

## **Group Name: Biomass Biology, Bioremediation & Eco-Auditing**

### **Group works On:**

### **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 the biomass biology of biofuel plants.
- Pollution remediation from contaminated soils and waters
- Plant responses to atmospheric pollution and climate change
- Environmental Management of degraded/marginal sites
- Waste Utilization & Management
- Environmental Impact Assessment & Environmental Auditing

### **Competencies:**

- Development and demonstration of agro-technology for Jatropha plantation on marginal soils
- Bioremediation of contaminated soils and polluted water bodies
- Evaluation of eco-restoration of sodic soil after reclamation
- Monitoring of auto-exhaust pollution by roadside plants
- Revegetation of overburden dump and degraded/marginalized sites
- Assessment of impact of fly-ash on growth and yield of plants in the vicinity of thermal power plants
- Low-cost vermicomposting and organic bioameliorant soil formulation
- Lead assessors and Internal Auditor for ISO 14001 and ISO/IEC 17025:2005

### **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.
- MoEF – ENVIS (Environmental Information System) Centre on “Plants and Pollution”
- EIA and Environmental Auditing of industrial projects.
- Low-cost scientific waste utilization and management.

## Significant Achievements:

### Upto 11<sup>th</sup> Five-Year Plan:

- **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 (Nodal Ministry, GOI for Biofuels) for distribution to farmers and entrepreneurs, across the country for biofuel production.

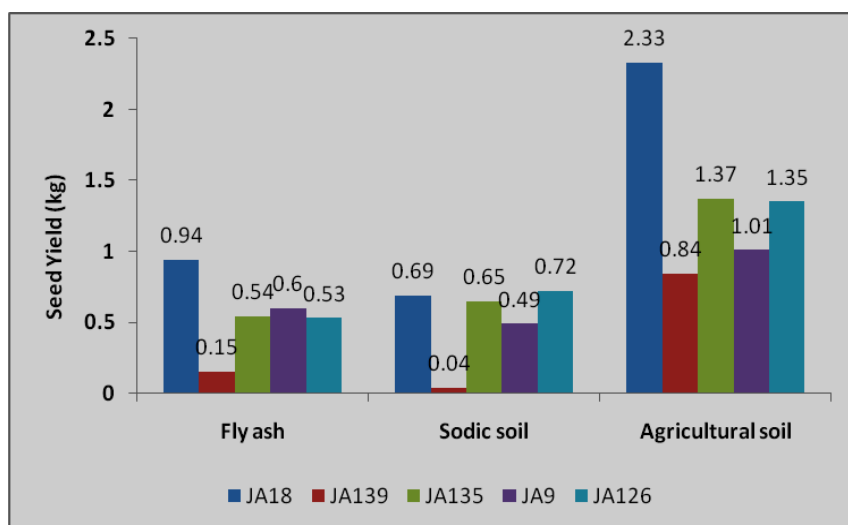


Fig. 1 Seed yield in different accessions of *J. curcas* in varying soil types after 3 year of plantation

- **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 Four fungal strains, isolated from arsenic contaminated paddy soils of West Bengal, India were found hypertolerant to arsenic and effective in arsenic removal (bioaccumulation/biosorption and biovolatilization).

## List of Ongoing projects in 12<sup>th</sup> Five Year Plan:

### NBRI in-house Project:

- OLP0086/DU-03 Bioremediation of organic and inorganic pollution

### CSIR Network Projects:

- Plant diversity: Studying adaptation biology and understanding/exploiting medicinally important plants for useful bioactives (SIMPLE). (2012-2017) (Nodal Scientist: Dr. Nandita Singh)
- Integrated NextGen approaches in health, disease and environmental toxicity (INDEPTH). (2012-2017) (Participating Scientists – Drs. Nandita Singh, Pankaj K. Srivastava)

### Grant in-aid

- Multilocational trial of *Jatropha curcas* in different agroclimatic zones and study of Agronomic practices. (DBT) (2009-2014) (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)
- Strategic knowledge for climate change on agriculture and forest ecosystem in Indo-Gangetic Plains (IGP) of U. P. (DST) (2012-2015) (Dr. Nandita Singh)
- Remediation of endosulfan contaminated soils using selected plant species and rhizospheric microbial strains. (DST) (2010-2013) (PI: Dr. Nandita Singh)

### Outside Agencies like DBT/DST/MOEF Projets:

### Foreign Collaborations:

#### Areas Open for Collaboration

- Phyto/Bioremediation of metals (As, Pb, Cr) and pesticides (lindane, endosulfan) from contaminated sites
- Phytostabilization of fly ash
- EIA and auditing of developmental projects especially Biological assessment
- C-sequestration and nutrient dynamics of forest ecosystem

### Recent Publications (2011-2013):

- Abhilash PC, Singh B, Srivastava P, Schaeffer A and Singh N- Remediation of lindane by *Jatropha curcas* L: Utilization of multipurpose species for rhizoremediation. *Bio. Bioen.*, 2013, 51: 189-193.
- Srivastava S, Verma PC, Singh A, Mishra M, Singh N, Sharma N and Singh N- Isolation and characterization of *Staphylococcus* sp. strain NBRIEAG-8 from arsenic contaminated site of West Bengal. *Appl Microbiol Biotechnol*, 2012, 95:1275–1291.
- Srivastava M, Gupta SK, Abhilash PC and Singh N- Structure prediction and binding sites analysis of curcin protein of *Jatropha curcas* using computational approaches. *J Mol Model*, 2012, 18: 2971–2979.
- Kumar A and Singh N- *Jatropha gossypifolia* L.: A potential genetic resource for herbal dye. *Genet Resour Crop Evol.*, 2012, 59: 949–954.
- Srivastava P, Kumar A, Behera SK, Sharma YK and Singh N- Soil carbon sequestration: An innovative strategy for reducing atmospheric carbon dioxide concentration. *Biodivers Conserv.*, 2012, 21:1343–1358.
- Srivastava PK, Shenoy BD, Gupta M, Vaish A, Mannan S, Singh N, Tewari SK and Tripathi RD- Stimulatory effects of arsenic-tolerant soil fungi on plant growth promotion and soil properties. *Microbes Environ.*, 2012, 7:477-82.

- Srivastava PK, Gupta M, Upadhyay RK, Sharma S, Shikha, Singh N, Tewari SK and Singh B – Effects of combined application of vermicompost and mineral fertilizer on the growth of *Allium cepa* Linn. and soil fertility. *J.Pl. Nutrition Soil Sci.*, 2012, 175(1): 101–07.
- Srivastava P, Behera SK, Gupta J, Jamil S, Singh N and Sharma YK – Growth performance, variability in yield traits and oil content of selected accessions of *Jatropha curcas* L. growing in a large scale plantation site. *Biomass Bioener.*, 2011, 35(9) : 3936-42.
- Raj A, Pandey AK, Sharma YK, Khare PB, Srivastava PK and Singh N – Metabolic adaptation of *Pteris vittata* L. gametophyte to arsenic induced oxidative stress. *Bioresour. Technol.*, 2011, 102(20) : 9827-32.
- Pandey VC, Singh JS, Singh RP, Singh N and Yunus M – Arsenic hazards in coal ash and its fate in Indian scenario. *Resources, Conservation Recycling*, 2011, 55 : 819-35.
- Srivastava PK, Vaish A, Dwivedi S, Chakrabarty D, Singh N and Tripathi RD – Biological removal of arsenic pollution by soil fungi. *Sci. Total Envir.*, 2011, 409 : 2430-42.
- Abhilash PC, Srivastava P, Jamil S and Singh N –Revisited *Jatropha curcas* as an oil plant of multiple benefits : critical research needs and prospects for the future. *Envir. Sci. Pollut. Res.*, 2011, 18 (1) : 127- 31.
- 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)
- Abhilash PC, Srivastava S and Singh N – Comparative bioremediation potential of four rhizospheric microbial species against lindane. *Chemosphere*, 2011, 82 (1) : 56-63.
- Sinha A, Srivastava PK, Singh N, Sharma PN and Behl HM – Optimizing organic and mineral amendments to *Jatropha* seed cake to increase its agronomic utility as organic fertilizer. *Arch. Agron. Soil Sci.*, 2011, 57(2) : 193–222.
- Srivastava M, Abhilash PC, Singh N – Remediation of lindane using engineered nanoparticles. *J. Biomedic Nanotechnol.*, 2011, 7(1) : 172-74.
- Vijgen J, Abhilash PC, Li YF, Lal R, Forter M, Torres J, Singh N, Yunus M, Tian C, Schaffer A and Weber R – Hexachlorocyclohexane (HCH) as new Stockholm Convention POPs—a global perspective on the management of Lindane and its waste isomers. *Envir. Sci. Pollut. Res.*, 2011, 18(2) : 152-62.

#### **Scientists:**

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

#### **Technical Staff:**

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