

R&D Area: Biomass Biology & Eco-Auditing

Goal:

R&D on eco-monitoring, environmental impact assessment, eco-friendly models that are technologically and economically feasible for remediation of polluted soils and waters.

Objectives:

- R&D related to biomass biology of biofuel plants
- Pollution remediation from contaminated soils and waters
- Responses of plants to atmospheric/climate changes
- Environmental Management of degraded/marginal sites
- Waste Utilization & Management
- Environmental Impact Assessment and Environmental Auditing

Competencies:

- Development and demonstration of agro-technology for *Jatropha* plantation on marginal soil for the production of biodiesel
- Revegetation of overburden dump and degraded/marginalized sites
- Monitoring of auto-exhaust pollution by roadside plants
- Assessment of impact of fly ash for growth of plants in and around thermal power stations
- Bioremediation of polluted water bodies: an ecofriendly and sustainable approach
- Evaluation of eco-restoration of sodic soil after reclamation
- Low-cost scientific vermicomposting models.
- Lead assessors and Internal Auditor for ISO 14001 and ISO 17025, respectively.

Facilities:

- NABL Accreditation under ISO 17025 for testing of environmental samples (Water and Soil)
- Recognized “Environmental Laboratory” under Section 12(1) of the Environment Protection Act, 1986 by Central Pollution Control Board, New Delhi for soil, water, nutrients and pesticide residue analysis.
- ENVIS Centre on “Plants and Pollution”
- Environment Impact Assessment and Auditing of industries
- Low-cost scientific waste utilization and management.

List of Ongoing projects:

Grant in-aid

- Multilocational trial of *Jatropha curcas* in different agroclimatic zones and study of Agronomic practices. (DBT) (2009-2012) (Dr. Nandita Singh)
- ENVIS Centre on “Plant and Pollution” at NBRI under Environmental Management Capacity Building Technical Assistance Project. (MoEF) (2003-continuing) (Dr. Nandita Singh)

- Assessment of arsenic pollution and bioremediation of arsenic contamination from agricultural soils. (DBT) (2011-2014) (Dr. Pankaj Kumar Srivastava)

Significant Achievements:

- **Biofuel: an alternative conventional fuel:** Around 50 accessions of *Jatropha curcas*, a known source of biodiesel, were collected from Uttar Pradesh, for field demonstration trials in degraded soil. Comparative evaluation was undertaken for plant growth, fruit and seed yield (Fig 3.), and seed oil content of the accessions in varying soil types for 3 years. Based on the performance elite accessions have been selected by Ministry of New and Renewable Energy (biofuel Nodal Ministry, GOI) for distribution to farmers and entrepreneurs, across the country for biofuel production.

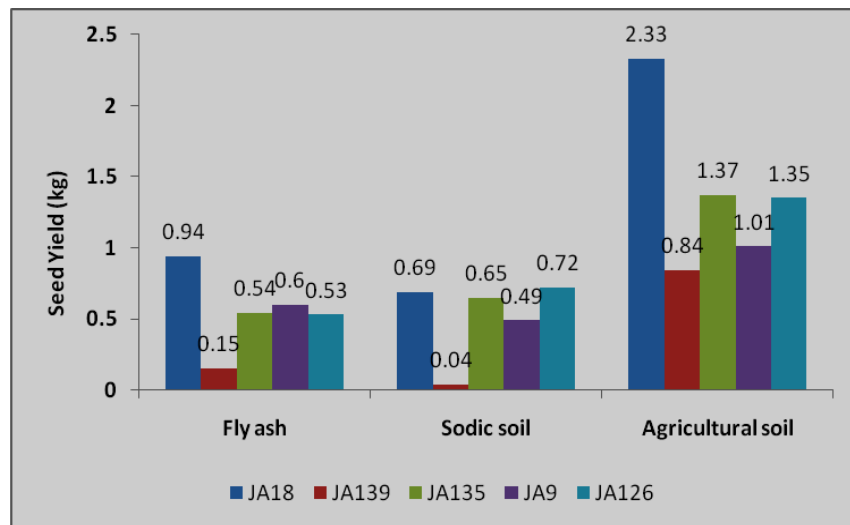


Fig. 1 Seed yield in different accessions of *J. curcas* in varying soil types after 3 year of plantation

- **Biocontrol of *Parthenium hysterophorus* through eco-friendly management:** A product prepared with methyl carboxylic acid, aliphatic carboxylic acid and leaf and bark extracted fraction of *Terminalia arjuna* was found to control the weed without effecting the grass, where it generally grows.



Fig. 2. Effect on *P. hysterophorus* before and after spraying of the product

- **Bio/phytoremediation of arsenic from contaminated soil using ferns, bacteria and fungi:** Based on high arsenic accumulation and translocation to fronds, as well as its effective anti-oxidative system comparable to *Pteris vittata*, a known arsenic hyper-accumulator, has established Indian fern *Adiantum capillus-veneris* as a new arsenic hyperaccumulator and suitable for phytoextraction. Seven bacterial strains and 3 fungal strains isolated from arsenic contaminated soil of West Bengal were found to be hyper-tolerant to arsenic and effective in arsenic removal (bioaccumulation/biosorption and biovolatilization)

Recent Publications:

- Singh N, Ma LQ, Srivastava M, Rathinasabapathi B - Metabolic adaptations to arsenic-induced oxidative stress in *Pteris vittata* L. and *Pteris ensiformis* L. Plant Science, 2006, 170: 274 – 282 (SCI).
- Srivastava M, Ma LQ, Singh N, Singh S - Antioxidant responses of hyper-accumulator and sensitive fern species to arsenic. Journal of Experimental Botany, 2005, 56:1335-1342 (SCI).
- Tripathi RD, Srivastava S, Mishra S, Singh N, Tuli R, Gupta DK, Maathuis FJM - Arsenic hazards: strategies for tolerance and remediation by plants. Trends in Biotechnology, 2007, 25: 158-165 (SCI).
- Abhilash PC, Jamil S, Singh N - Transgenic plants for enhanced biodegradation and phytoremediation of organic xenobiotics. Biotechnology Advances, 2009, 27: 474-488 (SCI).
- Singh N, Raj A, Khare PB, Tripathi RD, Jamil, S - Arsenic accumulation pattern in 12 Indian ferns and assessing the potential of *Adiantum capillus-veneris*, in comparison to *Pteris vittata*, as arsenic hyperaccumulator. Bioresource Technology, 2010, 101: 8960-8968 (SCI).
- Srivastava, PK, Kulshreshtha, K, Mohanty, CS, Pushpangadan, P, Singh A - Stakeholder-based SWOT analysis of successful solid waste management for Lucknow, India. Waste Management, 2005, 25: 531-537. (Elsevier - SCI)
- Srivastava, PK, Vaish, A, Dwivedi, S, Chakrabarty, D, Singh, N, Tripathi, RD - Biological removal of arsenic pollution by soil fungi. Science of the Total Environment, 2011, 409: 2430-2442. (Elsevier - SCI)
- Srivastava, PK, Baleshwar, Behera, SK, Singh, N, Tripathi, RS - Long-term changes in the floristic composition and soil characteristics of reclaimed sodic land during eco-restoration. Journal of Plant Nutrition and Soil Science, 2011, 174: 93-102. (WILEY-VCH - SCI)
- Srivastava, PK, Singh, PC, Gupta, M, Sinha, A, Vaish, A, Shukla, A, Singh, N, Tewari, SK - Influence of earthworm culture on fertilization potential and biological activities of vermicomposts prepared from different plant wastes. Journal of Plant Nutrition and Soil Science, 2011, 174: 420–429. (WILEY-VCH - SCI)

- Srivastava, PK, Gupta, M, Upadhyay, RK, Sharma, S, Shikha, Singh, N, Tewari, SK, Singh, B - Effects of combined application of vermicompost and mineral fertilizer on the growth of *Allium cepa* L. and soil fertility. Journal of Plant Nutrition and Soil Science, 2011, DOI: 10.1002/jpln.201000390 (WILEY-VCH - SCI)

Scientists:

- Dr. Nandita Singh, Principal Scientist
- Dr. Pankaj Kumar Srivastava, Scientist

Technical Staff:

- Dr. Sarah Jamil, Technical Assistant
- Mr. Sripal, Technician
- Mr. Munne Khan, Farm/ Field Assistant
- Mr. Surender Nath, Lab Assistant

Research Fellows/ Project Assistants:

- Ms. Vandana Singh, DST- Women Scientist
- Ms. Shubhi Srivastava, SRF
- Ms. Shailza Singh, JRF
- Mr. Ravindra Kumar, JRF
- Ms. Shikha, JRF
- Dr. Akhilesh Kumar PA-IV
- Mr. Pankaj Srivastava, PA-II
- Ms. Anshita Raj, PA-II
- Ms. Mugdha Srivastava, PA-II
- Mr. Ashish Shukla, PA-II
- Mr. Hemant Singh, PA-II
- Ms. Asma Rizvi, PA-II
- Ms. Namrata Singh, PA-II
- Ms. Manjul Gupta, PA-II
- Ms. Ayushi Kaul, PA-II