Journal of Applied Phycology 7: 229–230, 1995.

Introduction

The phycocolloid commanding the highest price on the world market is agar, of which currently around half is obtained from members of the Gracilariaceae with the most important genus being *Gracilaria*. In spite of the occurrence of about 10 species in the Mediterranean Sea, Europe has made an inconsequential contribution to the global *Gracilaria* harvest. If this situation were to change it would have to be through cultivation, for which there is considerable expertise outside Europe.

This is the background to the decision to hold a workshop on '*Gracilaria* and its Cultivation' in Trieste, Italy in April 1994. The site was appropriate for three reasons. First, Italy has been the only European country to export *Gracilaria* to Japan (the most important agar-producing country) over the last 10 years. Second, several groups of Italian scientists are currently interested in the cultivation of *Gracilaria*. Last, but by no means least, phycocolloid experts of the Poly-Bios Research Centre offered highly suitable facilities and were willing to undertake the local organization. Sergio Paoletti, Roberto Rizzo, Erminio Murano and Costanza Galbardi carried out this task very effectively. The programme was organized by Robert Fletcher, whose idea it was in the first place, and myself.

The main sponsor for the workshop was COST 48 Aquatic Primary Biomass – Marine Macroalgae. 'COST' is the acronym for 'Coopération européenne dans le domaine de la Recherche Scientifique et Technique' or 'European Cooperation in the Field of Scientific and Technical Research'. Although organized by the Commission of the European Communities it currently encompasses 26 European Community states. The funds are derived from contributions from the member state governments. The aim of the organization is to promote communication and co-operation between the scientists engaged in particular subject areas, either those already ear-marked and funded by the European Union itself or those which have been otherwise identified as worth supporting by the COST officials.

The workshop was organized in two parts. First there were invited speakers giving mainly review papers; the range of topics aimed to cover the main aspects of the biology of the plant and the practical methods of cultivating it. For this we invited several speakers from outside Europe. In the second part European scientists currently active in *Gracilaria* research contributed their recent results. The review papers, some of which also include new data, are published in this volume; the contributed papers will be published as a report of Working Group 3 of Sub-group I of COST 48. Unfortunately, due to a variety of factors, not all of the invited speakers were able to contribute written reviews.

The first paper sets the scene, showing how very important *Gracilaria* is to the phycocolloid industry. Rafael Armisen has been active in the agar industry for many years and has witnessed the rise of *Gracilaria* relative to the traditional agarophytes to its current status as the most important source genus. He traces the history of agar from its discovery in Japan to the present day variation in types and sources.

An understanding of the chemical structure of the agar obtained from *Gracilaria* can be gained from the paper by Erminio Murano, working at the institution which hosted the Workshop. He explains how the basic chain structure of agar is modified in a number of ways by different groups and linkages, resulting in various physical properties. This natural structure can be manipulated during or after extraction, in particular the agar from *Gracilaria* can be improved if the sulphate content is reduced by alkaline extraction.

An understanding of the biology of a plant is esential to efficient exploitation. The basic biological discipline, taxonomy, is dealt with by Carolyn Bird, a Canadian with varied experience of *Gracilaria*. She deals with the whole family, putting into perspective its most important genus. This is not an easy task as the vagueness of the morphological features and the obscurity of the anatomical characters used to distinguish the genera, let alone the species, have made identification of many species of Gracilariaceae a job only for the experts. Fortunately recent molecular work has involved some of the commercially important species and cleared up some ambiguities. On the other hand it is now clear that *Gracilariopsis* is a separate genus from *Gracilaria* and that the oldest species, *G. verrucosa*, has to be called *G. gracilis*.

For cultivation purposes it is important to understand how and when the plant reproduces and when it grows. These aspects are covered by myself and

Christophe Destombe who has worked on the autecology of *G. gracilis* in France. It seems that one cannot assume that any one of the species strictly follow the *Polysiphonia*-type life history regularly. Different populations, of the same or different species, show a wide range of reproductive behaviour. This helps to demonstrate that a knowledge of a species in its natural environment is a prerequisite for effective cultivation practice.

Neither, it seems, can assumptions be made about the stability of clones. This is demonstrated by Bernabé Santelices who, with his group in Chile, has worked on many aspects of the biology and cultivation of *Gracilaria*. They have shown that marked variations in growth rate can arise in different cultured thalli which were originally part of the same plant or were derived from spores from the same cystocarp. The implication to the cultivator is serious: it is not enough to select a suitable clone and grow it in farms, the selection process has to be continuous.

The next three reviews deal with the cultivation techniques in use or being developed. In the first, Alejandro Buschmann, with experience of the practical aspects of the extensive cultivation of *Gracilaria* in Chile, outlines the methods in operation in farming the plant on the sea bottom and points out the current problems. His account draws attention to the volume of scientific work that has allowed the commercial success of farming *G. chilensis* over a wide latitudinal range of a productive coast.

Suspended cultivation is dealt with by Chris Dawes who has initiated commercial farming in two hemispheres. He reviews techniques involving seeding with spores, which are not currently used commercially but may have their place in some circumstances, and then describes the successful systems in Namibia and Venezuela.

Tank and pond cultivation are described by Michael Friedlander who, with a group in Israel, has been involved in experiments on growth in tanks for some years. They have accumulated data on the behaviour of *Gracilaria* in intensive cultivation in containers of a wide range of sizes. His review is an important source of information on the ecophysiology of *Gracilaria*, outlining the effects of environmental factors on growth and production.

Finally, Bob Fletcher deals with the problem of epiphytes which contaminate cultivated *Gracilaria* populations. He lists the species that have been recorded in various sites and outlines the effects that they have. He then describes the various possible methods of controlling these nuisance algae.

In a discussion at the end of the Workshop it was agreed that there is a need for research on native European species in order to assess the economic feasibility of cultivation.

JOANNA M. KAIN (JONES)