from the soil. Thus, PGPR can directly facilitate the proliferation of plant growth by fixing atmospheric nitrogen. The production of plant growth regulators (PGR) has been suggested as one of the mechanisms, by which PGPR stimulate plant growth.

Anith[5] has developed a cost-effective and layman-friendly method to multiply PGPR using coconut water (CW). *Pseudomonas* sp. and *Bacillus pumilus* can multiply to the level of 10^8 cfu ml^{-1} in CW within 24 h. Moreover, when compared to treatments using CW alone or bacterial cultures grown in artificial media, the treatment of black pepper cuttings using bacterial cultures grown in CW had the best root initiation effect and produced the highest number of roots under soil conditions[5]. CW contains only a small amount of auxins[6]; therefore, this enhancement of root formation could be due to the extra auxins provided by the bacteria growing in the CW.

CW is a useful medium for enhancing plant growth[7,8]. It is the liquid endosperm of coconut fruit which contains a myriad of chemical compounds, including PGR[8]. CW is known to induce plant growth in tissue culture and is frequently used as a growth supplement in plant tissue culture media due to its rich content of nutrients and plant growth regulators. One way to enhance the effect of CW is to complement it with PGPR. Studies have been carried out indicating that PGPR can be used to increase crop yields[9,10]. Proposed mechanisms for plant growth promotion by PGPR include bacterial synthesis of the plant hormones (auxins, cytokinins and gibberellins); breakdown of plant-produced ethylene by bacterial production of 1-aminocyclopropane-1-carboxylate (ACC) deaminase; and increased mineral and nitrogen availability[11,12].

There is already a significant pool of nutrients and phytohormones in CW[8]. There are two purposes for the addition of the bacteria into CW: one is the *de novo* synthesis of PGR by the bacteria *per se*; second is the conversion of existing PGR present in CW into a potentially more active form. The next logical step is to find out the active compounds by using different mass spectrometries, such as LC-MS and CE-MS[6,13,14], to fully understand the growth-promoting properties of the biochemicals produced by the bacteria in combination with CW as reported by Anith[5]. It will be interesting to see the types of biochemicals produced by the various treatments of CW as described by Anith, and especially the media containing CW and bacteria. It is noteworthy that this treatment gave the highest growth enhancement.

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JEAN W. H. YONG*
S. N. TAN
L. GE
Y. F. NG

National Institute of Education, Nanyang Technological University, Singapore.
**e-mail: jwhyong@gmail.com*

R&D projects database

It was interesting to read a note on ‘Directory of publicly funded research projects’ by K. Gopalan[1]. He has highlighted the need for bringing out an annual directory of research projects in various disciplines being funded by various scientific departments/agencies of the Government of India that may be made available on a website. He has suggested that such a directory may incorporate information related to investigators, overall objectives, brief summary of the progress made during the previous year, projected work to be accomplished in the coming year and any relevant publication emanating from the said funded project. It may be mentioned that the National Science and Technology Management Information System (NSTMIS) Programme of the DST already has R&D projects database wherein a directory of extramural R&D projects funded by the selected central government agencies/ departments is available (www.dst.org). This database incorporates information related to the funding organization, project title, project investigator, department, institute’s name and address, amount in rupees and duration in months. So, initial information on the R&D projects is available, which is useful to the interested scientists, particularly the young researchers/scientists in various disciplines.

It is true that a lot of important data is available in the annual reports and project completion reports submitted by PIs of various projects to the concerned departments. In my personal experience, being associated with funding of the R&D projects in earth sciences in the DST, for more than two decades, it has been observed that invariably the projected progress for a three year project is not up to the mark vis-à-vis the set time schedule and hence delay in achieving the set objectives. There are a number of other unavoidable circumstances hampering the initiation of the project itself, thereby slowing the pace of progress of the project and meeting the projected objectives in a specific time frame. This has led to a situation wherein the progress of research work in the first year in a number of cases has been negligible. Accordingly, it may be worthwhile to have a directory of the completed projects incorporating various parameters. It may be mentioned that in case of the DST, the project completion report (PCR) submitted by PI includes all the elements referred to by Gopalan including procurement/usage of equipment/ plans for utilizing the equipment facilities in future, summary of achievements and indication of scope for future work as well as financial position of the project. The PCR also highlights S&T benefits accrued including a list of research publications, manpower trained on the project and patents taken, if any. Hence, it is suggested that it may be better if funding agencies bring out annual programmewise directory based on comprehensive information already available in the PCR and make it available on a website to the scientific community.

It would therefore be more appropriate that the funding agencies may annually bring out directory containing: (i) the list of funded projects, cost, etc. so that these programmes are not duplicated, and (ii) a two-page summary of the final completion report of each funded project. The funding agencies may evolve a common format for this purpose which will be filled in by the PI and submitted along with the project completion report as soft and hard copies.

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K. R. GUPTA

H-44B, Saket,
New Delhi 110 017, India
e-mail: khemgupta@yahoo.com

Endophytes: the real untapped high energy biofuel resource

The burning of fossil fuels keeps enriching the atmosphere with CO_2, one of the principal causes of increased global warming. So, there is a strong interest to find an efficient energy source which can be used as an alternative to gasoline. Many geologists view crude oil and natural gas products arising from the compression and heating of ancient organic substances over the course of geological time. It is also speculated that some hydrocarbons in the earth's upper mantle which may have arisen via fermentation of plant materials by fungi under conditions of limited oxygen could be an alternate fuel source.

Many microbes are known to produce enzymes, vitamins, primary and secondary metabolites and also produce volatiles including low molecular mass hydrocarbons[1,2]. Microbes producing such volatile high energy substances are of extreme general interest. Brazilian ethanol programme is the best example of the efficient use of bioenergy by growing sugarcane[3] which harbours enormous N_2 fixing bacteria in its healthy tissues. These microorganisms called endophytes live inside the plant tissue residing latently or actively, colonizing locally or systematically without showing visible harm to the plant and, in some cases, improving plant growth and reducing disease symptoms caused by several plant pathogens. For instance, the healthy stem of sugarcane colonized by N_2 fixing bacteria like *Glonacetobacter diazotrophicus*, *Herbaspirillum seropidicae* and *H. rubrisalbicans*[4]. Similarly, N_2 fixing *Azospirillum brasilense*, *A. amazonense*, *A. lipiferum* and *H. seropidicae* were isolated from palm trees[5]. The endophytic fungi are well known for production of volatiles including low molecular mass hydrocarbons. A volatile producing endophytic fungi, a mycofumigant *Muscodor albus* was isolated from *Cinnamomum zeylanicum*[6]. NRRL 50072 a strain of *Gliocladium roseum* isolated from Patagonian angiosperm *Eucryphia cordifolia* (ulmo) can produce volatiles with antibiotic properties[7]. This fungus produces many volatile alkanes/alkenes including 4-decene, 9-methyl, 1-octane and 1,3-octadiene along with a plethora of low molecular mass esters, alcohols, ethers and fatty acids[8]. However, due to the slow growth rate of NRRL 50072, it would be difficult to meet the commercial demand at the present stage[9].

All these new findings open a perspectives for the replacement of fossil fuels by bioenergy resources and it would seem that a much larger search for such organisms in our natural environment needs to be launched.

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B. SHANKAR NAIK*
Y. L. KRISHNAMURTHY

Department of Applied Botany,
Kuvempu University,
Jnana Sahyadri,
Shankaraghatta 577 451, India
**e-mail: shankar_sbn@yahoo.co.in*