

AICRP- AGROFORESTRY

Objectives

- Diagnostic survey and appraisal of the existing agro-ecological conditions and agroforestry systems/practices and determination of the needs and priorities of agroforestry research in the area.
- Collection, evaluation and improvement of multi-purpose tree species suitable for agroforestry in different agro-ecological zone of the area.
- Development and evaluation of appropriate agroforestry systems/practices for the area with special reference to their productivity and sustainability under variable soil management conditions.
- Assessment of the impact of agroforestry systems/practices on soils and micro-climatic conditions in relation to productivity of intercrops as well as the trees.
- Development of nursery and tree management practices for agroforestry tree species.
- Assessment of the role and impact of agroforestry interventions in social, anthropological and economic relations, environmental conservation and development of waste and community lands.

Agroforestry research was started under All India Coordinated Research Programme (AICRP) of ICAR in 1983. Recognizing the importance, a separate Agroforestry Research Centre (AFRC) was established in the year 2003.

1. Significant Achievements:

- Four agroforestry technologies developed and recommended for the indo-gangetic region of the country.
- Patent Filed: Titled as “Development of antioxidant enriched whey-based chalta (*Dillenia indica L.*) beverage and process there of” Application Ref. No.: CA/FST/1564, Dated: 02-08-2017. Inventors: Dr. Anil Kumar, Ms. Deepika Kathuria, Ms. Garima Gandhi, Dr. Satish Kumar Sharma, Dr. C.S. Chopra, Dr. V.K. Sah and Dr. Salil Tewari
- Poplar germplasm PP-5 straight bole and borer resistant clone - registered with NBPGR (INGR11053) in 2011. Clone released for farmers’ field. This clone is being planted as check in agroforestry trials and commercial plantation in U.P. and Uttarakhand.
- **S h i s h a m** germplasm PS-52 straight bole and mortality resistance genotype registered with N B P G R (INGR11052) in 2011. This genetic stock is being used as national check in national trial and commercial plantations in forests Genetic stock : PBN 12-1 of *Bambusa nutans* for tolerant to water logged conditions registered with NBPGR: INGR-16012 after 8 years testing.2016
- Genetic stock: PDA-01 of *Dendrocalamus asper* for variegated leaves registered with NBPGR: INGR-16011 after 10 years testing.2016
- Registration of gene sequence of *Trichoderma harzianum* isolated from Bamboo rhizosphere (# bankit1249995) 935bp DNA linear for phytase protein (phy) gene with The GenBank, Bethesda, Maryland,



USA in 2009.

- Registration of gene sequence of *Trichoderma harzianum* isolated from Bamboo rhizosphere (# bankit1250155) 935bp DNA linear for phytase protein (phy) gene with The GenBank, Bethesda, Maryland, USA in 2009.
- Significant seed germination and seedling establishment was recorded in teak in March-April. Vegetative propagation through branch cuttings and roots also showing promising results.
- 5 mortality resistant and straight bole elite genotypes (PS-20, PS-38, PS-52, PS-54 and PS-90) of *Dalbergia sissoo* were selected after II generation testing (20 years evaluation) for III generation testing and establishment of seed orchard. These genotypes were included in the multi-location trials.
- Bacterial diversity in three *Dalbergia sissoo* provenances have been analysed. The soil microbial enzyme activity, metagenomic bacterial diversity and physicochemical properties indicated significant variation in phosphorous solubilizing bacteria.
- Use of biochar tried as growing media for clonal eucalyptus propagation. The results indicated higher rooting per cent, root length, shoot length and plant height of mini-cutting of *Eucalyptus* under perlite + pine needle biochar (50:50) followed by rice husk biochar

growing media.

- Poplar hybrids PH-7 and PH-9 showing promising results for height and diameter growth and borer resistance after 3 years testing.
- Regeneration of Kailashpati (*Bertholletia excelsa*) was achieved.
- New clones of Eucalyptus and *Bambusa balcooa* identified.
- Successfully coordinating master's degree programme involving different aspects on production, protection and environmental importance.
- Establishment of arboretum with collection of 110 tree species for awareness generation and growth behavior study.
- Standardization of nursery and plantation techniques for important agroforestry trees species (Poplar, Eucalyptus, Bamboo, Shisham, Kadamb and Willow).
- Registration and release of "Pant Poplar-5" clone having higher productivity and tolerance to blight and stem borer as compared to national checks (G-3, G-48 and D-121)
- Registration and release of PS-52, a shisham line for cultivation.
- Bamboo Coordinating Centre (BCC) was established under AFRC to coordinate the research trials on different aspects of bamboo in the 12 different centres across the country (2005-10)
- Clonal development of Eucalyptus, Bamboo and Shisham having higher productivity and resistance to diseases and insect.
- Agroforestry awareness raising activities such as conducting training programmes, celebration of World Forestry Day, Environment Day, Poplar Day, Bamboo Day etc. are undertaken for popularizing agroforestry technology.





2. Research Publications:

- Joshi, Kuldeep; Singh, Virendra; Kumar Ajit and Tewari, Rajnish (2018). Effect of herbage and oil yield in different *Mentha* species intercropped with poplar. *Journal of Pharmacognosy and photochemistry SPI*: 1750-1754
- Kausahl, Rajesh; Banik, RL and Salil Tewari. 2015. Flowering in culm cuttings at nursery stage in *Bambusa nutans*. *The Indian Forester*. 141(5):585-586.
- Bhandari, MS; R. Kaushal; RL Banik and SK Tewari. 2015. Genetic Evaluation of nutritional and fodder quality of different Bamboo species. *The Indian Forester*. 141(3):265-274.
- Tewari, Salil; R. Kaushal; RL Banik; L. Tewari and S Chaturvedi. 2014. Evaluation of Bamboo species in India: Results from a multi-location trial. *Indian Journal of Agroforestry*. 16(1):68-73
- Arora, Gurveen; Sumit Chaturvedi; Rajesh Kaushal; A.S. Nain; Salil Tewari, N. Meherul and OP Chaturvedi. 2014. Growth, biomass, carbon stocks and sequestration in an age series of *Populus deltoides* plantations in Tarai region of central Himalaya. *Turkish Journal of Agriculture and Forestry*. 38: DOI: 10.3906/tar-1307-94
- Kaushal, R; Salil Tewari; RL Banik; S Chaturvedi and OP Chaturvedi. 2014. Stable variegated mutant in *Dendrocalamus asper* (Schult.) Backer ex. Heyne. *Indian Forester*. 140(3): 320-321
- Tewari, Salil; R Kaushal; Lakshmi Tewari and RL Banik. 2014. Genotypic x environmental interaction in bamboo species in pan India: results from multilocation trial. *International Journal of Innovative Horticulture*. 3(1):71-77.
- Pingle, B; OPS Bana; A Banga, S. Chaturvedi, R Kaushal, S Tewari and Neema. 2014. Accounting biomass and carbon dynamics in *Populus deltoides* plantation under varying density in tarai of central Himalaya. *Journal of Tree Sciences*. 33(2): 1-6.
- Pashupat Vasmatkar, Ashutosh Dubey, Bhawna Tyagi, Pratibha Baral, Shishir Tandon, Amar Kadam (2014) "Antibacterial activity and GC-MS analysis of methanolic extract from stem, bark and leaves of *Mitragyna parvifolia* (Roxb.) Korth"; *Indo-American Journal of Pharmaceutical Research*, Vol 4 (1) pp 9345-9352 [ISSN no. 2231-6876]
- S. Sarvade, H. S. Mishra, Rajesh Kaushal, Sumit Chaturvedi, Salil Tewari and T. A. Jadhav. 2014. Performance of wheat (*Triticum aestivum* L.) crop under different spacings of trees and fertility levels. *African Journal of Agricultural Sciences*, Vol. 9(9), pp. 866-873
- Kumud Gariya1, Dwivedi, G.K.2, Vikas Kumar* and Tewari, S.K. 2016. Socio-economic Characteristics of Homegardens in Bhimtal block of Nainital District, Uttarakhand, India. *International Journal of Agriculture, Environment and Biotechnology*. Citation: IJAEB: 9(6): 1001-1013, December 2016.
- Pramila Rana1, Salil K. Tewari and Vikas Kumar. 2016. Floristic Structure, Composition and Functional Characteristics of Homegardens in Garhwal Region, Uttarakhand, India. *International Journal of Agriculture, Environment and Biotechnology*. Citation: IJAEB: 9(6): 1045-1059, December 2016
- Raj Kumar Pandey, Babita Rana1, Salil Tewari,

Anwesa Sarkar, Ashutosh Dubey, Dinesh Chandra and Lakshmi Tewari. 2016. Exploration of Plant-Biomass Degrading Fungi for In Vitro Mycoremediation of 26.

Manish. 2009. Genetic Diversity,

3. Thesis Guidance

M.Sc.

1. Anshu Aswal (39464).2011. Propagation Techniques of Kanju (*Holoptelia integrifolia* Planch.)
2. Ms. Monika (Id 40848): “*In vitro* establishment of *Mitragyna parvifolia*, medicinally important endangered tree species from apical buds” (2011-12).
3. Mr. Vasmatkar Pashupat D (Id 42750): “*In vitro* micropropagation of *Mitragyna parvifolia* (Roxb.) Korth with phytochemical profiling of its bioactive Compounds” (2011-13).
4. Tarun Kumar Rai. 2013. Genetic divergence analysis of shisham (*Dalbergia sissoo* Roxb.) elite clones under agroforestry system.
5. Ms.Pramila Rana. 2014. Assessment of structure, composition and diversity of homegarden in Garhwal region of Uttarakhand.
6. Mr. Abhay Kumar (39695). 2016. Differential Genotypic Response for Germination and Vegetative Propagation in Teak (*Tectona grandis* L.f.)
7. Ms. Apoorva Karki (Id 35976): “*In vitro* antioxidant activity and micronutrient profiling in edible bamboo species” (2012-14).
8. Ms. Nidhi Sharma (49484).2017. Genetic Variability, Selection Intensity and Early Selection in Eucalyptus species under Agroforestry System
9. Mr. Raju Pandey (48087). 2017. Clonal Evaluation and Carbon Sequestration of *Populus deltoides* Bartr. Under Agroforestry System
10. Ms.Divya Soman (51047). 2018. Comparison of Yield and Yield Attributes of Wheat and Barley

under poplar based Agroforestry System

11. Ms. Harshita Pandey (Id. 47061):2016. “Studies on soil biochemical and physio-chemical parameters in two ecosystems for soil quality evaluation”
12. Mr. Jitendra Singh (Id. 49351).2017. “Potential assessment of Poplar based agro-forestry ecosystem for soil vitality and conservation in comparison to agro-ecosystem”
13. Mr. Himanshu Pathak (Id. 50973): “Biochemical and ecochemical assessment of healthy and declining *Dalbergia sissoo* plantation to recognize plant mortality reason” (2016-18).
14. Mr. Avedanand Ray (Id.52709). 2019. Efficacy of bamboo biowaste for bio-oil production and applications of bio-oil and other byproducts’ (TENTATIVE)

Ph.D.

1. Mr. M.K. Singh . 2000. Genetic diversity, Heterosis and Isozyme Analysis in *Populus deltoides* Bartr.
2. Ms. Shubhanjana. 2001. Flowering Pattern, Reproductive Biology and Genetic Evaluation of Shisham (*Dalbergia sissoo* Roxb.)
3. Mr. S.K. Upadhyay. 2001. DNA Fingerprinting of Shisham (*Dalbergia sissoo* Roxb.) Genotypes Using RAPD Markers
4. Ms. Preksha. 2005. Germplasm Evaluation, Reproductive Biology and Polyploidy Induction in Shisham (*Dalbergia sissoo* Roxb.)
5. Ms.Lakshmi Chaudhary. 2005. Studies on Genetic Diversity in Poplar (*Populus deltoides* Bartr) using Morphological and RAPD Markers
6. Manish Singh Bhandari 2009. Genetic Diversity, Characterization and Fodder value in Bamboo species
7. Bhawana Tygai (Id 40938): “*In vitro* propagation, genetic diversity analysis and antioxidant potential of promising bamboo species.” [Completed December 2016]

8. Mohd. Talha. 2018. Studies on Genetic Diversity based on morphology, SSR Markers and Reproductive Biological Parameters in Bamboo species.
9. Pratima Raypa (Id 40846): 2019. "Studies on micropropagation with metabolite profiling for pharmacogenosic efficacy of *Adina cordifolia* and biochemical investigations of flowering in *Dendrocalamus giganteus*." [Submitted February 2019]
10. Mr. Yashwant Kumar (Id 49610):2019.

4. Future Thrust s:

- Development of the Agroforestry systems for climatically stressed conditions
- Development of the Agroforestry systems for higher carbon sequestration and carbon stocking.
- Identification of crop varieties for shade tolerance under agroforestry system Course work + Studies on PGPR and C-sequestration efficiency of bamboo species.