phasis that they provided to future course of action. Oscillating between five concurrent symposia, browsing through 638 posters, ca. 1200 delegates representing 41 countries, immensely benefited at the end of 5 days hectic schedule. The scenic ambience in the backdrop of the expansive Adelaide Convention Centre providing a relief amongst South Australian winter settings.

In conclusion, a dramatic paradigm shift has occurred with the advent of the 'OMIC' era in plant molecular biology. The subject now revisits old problems with new tools to evolve 'Virtual Plants' through *in silico* planning for designer crops for wide adaptation. Thereby, this heralds an integrative biology era bringing together ecology, genetics, molecular biology and chemistry with a diminishing interphase between animal and plant biology. Efficiency of operations is implied in the area of gene isolation, expression, introduction, evaluation and optimization in heterologous environments through Systems Networks. This is a challenge for competent and competitive S&T work force that would endeavour towards team goals in a network mode. Our capacity to have command over the hardware and to deliver facelessly against challenge of time schedules is the need of the hour. Are we ready?

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MEETING REPORT

Apiculture in India*

Honey bees are one of the important primitive social insects as well as a rich source of honey. Honey has been traditionally used in various diet preparations, medicines, cosmetics, ointments, candles and house-hold bee-wax items[1], besides Ayurvedic drug preparations. The propolis of the bee hive is used in lip balms and tonics, whereas royal jelly is used to strengthen the human body, for improving appetite, preventing aging of skin, leukaemia and for the treatment of other cancers. On an estimate, about 80% of honey is used directly in medicines and 10% is used in Ayurvedic and pharmaceutical production. Honey bees during foraging for pollen and nectar from flowers of different plant species, enhance agricultural productivity to the tune of 30–80% annually through cross-pollination[2]. Five species of honey bees are found all over the world, namely *Apis florea*, *A. cerana*, *A. dorsata*, *A. mellifera* and *Trigona iridipennis*. However, *A. cerana* and *A. mellifera* are reared in hives in India.

Currently, China captures 40% of the world market and the biggest importers of honey are Germany, Japan and the United States. Germany imports about 90 thousand tonnes of honey annually. India produces about 70,000 tonnes of honey every year of which 25–27,000 tonnes is being exported to more than 42 countries, including the European Union, Middle East and the United States (2002–03). The major honey-producing states are Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal[3]. Due to the economic importance of honey bees and their products, the biotechnological interventions need to upgrade the qualitative and quantitative production taking into account further investigation on genetic stock of Indian bees that may lead to new biotypes.

To evolve an effective network programme by identifying key issues on apiculture in India, a brainstorming session was held under the chairmanship of Raghavendra Gadagkar (Indian Institute of Science, Bangalore) along with senior DBT personnel, and 20 scientists/professors of our country to formulate future viable lines of research work.

In the opening session of the meeting, Gadagkar spoke about the uniqueness in honey-bee science and its application regarding flavour management to lure worker bees towards their specific pasture, giving the example of orange spray in bee colonies. Appreciating the lead efforts of DBT, he mentioned about the needs of various biotechnological interventions in different areas of honey bee ecological science. He focused on genomic studies of our native honey bee species, study on sex determination, role of bees in pollination along with their selective behaviour towards specific crops, and development of molecular markers to study diversity of native species. The honey bee genome has been already sequenced and our country is believed to have the largest bee diversity (out of eight species found in the world, six occur in India). S. Natesh (DBT) emphasized the need for biotechnological research in view of economic importance of bee colonies for pollination as well as molecular analysis of bees for disease resistance and other traits for native bee species, *A. cerana*. Other participants presented their views on biotech-

*A report on the brainstorming session on 'Apiculture in India – Problems and Prospects and Need for Biotech Interventions' under the auspices of National Bioresource Development Board of DBT, Ministry of Science and Technology, Government of India at New Delhi on 22 August 2006.

nological interventions in honey bees of native species. Dwijendra Singh presented his views on the following issues for biotechnological interventions: (a) Management of diseases and pests with special reference to mite species (*Varroa* and tracheal mite), including development of new superior strains of bees that could develop significant mite resistance besides investigation on phyto-chemicals[4]; (b) Identification of flowering pastures of plant species that may attract maximum number of worker bees for foraging, leading to higher production of honey and associated products[5]; (c) Investigation of granulation problem in mustard honey compared to litchi honey during storage; (d) Developing superior strains of honey bees for other value-added natural products of medicinal importance, namely propolis and royal jelly that may fetch high foreign exchange; (e) Need to identify 'magic bee tree' species similar to *Kampassia alaccensis* that bear about sixty-nine colonies of giant honey bees (*A. dorsata*) on their branches under natural conditions, that could be planted in orchards for maximum cross-pollination in plants, and (f) Identification of novel biotypes through new tools and methods of molecular determination for high productivity of honey and foraging capability of bees.

After the discussion on different subtopics for apiculture in India and need for biotechnological interventions raised by the participants, Gadagkar concluded the session identifying ten important issues, namely Diversity of non-Apis species, Pollination and bee flora studies, Breeding of bees for mass rearing of queens, Honey certification, Development of molecular marker of *A. cerana*, Bioprospecting for royal jelly, etc. Development of database, Documentation of status report, Disease and pest management, behaviour of bee-mite in relation to *A. cerana*, and Bee pheromone science and technology for cross-pollination in agriculture. Based on this brainstorming session, these major areas were classified into 16 sub-priority areas for future studies: genetic diversity (1), pollination studies (3), development of breeding techniques/mass rearing of honey bees (8), honey products (2), molecular markers (2), besides development of database and status report. It is expected that these biotechnological interventions in honey bees will change the present scenario of apiculture in the country leading to nutritional security, natural medicinal source, new genotypes and behaviour, employment and income generation through quantitative and qualitative transformation in national and international trade of honey and its associated products to make India the number one exporter in the world market.

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MEETING REPORT

Insect pest management*

One of the important problems in agriculture is the loss of agricultural produce due to attack by insects. Farmers rely largely on chemical pesticides to save their crops from insect pests. The use of chemical pesticides like DDT, BHC and organophosphate pesticides for insect pest management (IPM) has resulted in the decline of biocontrol agents and other beneficial insects, secondary pest outbreak and emergence of insect strains resistant to pesticides. There is a growing concern among people over the accumulation of pesticides in the food chains. These problems have prompted the scientific community to find non-toxic and environment friendly alternatives to chemicals.

From time to time, researchers have found many ecofriendly alternative methods such as botanical pesticides, attractants and repellents, insect growth inhibitors and biological control. IPM strategies have gained increased attention in recent years as a potential means of reducing commodity losses to pests. Biointensive IPM or 'ecology-based pest management' is gaining grounds. Recently, many farmers have followed non-pesticidal management.

Pest management tactics that minimize environmental impact will contribute to the stability of agricultural systems. With a view to review the latest trends and technologies in IPM, a national symposium on recent trends in IPM was organized.

Deliberations during the symposium covered various aspects of pest management techniques. Totally 62 papers under eight sessions were presented by scientists and scholars from different parts of the country on aspects of host plant resistance and transgenics, microbial technology in IPM, induced resistance in host plants, genetic improvement of entomophages, improved technology for mass rearing of natural enemies, bioefficacy of entomopathogenic fungi and nematodes, insect cell culture technology for production of entomopathogenic viruses, new botanical formulations for ecofriendly pest management, importance of molecular and beha-

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