryhaline diatoms such as *Cyclotella meneghiniana* Kütz., *Skeletonema costatum* (Grev.) Cleve, *Amphora coffeaformis* (Agardh) Kütz., *Navicula halophila* (Grun.) Cleve and *Nitzschia closterium* (Ehr.) Wm. Smith occur in sufficient numbers to be recognizable. These euryhaline diatoms may survive in coastal waters in non-monsoon season and may multiply in the estuary, its low salinity favouring their growth. They may also multiply in nearshore waters during monsoon season, when there is a decrease in salinity of the waters. While a small decrease may favour macrovalent species, a large decrease may favour meso- and even microvalent species. Rivers during this period will add more euryhaline diatoms to nearshore water and together they may produce a coastal bloom of euryhaline diatoms.

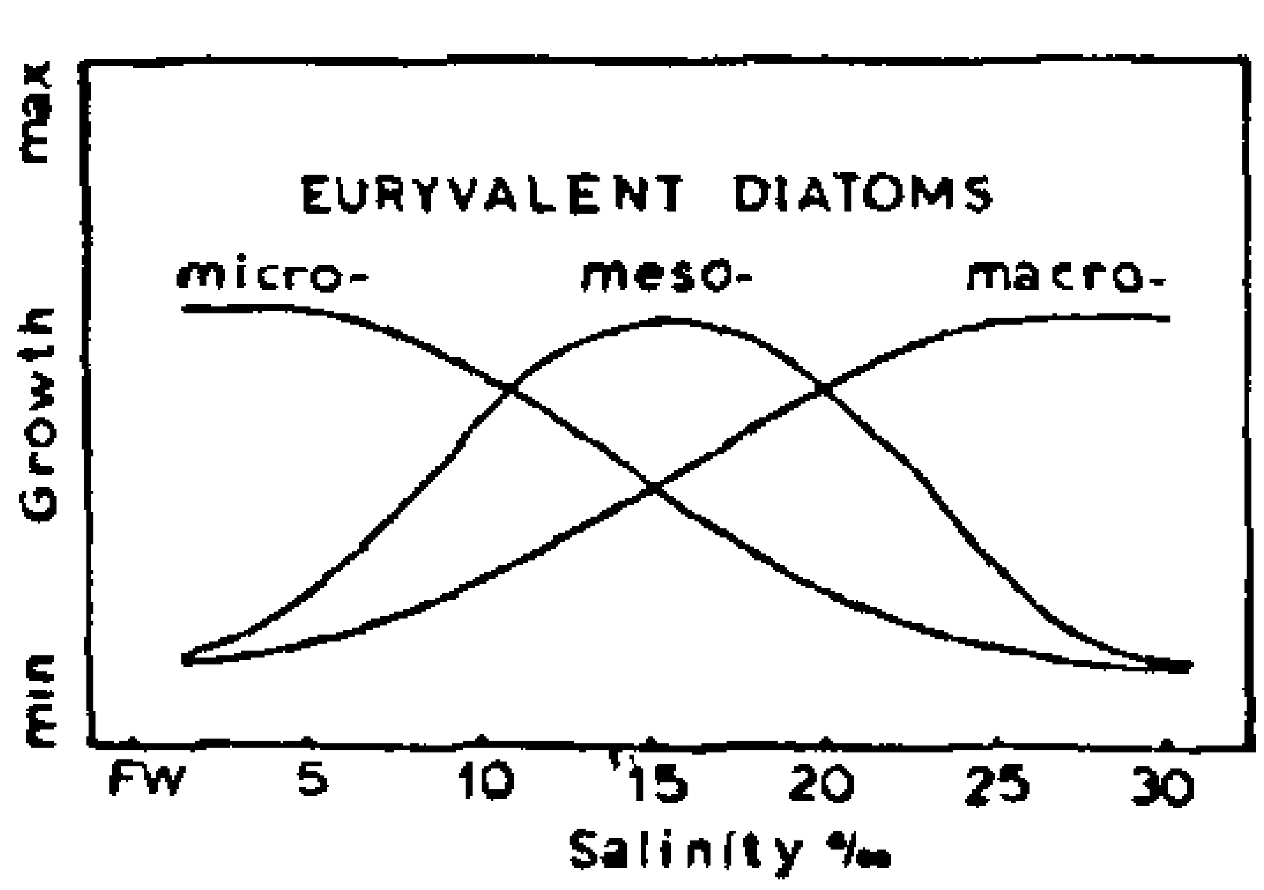

Figure 2. Hypothetical curves explaining the growth behaviour of euryhaline diatoms (after Desikachary and Rao[6]).

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1. Williams, R. B., *Ecology*, 1964, **45**, 877.
2. Iyengar, M. O. P. and Venkataraman, G., *J. Madras Univ.*, 1951, **B21**, 140.
3. Krishnamurthy, V., *J. Madras Univ.*, 1954, **B24**, 161.
4. Reimann, B. E. F., Lewin, J. C. and Guillard, R. R. L., *Phycologia*, 1963, **3**, 75.
5. Guillard, R. R. L. and Ryther, J. H., *Can. J. Microbiol.*, 1962, **8**, 229.
6. Desikachary, T. V. and Rao. V. N. R., *J. Mar. Biol. Assc. India*, 1972, **14**, 524.

SEED-BORNE INFECTION OF *FUSARIELLA HUGHESII* IN MUNGBEAN

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DURING the seed health testing of mungbean, seed samples received from Directorate of Pulses Research, Kanpur for screening against various diseases under natural conditions in spring and summer seasons showed the occurrence of 10% *Fusariella hughesii* infection in mungbean cultivar UPM 82–4 under standard blotter method test[1]. The fungus was isolated from untreated as well as treated seeds with 1% sodium hypochlorite for 5 min. In most cases the fungus did not allow the seed to germinate but it covered the whole surface of the seed with greenish black stromatic conidial masses (figure 1a). Conidia taken directly from the seed surface were fusoid, conicotruncate at the base, smooth, mostly 3 septate, 14–26 × 4.6 μm (figure 1C, D).