Phytoremediation applications are reaching commercial utility. They include phytoextraction, the accumulation of high concentrations of certain contaminants in plant biomass; the creation of hydraulic barriers or vegetative caps through uptake and transpiration of large amount of water; and rhizofiltration, the removal of contaminants from aqueous waste-stream by absorption onto plant roots. In other applications, the contaminants are degraded or metabolized within the plant (phytotransformation), sometimes coupled with the volatilization into the air from plant biomass (phytovolatilization). Contaminants may also be degraded in the soil by the action of secreted plant enzymes (in one form of phytotransformation) or by plant stimulation of microbial biodegradative activity (phytostimulation), or contaminants may be immobilized in the soil by plant exudates or other mechanism (phytostabilization). There are at least two dozen companies in the U.S., Canada and Europe known to have phytoremediation expertise.

Does the technology work, and if so, how well? It is important that there be some generic proof to show that the technology is efficacious, to give it legitimacy and to make it a viable option. Two things are needed to satisfy these goals. First, generally accepted testing protocols for determining whether phytoremediation can be a cost-effective option, and second, a set of broadly applicable, credible data providing generic evidence of efficacy in certain well-defined scenarios.

The use of plants is generally considered to be an aesthetically pleasing means of remediating a contaminated area compared to the use of heavy machinery for excavation or other remedial activity which can involve noise, disruption, frequent worker activity and unsightliness. Basic research is needed to improve performance to gain greater market in developing countries like India, especially in the following areas:

(a) Obtaining a better understanding of mechanisms of uptake, transport and accumulation;
(b) Improved collection and genetic evaluation of hyperaccumulating plants;
(c) Obtaining a better understanding of plant root interaction with the microbes and biota in the rhizosphere.

Recombinant DNA technology and improved tissue culture technologies offer significant promise towards improving those naturally occurring plant species that are used in phytoremediation. Some success has already been scored along this path. For example, genes encoding the cadmium-binding protein, metallothionein, have been expressed in plants in a seemingly successful attempt to increase cadmium bioaccumulation. Introduction of genes responsible for metal accumulation from the wild metal accumulators is another successful step. In the absence of known phytoremediation genes, this may be accomplished via somatic and sexual hybridization followed by extensive screening and backcrossing of progeny. However, a long-term effort should be directed toward developing a ‘molecular toolbox’ composed of genes valuable for phytoremediation. Systematic screening of plant species and genotypes for metal accumulation will broaden the spectra of genetic material available for optimization and transfer. Mutagenesis of selected plant species may also produce improved phytoremediating cultivars.


B. S. MOHAN*#
B. B. HOSETTI#

*Department of Biology,
T. John College,
Banerghatta Road,
Bangalore 560 083, India
Department of Applied Zoology,
B.R. Project,
Kavempu University,
Shimoga 577 115, India
For correspondence
e-mail: mohanbettiager@yahoo.com

Bambusa bambos: A rich source of a nutritive liquid – Bamboo ‘neera’

Accidental observation of the exudation a nutrient sap from the cut ends of bamboo culms belonging to Bambusa bambos sp. is being reported. Work on the technology of extraction, quantity of the sap produced, best season for extraction, chemical analysis of the sap, etc. are yet to be studied.

Bamboo is a giant grass belonging to family Gramineae. Among the different species of bamboo, B. bambos or thorny bamboo is the most prominent one in Kerala. Wetlands in Kerala up to 1000 ft altitude are suitable for its growth. Attappady area and Palakkad region are heavily inhabited by bamboo colonies.

A bamboo colony usually contains more than hundred culms, up to 30 m long and weighing 100 kg. New culms are produced during the monsoon months and they mature within four or five months. A colony is in bloom by thirty years of growth, and after flowering and seedset the colony perishes. Cutting of mature culms of 3–4 years of age is recommended during the summer months.

While cutting bamboo culms during July 2001 for construction work in connection with a research project at the Integrated Rural Technology Centre, Mundur, a peculiar phenomenon was noticed. Out of the 30 culms cut off, two exuded a colourless liquid in large quantities from the stumps and got converted into a white mass. The mass increased in quantity each day and accumulated around the base of the stump, the white material gradually turning into brown downwards. Bluish fungal growth appeared on the surface on the mass emanating clouds of fungal spores (Figure 1). Drosophilida flies hovered over the mass and different varieties of beetles and caterpillars were found in plenty inside the mass. The sap was rather tasteless, except for a little sweetness. The exudation continued up to one month.

The bamboo has an underground stem, a rhizome, and the culms are the branches of the plant, as in the case of ginger plant. The foliage of the plant, the physiological source, synthesizes the carbohydrate-rich assimilates by photosynthesis and this assimilate passes downwards, towards the
rhizome which is the sink. The whole quantum of the stored assimilates during the tenure of its lifecycle will pass on to the inflorescences on the branches by the end of its tenure. A large number of seeds are produced utilizing the assimilates. When the stock is exhausted, the colony perishes.

When the colony grows during the monsoon season, each new culm during its development acts as a sink. Bamboo being the fastest growing plant and the second highest as far as solar energy conversion is concerned, requires enormous quantum of food material for its growth and development. The nutrients are sent up towards the growing point from the rhizome which acts as the storehouse. This process continues until the culm becomes mature enough and self-sufficient as far as photosynthesis is concerned. It is this translocation stream that we had encroached into by cutting the culm. On close examination we found that among the 30 culms cut, two were rather immature and exuded nutrients in large quantities.

Normally, bamboo culms are not seved during monsoon season and immature ones are never collected. But these recommendations had to be overlooked due to exigency of work and it was this mistake that was responsible for these observations.

Scanning of the literature on bamboo showed no reference on exudate production by the plant, except for a mention by Vinoo Kaley in his book *Venu Bharaty*. He reports that some African species of bamboo on cutting, yield a liquid resembling palm ‘neera’. By judicious exploitation of the bamboo colony by cutting the culms of the exact age in the proper season, extensive carbohydrate-rich nutrient material can be extracted from the plant. The long duration of flow of the sap from the same wound is also due to the fact that being a monoeot plant it lacks the ability to callus and block the wound, once the cell attains a certain amount of maturity.


L. THANKAMMA

Integrated Rural Technology Centre,
Mundur P.O.,
Palakkad 678 592, India

CURRENT SCIENCE

SUBMISSION IN ELECTRONIC FORM

Authors who have been informed of acceptance of their manuscripts may send the final version in electronic form on floppy diskette (3.5" preferred; IBM PC format only, *not* Mackintosh). The text of the manuscript only should be supplied as a plain ASCII file with no formatting other than line and paragraph breaks. (WordStar 5.5 or 7.0 and Microsoft Word for Windows 6.0 are acceptable, but ASCII is preferred.) A hard copy of the text, with all typesetting information (italics, bold, mathematical type, superscripts, subscripts, etc.) must accompany the electronic copy. The diskette must be labelled clearly with the following: manuscript number, file name, file information (ASCII or WordStar, version number, etc.).

Text may also be transmitted as ASCII only by e-mail to currsci@ias.ernet.in.

We expect that electronic submission will result in quicker processing for publication.