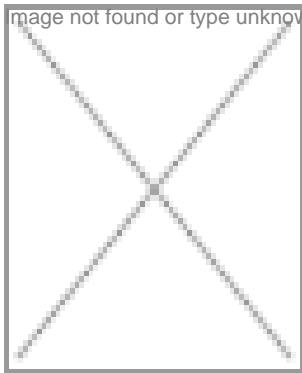


Mycorrhizal intervention to boost agri outcome

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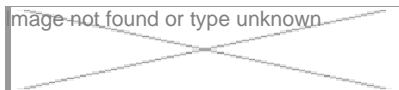


The novel Mycorrhizal technology created by Dr Alok Adholeya and his team at The Energy and Resources Institute (TERI) New Delhi has made a significant foray in creating agricultural transformation. In this part of the CSO series BioSpectrum meets up with Dr Alok Adholeya to understand the technology and its applications.



In an agriculture dependent country like India where there are large tracts of barren land, the mycorrhizal technology can change the topography. From the reclamation of abandoned fly ash dumps and dump yards contaminated with chlor alkali sludge to food and fodder crops in saline is technology has proven to be highly effective.

With utilization of this technology at the basic level, agricultural investments can be significantly controlled. Its use in forestry and agricultural activities can reduce chemical load into the system production cost effective.



Technology nitty-gritty

Mycorrhiza is the only known fungal system categorized as a biofertilizer. It helps the roots to tap soil nutrients, which are otherwise beyond their reach. However, its application is limited owing to constraints related to mass inoculum production. The Centre for Mycorrhizal Research (CMR) at TERI solved the problem by developing mass inoculum production technology for AM (arbuscular mycorrhizal) fungi. Initiated by Dr Alok Adholeya, in 1991 the project received impetus in 1993—with the funding of around \$2 million (10 crore) from Department of Biotechnology (DBT), India, the technology reached

commercialization point in 2000. Since then it continues to be the only such available technology in the world.

This technology has exploited the genetically modified host roots using *Agrobacterium rhizogenes*, carrying Ri T-DNA plasmid to mass produce viable, healthy, genetically pure, and high quality fungal propagules without any pathogenic contamination under in vitro sterile environment.

The CMR Area's Mycorrhizal organic fertilizers offer sustainable and environment-friendly solutions to most of the cultivated plants and crops. It is said to enhance nutrition and yields upto 25 percent and curtail the chemical fertilizer inputs by 50 percent. Fertilizers are also effective in wasteland reclamation, and offer benefits to agricultural, forestry, horticulture, and bio-diesel plants.

Applications abound

According to Dr Alok Adholeya, who has led this development the farmers generally use *Rhizobium* for all the crops while it can be used for around 85 percent of the total crops in India. They are ignorant about the fact that it cannot be used everywhere. With this technology, both the existing and the remaining 15 percent can be covered. Dr Adholeya is the director, Biotechnology & Management of Bioresources Division at the Energy and Resources Institute (TERI) in New Delhi.

Dr Adholeya who bets on its cost effectiveness. "This cost effective safe technology on the higher side can save about 30-50 percent per acre in forestry and approximately 25-50 percent per acre in agriculture," he says.

The Mycorrhizal product formulations developed by the CMR according to each type of plant and kind of implementation are tablets, granules, gels, dry spray, seed coating, seed inoculation, root dipping and irrigation system compatible. The wide applications of the technology include the phytostabilization which revives soil where pesticide-use frequency is high. It revives disturbed and degraded soil, prevents erosion, prevents removal of top soil and also enables greening of desert areas thanks to reclamation technologies. More than 90 percent of all plants in nature can form a symbiotic association with the Mycorrhiza.

Mycorrhizal application to *Jatropha* was found to speed up the process of flowering and fruiting, and the first yield was after seven months of cultivation. This technique also leads to higher yield (upto 30 percent) and plant biomass. This is an innovative way to manage effluent disposal in the country employing Microbial Remediation Technology (MRT) to reclaim one of the distillery effluent loaded site in Madhya Pradesh. The technology employs Mycorrhiza and a few other useful microbes to restore the greenery of the land. It alleviates the loading of effluent in unit land area, lowers the level of groundwater contamination, and reduces land pollution of adjoining agricultural lands.

The CMR has developed the reclamation technology based on Mycorrhiza organo-biofertilizer for fly ash, which is promising enough to metamorphose the 30,000 odd hectares of fly ash dumps in India into huge commercial plantations. Besides that the toxic wastelands created by the alkali-chlor sludge were successfully reclaimed.

Industrial value

The technology was transferred to many industries and resulted in the development of the commercialized product, which is available to end users. The mass production of Mycorrhiza Biofertilizer catered to Cadila Pharamceuticals, Ahmedabad in December 2000 and to KCP Sugar and Industries Corporation, India, in February 2001. Besides that the improved technology of mass production of Mycorrhiza Biofertilizer was supplied to Cadila in May 2001. Mycorrhiza Consortium Production was done for KCP Sugars and Industries, Andhra Pradesh, in 2005; Magestic Biotech, New Delhi, in 2004, Cosme Pharma, Goa in 2005 and to Sarita Ganga Farms, Ahmedabad in 2006.

Also for the reclamation of industry created wastelands, the beneficiaries of the technologies are National Thermal Power Corporation, Tata Chemicals, Fly Ash Mission, TIFAC, Madhya Bharat Papers, Associated Alcohols and Breweries all based in the country.

Technology Creator

Dr Alok Adholeya got his doctorate from the department of microbiology, G.B Pant, University of Agriculture & Technology, Pantnagar and Jiwaji University, Gwalior, India which he completed in the year 1988. Prior to that, after doing his Master's in Botany from Jiwaji University in 1984, he worked at Tata Energy Research Institute (TERI), New Delhi for couple of years from August 1986.

His research interests include the soil fertility, soil and plant microbiology, nutrient cycling, bioremediation using microbes and plants, mass production of Mycorrhizae biofertilizer using transformed root organ cultures.

Dr Adholeya is well versed with mycorrhizal isolation, characterization (both morphological and molecular), inoculation, colonization assessments and efficiency tests. He also has working experience of soil and plant analysis methodologies. He

has a practical experience of field trial evaluation, designing and management, transformation techniques, enzyme assays, Radio tracer techniques and a fair knowledge of statistical analysis of data.

Recipient of numerous awards for developing this technology, Dr Adholeya has been a well known name in this field now. He was presented a memento of honor by then Minister of Science & Technology, Dr Murali Manohar Joshi for mycorrhiza technology on in 2000. He also received 'Paryavaran Sanrakshan Samman' in the year 1999 by then Chief Minister of Madhya Pradesh, Mr Ajit Jogi. He was awarded by Bhoomi Nirman, Agricultural and Rural Development monthly newspaper for his significant contributions in biotechnological applications in rural areas. He was also honored with the Best Paper Award on Environmental Applications in the VIIth World Bamboo Congress in February 2004 at New Delhi.

But among all of the honors and awards received so far, Dr Adholeya feels proud to have received the honor by Department of Biotechnology, Ministry of Science and technology on Technology Day in 2004. DBT recognized his efforts awarded him with the prestigious "Biotech Product & Process Development and Commercialization Award, 2004"

Besides being the chief editor of Mycorrhiza News, Dr Adholeya is a member of editorial boards of many national and international journals. Few of those include the International Mycorrhiza Journal, published by Springer Verlag, Germany, as the only Asian in the editorial board. Swedish Journal of Agriculture, a reputed international journal of Agriculture published by TAYLOR & FRANCIS group. Indian Journal on Microbiology, published by the Association of Microbiologists of India, IARI, India. Biology and Fertility of Soils Journal, published by Springer-Verlag, Germany.

Dr Adholeya who has attended 80 conferences and seminars so far, has around 58 publications in international referred journals and 22 publications in national journals. Besides guiding nine PhD students, he has also authored a book on Production and Technology of Biodiesel-Seeding a Change. He has been a visiting faculty of Deakin University, Australia since March 2010.

He is the member of numerous expert groups and societies. Such as the World Bank Biofertilizer Programme and Indian Council of Forestry Research and Education.

Dr Adholeya is also a member of a large number of expert groups/societies, DBT, Ministry of Science and technology, New Delhi; Member, Inter-disciplinary research committee (IDRC); DBT Member, Program Advisory committee (PAC) for Fly Ash Unit; DST Member, Science and Society; DST Indian Council of Forestry research and Education; Department of Science and Technology, New Delhi; Department of Biotechnology; Indian Council of Agriculture Research; Ministry of Non-Conventional Energy Sources, New Delhi; and Department of Environment, New Delhi.

Besides being a part of the World Bank Biofertilizer Programme, Dr Adholeya has been a member of International Foundation for Science, Sweden; Food and Agriculture Organization, Thailand; Technical Advisory Committee of Mycorrhizae Network Asia; Mycological Society of America, New York, USA; British Mycological Society, UK; Society of Biological Editors, USA; Chairman, Task Force-Biofertilizers; Member, Advisory Board, International Risk Governance Council (IRGC)

Dr Adholeya who is also on the European Network for Mycorrhizal technology, says " Europeans have been fast to adopt this technology. India has to gear up and learn a lot from them."

The current research activities in his lab include the evaluation of this technology for the different cropping system in India and worldwide. These include the ones in agriculture, horticulture and forestry, essentially the crops such as sugarcane, wheat, various vegetables, pomegranate and jatropa.

The continuous efforts are on to better this technology. How it can be utilized for different purposes is being evaluated.

In the words of Dr Adholeya, "My mission is to make the end user happy and the vision is to develop this technology towards offering the one stop-solution to the farmer."

Rahul Koul in New Delhi