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TERI a technology leader for sustainable tomorrow

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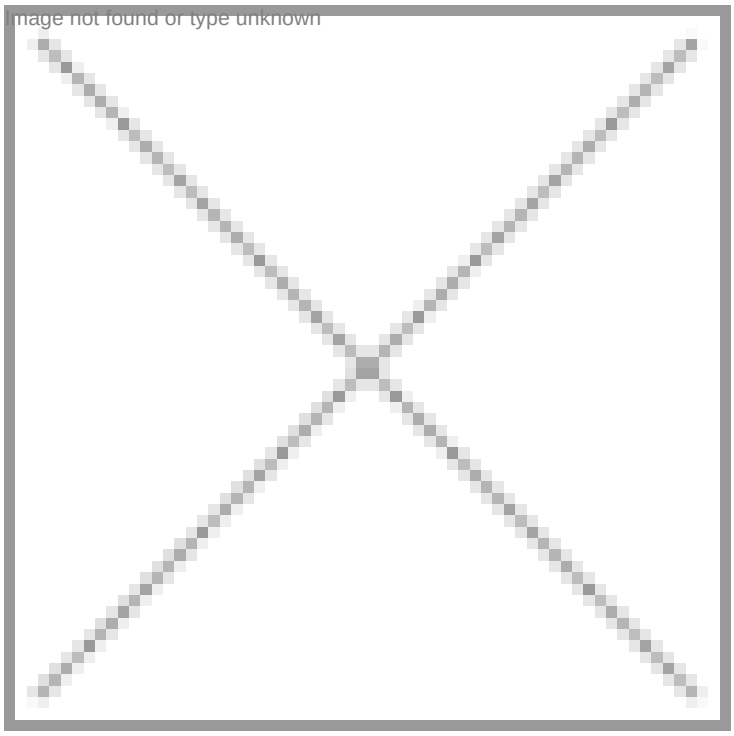


TERI a technology leader for

sustainable tomorrow

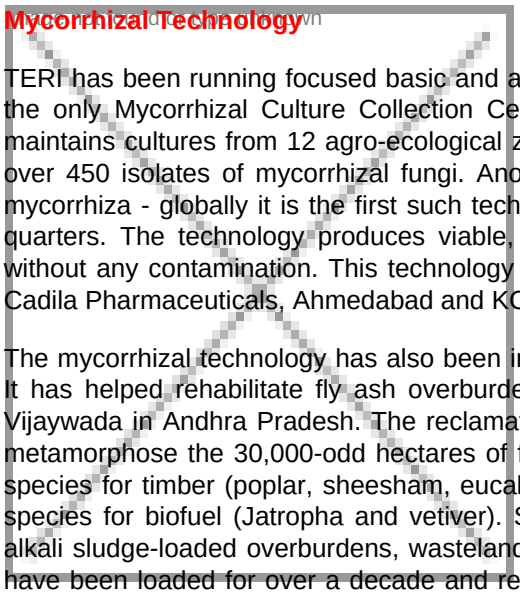
TERI has purposefully developed a bank of technologies that have immense potential to reduce the modern development stresses on the world's natural wealth.

The research inter
ests of The Energy and Re
source Institute (TERI)
span a wide spectrum focusing on energy, environment, and sustainable development. Its vibrant bioresources and biotechnology division has developed an array of technologies/products that are consumer-friendly, cost effective and environmentally safe. In a unique development, recently, TERI partnered with the US-based GTI Ventures LLC, for global commercialization of its technologies. This collaborative approach will marry the world-class technologies developed at TERI and GTI Ventures expertise in launching new business enterprises. GTI and TERI expect to launch their first commercial spin-out in early 2006. The new venture will focus on the sophisticated research in microbial biotechnology for remediation of oil spills and micorrhizal technologies developed and patented by TERI. It is envisaged that this tie-up will increase TERI's technology leadership for a sustainable tomorrow and will mark the beginning of a new chapter in the history of the institute.

Over the years, TERI has silently and steadily developed a strong focus in the microbial and plant biotechnology arena. A

snapshot of the activities at its biotech division is presented here.

Mycorrhizal Technology



TERI has been running focused basic and applied mycorrhizal research programs since 1986. Presently the institute houses the only Mycorrhizal Culture Collection Center, not just in India but also in Asia too. The culture depository holds and maintains cultures from 12 agro-ecological zones out of the 20 identified for the country and has an impressive collection of over 450 isolates of mycorrhizal fungi. Another laudable achievement is an innovative technology for mass production of mycorrhiza - globally it is the first such technique developed and has been arousing interest from national and international quarters. The technology produces viable, healthy, genetically pure and high quality fungal proagules on a mass scale without any contamination. This technology was commercialized in 2000 and has been licensed to four industries including Cadila Pharmaceuticals, Ahmedabad and KCP Sugar and Industries Corporation, Hyderabad.

The mycorrhizal technology has also been innovatively used for diverse applications in environmentally stressed ecosytems. It has helped rehabilitate fly ash overburdens in Thermal power stations at Badarpur in Delhi, Korba in Chattisgarh and Vijaywada in Andhra Pradesh. The reclamation technology based on mycorrhiza organo-biofertilizer is promising enough to metamorphose the 30,000-odd hectares of fly ash dumps in India into a huge commercial success with the planting of tree species for timber (poplar, sheesham, eucalyptus), floriculture and aromatic species (marigold, sunflower, lemongrass), and species for biofuel (Jatropha and vetiver). Similarly major success stories have been achieved in the reclamation of chlor alkali sludge-loaded overburdens, wastelands loaded with high organic distillery effluents as well as solar drying ponds that have been loaded for over a decade and reclamation and disposal of black liquor from paper industry sites. This innovative process has been highly cost effective and offers economic gains from soils that have been considered dead for all this while.

Realizing the importance of Jatropha as a clean substitute to biodiesel, the division has developed an unconventional method of "mycorrhiza application", which helps the plants to grow faster and better. Compared to the standard method that takes two years for the plant to yield, with this unconventional method, the first yield arrives seven months after cultivation. This technique also leads to higher yield and biomass in Jatropha. Based on the success of mycorrhized Jatropha plantations in the country, TERI has been identified by the Ministry of Rural Development, Department of land resources, Government of India to prepare a detailed project report for the National Mission on Biodiesel. Besides collaborative plantations, TERI is also transferring the know-how of the technology to several corporate houses. Presently the division is working on next generation technologies. It is developing hyphal fusion based species which can isolate and retain heavy metals and can withstand high temperatures, ideal for plantations in deserts and the gulf countries.

Nutritional improvement of oilseeds

Nutritional improvement of oilseeds has been an important mandate for TERI. Rapeseed mustard, the second most important edible oilseed crop in India, in spite of its nutritional advantages has a high content of harmful erucic acid and glucosinolates and does not match up to the requisite international standards of canola quality. The division initiated work on the genetic enhancement of oilseeds during the early 1990s to improve the nutritional quality of Brassica species. A combination of conventional methods of plant breeding and biotechnological approaches were employed to develop new strains. As a result seven genetically enhanced rapeseed-mustard strains have been registered with the ICAR's committee on germplasm registration. One of them, TERI Uttam Jawahar is the first double low variety of Brassica napus in India. It has a high oil content, (more than 43 percent), is tolerant to pod shattering, and white rust and has high oleic acid (more than 60 percent) desired for better shelf life. It yielded on par or higher than the national check varieties and has been released for cultivation in Madhya Pradesh.

Even with a conservative estimate, the TERI Uttam oil and meal together is expected to fetch almost double the price per hectare and have tremendous export potential in the global markets. Currently work is on to combine these improved traits in other Brassica species as well as to create a useful variability for fatty acids to derive value added products for consumption. Simultaneously efforts are being made to transfer genes that confer resistance to fungal diseases in mustard through in vitro embryo rescue techniques.

Bioprospecting

Bioprospecting of plant species for different uses is another important area of research at TERI.

It focuses on screening the diversity of bioactive molecules. In a two-pronged approach, on one hand, new active molecules are identified, while on the other, the diversity of active principles are screened in different accessions growing in various parts of India. Laboratory and field studies have been undertaken to test the pesticidal activity of plants of family Myrtaceae against the Cotton bollworm (Helicoverpa armigera). Results have shown that the formulations are effective in disrupting the behavior and physiology of these pests, while maintaining the balance and cleanliness of the agroecosystem and have the potential of being utilized under integrated pest management of conventional cotton, Bt cotton, and chickpea.

The division is also studying the chemical variability of known active principles and has identified elite neem trees with azadirachtin content of more than one percent and oil content of more than 50 percent. These trees serve as valuable germplasm for plantation programs. Work on other species like Withania somnifera, glycerrhiza glabra, Tylophora indica, Jatropha curcas, Pongamia pinnata and the wild apricot is in progress. TERI is the nodal centre for chemical characterization (oil content and fatty acid analysis) of Jatropha and Pongamia under the Indian Government Bio-diesel network program. More than 700 accessions of Jatropha curcas collected have been analyzed by TERI for their oil content. Accessions having more than 35 percent of oil content have been identified, which will serve as valuable germplasm, not only for plantation programs but also for genetic improvement of the tree.

Micropropagation Technology Park

TERI has successfully achieved large-scale propagation of superior clones of various plant species through tissue culture, where conventional methods of propagation have failed. Its
36-hectare Micropropagation Technology Park at Gual Pahari, Gurgoan has an annual capacity to produce over 2 million tissue-cultured plants. So far, over12.8 million tissue-cultured plants of various forest trees, fruit crops, medicinal and aromatic plants, vegetables, cash crops and ornamentals have been supplied by TERI to various forest and horticulture departments, agro-based companies, farmers etc. The division currently possesses the expertise to undertake mass multiplication of over 75 different plant species. It is currently working on the mass production of citrus fruit crops, apples, walnut and bamboo species through tissue culture. And in association with the forestry department, TERI is developing three bamboo situms at Hyderabad, GB Pant University in Pantnagar and Guwahati housing the best mother clumps, which will be available to all
researchers across the country. In a recent initiative, TERI has set up "TRISHA", TERI's Research Initiative at Supi for Himalayan Advancement in Mukteshwar, Uttranchal. Currently here the tissue cultured plants of various temperate crops; particularly those of medicinal interest are being hardened.

Microbial Biotechnology

The microbial biotechnology group at TERI has developed technologies, which hold immense potential for the production of energy and the control of environmental pollution. It is involved in bioremediation of sites contaminated with crude oil spills and treatment of oily sludge using "Oilzapper", a bacterial consortium. More than 30,000 tons of soil contaminated with oily sludge and oil have been treated and about 10,000 tons is under treatment at several oil refineries. At present, Bharat Petroleum Corporation, Hindustan Petroleum Corporation, the Oil India and ONGC are using Oilzapper. This technology has been transferred to Bharat Petroleum Corporation, Mumbai for their captive use and has been successfully demonstrated abroad as well, at Kuwait Oil Company, Kuwait. In a related innovation, the division, along with the R&D center of the Indian Oil Corporation has developed Oilivorous-S for treatment of high sulphur containing oily sludge and Oilivorous-A, for acidic sludge. For this breakthrough, TERI and its partner, Indian Oil Corporation jointly won the Annual National Petroleum Management Program Award in May 2004 under the "Creativity and innovation in R&D category". Further the division has identified and isolated bacterial strains for the removal of paraffin from oil wells, enhanced oil recovery from oil wells, and selective removal of sulphur from diesel oil.

Presently active research is under way for the production of hydrogen using microbes and the principle of photosynthesis; quick identification of microbes using PCR based techniques; and bioremediation of soil contaminated with pesticides.

Thus, TERI's Bioresource and Biotechnology Division has been developing a pool of sustainable, workable and viable solutions in the areas of microbial and plant biotechnology, which can help not only the country but the world at large to grapple with some of the environmental and energy issues plaguing it.