glycerol and sucrose content. However, further investigation is warranted to refine the technique, once the exact nature of the damage to the embryos and nauplii by various factors during cryopreservation is known.

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NEWS

Ecofriendly microbes as agents in insect pest control*

Pesticides have been the weapon against all insect pests and have contributed unprecedented effects in nature. The growing concern about their ill-effects has necessitated a change in our strategies to manage insect pests in an ecofriendly manner. Search for alternatives that would leave no negative effects on the environment prompted scientists to look for biopesticides such as microbial pesticides. India with a large agrarian society and with agriculture as the prime occupation needs to concentrate on this aspect. Papers presented by scientists from all over the country in a national symposium on microbials in insect pest management, that was organized to discuss the developments in India have stressed this aspect. Research papers were drawn on different areas such as identification and development of new microbial agents for pest management, mass production and utilization, microbial management for education, employment, economics and manpower development, etc. Some of the desirable attributes of microbial control agents and nematodes are: Rapid spread, power of search for host, persistence, safety and acceptability, control to sub-economic level, predictable control, virulence, easy production, low cost, good storage and easy application.

While admitting the success of *Bacillus thuringiensis* (*Bt*) in insect pest management this conference discussed the part played by various other microbes, viz. virus, bacteria, fungi and protozoans. A survey for the indigenous microbial pathogens resulted in the isolation of *Pandora delphacis, Beauveria bassiana, Entomophthora aulicae, E. grylli, Fusarium* sp., *Metarhizium anisopliae, M. flavoviridae, Verticillium lecanii* and isolates of NPV, from different insect pests like *Helopeltis theivora, Buzura suppressaria, Oligonychus coffeae, Nephotettix virescens, Oxya velox*, etc. (Table 1).

Most of the organisms tested for field insect pest control caused more than 50% mortality.

Results on the combinational studies revealed possible synergism of *M. anisopliae* and optimum level of synthetic insecticides against *Spodoptera litura*. *Bt* and Neem Azal were found to be more effective on *S. litura* whereas *Bt* alone was effective on *Plutella xylostella*. Additive and synergistic interactions of nematodes (*Steinernema carpocapsae*) and *Bt* showed considerable effect on root grub (*Holotrica serrata*).

Field application tests proved the superiority of wettable powder formulations where 66% mortality of rice green leafhopper (*Nephotettix virescens*) was recorded. Wettable powder, oil and freeze dried formulation showed differential

Table 1. Micro-organisms isolated from various sources

Micro-organism	Source
Verticillium lecanii *Beauveria bassiana* NPV	*Oligonychus coffeae* *Helopeltis theivora* *Buzura suppressaria*
Pandora delphacis, Beauveria bassiana, Entomophthora aulicae, Fusarium, Metarhizium flavoviridae	*Nephotettix virescens*
Bacillus thuringiensis	Soil

*Based on the National Symposium on Microbials in Insect Pest Management conducted at Entomology Research Institute, Loyola College, Chennai during 24–25 February 2000.

results in *S. litura* population in field conditions. Liquid formulations of *M. anisopliae* were stable and effective against diamond black moth (*Plutella xylostella*).

The use of NPV against teak leaf defoliator (*Hyblae puera*), groundnut red hairy caterpillar (*Amsacta albistriga*), southern armyworm (*Spodoptera litura*), cotton boll worm (*Helicoverpa armigera*) and caterpillars of *Spilosoma obliqua* was highlighted. While the protozoan *Vairimorpha* sp. was found to be effective against *S. litura*, it was not effective against *Bombyx mori* and *Apis cerana indica*. Local isolates of *Bt* available in the Indian soil proved to be toxic to *S. litura*.

The much studied and discussed fungi *Beauveria bassiana* was found to be effective against *H. armigera, S. litura* and stored product pest *Sitophilus oryzae*; also the fungus *Nomuraea rileyi* was found to be effective against *H. armigera* and *S. litura*.

The symposium admitted the necessity to isolate more geographical isolates of NPV, *Bt*, and promising fungi for insect pest control and highlighted the need for genetic improvement of microbials. Issues related to the formulations, mass production possibilities, culturing of host insects, environmental factors, timing of application, inoculum potential, inoculum load, virulence, safety and quality control were also discussed.

Improvement of inoculum load in the formulations, safety to non-target organisms and beneficial insects, genetic changes in the hosts, standard bioassay procedures, combating spurious cultures, adverse effects to humans during production and use, were discussed.

The symposium concluded with the panel discussion that highlighted the need for the following:

(1) Technology for large-scale production of microbials; (2) Identification of nodal centres of excellence for technology transfer like, KVK, SAUs, ICAR, and institutions like ERI; (3) Developing a protocol for an effective implementation of programmes in vast and diverse areas; (4) Detachment of scientists from commercialization and involvement of commercial organizations for bioefficacy testing; (5) Development of good R&D based programmes in microbials by research institutes at least for another 10 years till effective and quality commercialization takes root; (6) Training of manpower for microbial production and entrepreneurship; (7) Anticipatory research in the management of insect resistance; (8) Further work on insect fungal pathogens and establishment of identification services; (9) Identification of important crops for use of microbials and economic threshold level; (10) Encouragement of combinational studies such as botanicals, microbials, etc.

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Genetically modified foods: Report on a workshop

Gene Campaign, a 'specialist' science-based NGO working on bioresources, related-IPR, food security, farmers rights, etc. organized a day-long workshop on 'Genetically Modified Foods: Pros and Cons for Developing Countries', in Delhi on 25 April 2000. This workshop was the first in a series of several such meetings planned to debate the pros and cons in India of genetically modified (GM) crops.

This interactive workshop, aimed at starting an informed debate on this contemporary and controversial subject of far-reaching importance for India, was attended by a large number of people from relevant government departments and ministries, consumer organizations, science and research institutions, students, research scholars of various universities, policy-makers, trade unions, politicians, diplomats, lawyers, media and the NGO community. Speakers at the workshop highlighted various aspects of GM technology and its relevance to countries such as India, as also the areas of concern with respect to GM foods.

Deepak Pental of the University of Delhi highlighted the importance GM technology to Indian agriculture. He noted that in future GM varieties would help achieve durable disease resistance and increase the nutritional value of crops. To achieve this, a careful identification of goals, collaborative research, proper safety tests and evaluation of yield potential and ecological impact were necessary. Pental stressed that transgenic technologies should be explored as an adjunct to conventional methodologies. To exploit this, India will have to put in place a durable infrastructure and nurture its vast human resources potential.

Malathi Laxmikumaran from TERI, explained the methods by which genetic engineering is done in the lab, and how genes are cut out from bacteria and put into plants to make GM varieties. She explained how GM technology can be used to add value to crops, giving the example of the research on 'golden rice' supported by the Rockfeller Foundation. This research has added vitamin A and iron to rice which is otherwise a nutritionally poor cereal. Researchers in the Jawaharlal Nehru University, Delhi are trying to put protein genes from Amaranth (Chaulai) into potato to increase its nutritional value.

Suman Sahai of Gene Campaign spoke about the areas of concern associated with the new GM technology. Whereas GM foods had undoubted potential to help produce more and better food, this was not being done. GM technology was controlled by six multinational corporations who were directing the research to commercial agriculture and maximizing corporate profits, not to the needs of small farmers or to alleviating hunger. The attempt of the MNCs to establish their monopoly over the GM sector by IPR laws must be countered.

GM technology in India should not follow the research goals in the West; it should be applied to our problem areas where conventional breeding has not succeeded, like in producing improved varieties of pulses and oilseeds.

GM foods is a new and emerging science-based technology. Further studies are needed to understand its impact on human health and the environment, specially in Indian conditions. Serious efforts will have to be made so that this