

# Annual Report

2020-21



**Arid Forest Research Institute**  
**Jodhpur**



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# ARID FOREST RESEARCH INSTITUTE, JODHPUR

## Annual Report 2020-21

### Overview

AFRI has executed both plan as well as externally funded projects of different funding agencies of Government of India. During 2020-21, 10 plan projects and 2 externally funded projects were ongoing. Out of this, five plan and two externally aided projects have been successfully completed, whereas two new projects (one plan and one externally aided) were initiated during this period.

Different programmes involved assessment of biological diversity of Raj Bhawan areas of Jaipur and Mount Abu, wherein a total of 412 plant species and 39 faunal species were identified from these areas. Tree species richness had been observed beneficial to herbaceous species richness, but it was stronger at Mt Abu than at Jaipur. The trials of sandalwood plantations at different locations in Gujarat and Rajasthan performed better with *Casuarina* host in Gujarat and with *Embllica officinalis* at Jaipur. Assessment of crop production, gum yield and economic benefits of *Acacia senegal* based agroforestry farmer's lands indicated significant effects of canopy density on crop yield. For IGNP plantations, allometric equations of *E. camaldulensis* and *Vachelia tortilis* have been developed for estimation of standing biomass of these species and carbon accounting of IGNP plantation.

In silvicultural practices and genetic improvement work, fruits of *Capparis decidua* collected from different locations and were categorized into large, medium and small size fruits. In this number of seeds ranged from 16-36, 18-62 and 2-6 respectively. Among three morphotypes of *Tecomella undulata*, orange colour morphotypes was higher in percentage than yellow and red morphotypes. The red flower morphotypes of *Tecomella undulata* was better in wood quality than other. Guggal (*Commiphora wightii*) plants produced black viable and white non-viable seed, where seed yield per plant varied with season and month being highest in December (24.7 seeds) and lowest in May (0.7 seeds per plant). Number of black seeds changed with the period of seed collection and seed sources also. Degenerate primers have also been prepared for cloning of the NHX1 gene from *Prosopis juliflora* and *Salvadora persica* using bioinformatics tools and characterization of salt tolerance conferring vacuolar Na<sup>+</sup>/H<sup>+</sup> antiporter genes. In study on non-destructive natural guggulsterone production, vessel conditions have been optimized and growth of good callus without any contamination was achieved.

Value addition in form of making gular, chutney, Jam & Squash and pickle of some underutilized non-timber forest products were demonstrated to SHGs, villagers, NGOs by 12 trainings in tribal areas of Sirohi and Pali district. Pod setting in Khzri trees was observed very low in heavily infested trees by mites in comparison to un-infested trees (12-16 pods per inflorescence). Integrated approach was adopted to reduce galls formation using different chemical, botanical and biological agents. A consortium of fungi, PSBs and *Azospirillum* have been developed for enhancing growth and biomass productivity of *D. strictus* and *B. bambos*

in both nursery as well as field conditions. In another study, different strains of *Rhizobium* isolated from Khejri nodules showed adaptability alkalinity, tolerant to 3% NaCl concentration, solublise phosphorus and positive chitinase activity. Consortia pf Rhizobium +Azotobacter+Bacillus were best as compared to single isolate for raising quality planting material of khejri. Hands on traing were also given to women farmers to empower them on use of biofertilizer and improve crop productivity and household earning.

Out of 31 All India Coordinated Research Projects (AICRP)and one National Programme on Conservation and Development of Forest Genetic Resources (FGR), sanctioned to ICFRE and its institutes. AFRI has taken up a total 22 AICRPs as well as in FGR programme. Among all, two AICRPs (AICRP-24 and AICRP-26) are being implemented by AFRI, Jodhpur based NPCs.

Various trainings, workshops, meeting organized including one-week compulsory training for IFS Officers awarded to Arid Forest Research Institute (AFRI), Jodhpur by MoEF&CC with the theme – “Integrated Approach for Sustainable Development of Fragile Desert Eco-system”. It was organized successfully from December 14 to 18, 2020 in online format.

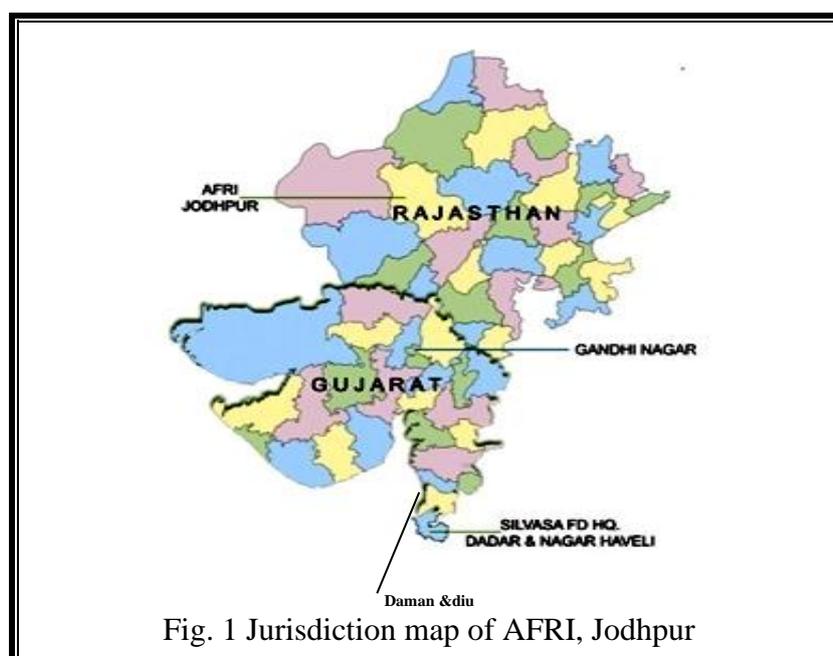
A total of 13 booklets & pamphlets were published at AFRI, Jodhpur. Total 42 of workshops/ seminars/ conference, etc., were attended/participated by scientific staff of the institute. There are 8 numbers of abstract published in abstract books of different workshops/seminar/conference. Total published papers in national and international journals are 3 and 9 respectively.

### **Summary of the projects**

<b>Projects</b>	<b>Completed Projects</b>	<b>Ongoing Projects</b>	<b>New Projects Initiated During 2020-21</b>
<b>Plan</b>	5	4	1
<b>Externally Aided</b>	2	1	1
<b>Total</b>	7	5	2

## 1. Introduction

Arid Forest Research Institute, Jodhpur (Rajasthan) is one of the nine institutes of the Indian Council of Forestry Research & Education (ICFRE), an autonomous organization of the Ministry of Environment, Forests & Climate Change, Government of India. The goals of the institute are to carry out scientific research in forestry & allied fields to enhance the productivity and vegetative cover, to conserve the biodiversity and to develop the technologies for the stakeholders working in forestry sector in Rajasthan, Gujarat, Dadra & Nagar Haveli and Daman & Diu (**Fig. 1**). Major emphasis of research at the institute are on soil, water & nutrient management; technologies for afforestation of stress sites; management of plantations; growth and yield modeling; planting stock improvement and biotechnology; bio-fertilizers and bio-pesticides; Agroforestry & extension; phytochemistry & non-timber forest products; integrated pest and disease management; biodiversity and climate change; and forestry education and extension.



### 1.1 MoU Signed:

1. MoU signed on 30.01.2021 between Director, AFRI, Jodhpur and DFO, IGNP, Jaisalmer to establish New Demo village at 1445 RD of IGNP area, Mohangarh, Jaisalmer.
2. MoU signed on 05.10.2020 between Director AFRI and Vice-Chancellor, Jaipur National University, Jaipur for mutual cooperation towards the advancement of knowledge of the employees, faculty, scholars and students of both the institutions.

## 1.2 Visit of Dignitaries:

1. Sh. Rajiv Banerjee, Hon'ble Minister of Forest, Government of West Bengal, visited AFRI on 27.10.2020.

## 1.3 New Initiatives

Sr. No.	Title of the Project	Principal Investigator	Remark
<b>Theme 1: Managing Forest and Forest Products for Livelihood Support and Economic Growth</b>			
<b>Theme 2: Biodiversity Conservation and Ecological Security</b>			
<b>Thrust Area 3: Forest and Climate Change</b>			
<b>Thrust Area 4: Forest Genetic Resource management and Tree Improvement</b>			
01	Improvement of survival rate in Kair ( <i>Capparis decidua</i> ) under field planting conditions by architecting root biomass and <i>in situ</i> moisture management (No. AFRI-51/S&FM/ICFRE/2020-2024)	Dr. M.T. Hegde, Scientist-F	

## 1.4 Recruitment and Promotions during the year:

**vof/k 01-04-2020 ls 31-03-2021 rd**

**[LFkkukUrj.k@dk;Z&eqDr@lsokfuo`ÿk](mailto:LFkkukUrj.k@dk;Z&eqDr@lsokfuo`ÿk)**

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### **देहावसान**

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## **2. Research Highlights**

### **A. CAMPA Activities**

Out of 31 all India Coordinated Projects (AICRPs) running in different institute of ICFRE, and taken care of by National project Coordinator (NPC), two are being implemented by AFRI, Jodhpur based NPCs. These are AICRP-24 and AICRP-26. Achievements in these AICRPs conducted at different institutes are presented below:

**AICRP-24:**Combating desertification by enhancing vegetation cover and people livelihoods in degraded drylands and deserts of India

*NPC: Dr G. Singh, Scientist-G*

This coordinated research and extension project involves survey assessment of different species for listing best fitting species/ variety or strains of trees, shrubs and grasses for their uses in restoration of different types of degraded sites, people mobilization by developing region specific live fencing techniques on farmers lands for improved protection from stray domestic/wild animals, and field oriented restorations of degraded hills, reactivated sand dunes, ravine areas, mine-overburdens and saline lands. This also includes assessment of different restoration works on recovery of indigenous flora and their diversity, soil water and soil organic carbon and nutrient status and more importantly selecting best models/technologies with high diversity and productivity and high rate of carbon sequestration and carbon storage in both plants and soils. ICFRE institutes involved in this AICRP are AFRI, Jodhpur, HFRI, Shimla, TFRI, Jabalpur, FRI Dehradun, IFGTB Coimbatore and IFP Ranchi. Different objectives of this research proposal are: (i) Survey and selection of indigenous herbs/grass, shrubs, and trees species and their combinations for effective use in various restoration programmes; (ii) People mobilization and development of live fencing around a cluster of farmer's field for soil and water conservation to enhance farm production and people livelihoods; (iii) Restoration of degraded hills, hillslopes, sand dunes, ravines and saline areas through introduction of new genotypes/ varieties/ species and natural resource conservation in different landscape; (iv) Assessment of the impact of different species under afforestation/reforestation on vegetation recovery, soil health improvement and carbon storage; and (v) Popularization of ecological, environmental and economic benefits of improved practices of mitigation of the effect of land degradation and desertification among the local people.

#### **Achievements**

Although most of the activities of the project have been affected by COVID-19, listing and purchase of most of the equipments to be utilized in the project have been procured. Objective-wise achievements are presented below:

#### **1. Survey and selection of indigenous for effective use in various restoration programmes.**

Existing literature from different sources were surveyed covering all the aspects and species selection was completed by all institutes. Detailed work plan and methodology was prepared

for each project component and tentative list of species finalized for seedling raising and plantation. Survey in Cold Desert area at Tabo, Poh, Maini, Lalung and Gue areas of H.P. was done by HFRI, Shimla for knowing tree, shrub and associate species. The dominating tree and shrub species were *Juniperus polycarpus*, *Salix alba*, *Populus ciliata*, *Populus nigra*, *Rosa webbiana*, *Colutea nepalensis*, *Hippophae rhamnoides*, etc. Vegetation survey near the selected site in MP to get a broad understanding of indigenous species of grass, herbs, shrubs and trees have also been carried out by TFRI, Jabalpur. Field tour of different districts of Haryana, Punjab and Rajasthan was conducted by FRI, Dehradun to explore *S. oleoides* and *S. persica* sites to record the data on their morphological parameters, such as tree height, GBH, crown canopy, incidence of disease and pest infestation, etc. Leaf and soil samples were also collected from the decertified areas of *S. oleoides* and *S. persica*. Nursery level experimentation is going on to screen drought and salt hardy (tested at 50 mM, 100 mM, 150 mM and 200 mM NaCl) strains of these species for transplantation in field condition (**Fig. 2**). Presently 95 out of 100 transplanted cuttings failed to survive under extreme cold conditions of Dehradun. Existing germplasm of *S. oleoides* through fertilizers (NPK, Urea, compost) is maintained at FRI, Dehradun.



**Figure 2.** Screening of strains of *S. oleoides* for salt and drought stresses in laboratory condition. (a) and (b): cuttings of *Salvadora oleoides* and after transfer in polybags, (c): salt stress experiments, and (d): drought stress experiment on *S. oleoides*.

Base line data about numbers of households/ villages and general statistics of land uses existing in the state of Tamil Nadu has also been collected from primary and secondary sources. Likewise, suitable species (trees, shrubs and herbs) have been screened in on the basis of lit-

erature survey and the indigenous species available in the nearby vicinity areas of the selected site by IFP, Ranch and raising of seedlings are in process.

## 2. People mobilization and development of live fencing around a cluster of farmer's field.

For erection of live fencing in arid region of Rajasthan five groups of farmers in Pratapgrah and Chouradiya villages in Shergarh tehsil of Jodhpur district have been selected for field trial. Seedlings (silvi and horti species) raising is under progress. Survey have also been done in five villages, i.e. Tabo, Poh, Maine, Lalung and Gue for selection of cluster of farmers for live fencing and for establishing snow harvesting structures. Survey work of TFRI, Jabalpur is in way. Cluster of farmers for erection of live fencing or boundary plantations in salt-affected soils of Cauvery delta zone and Western Zone have been identified. Raising of planting stock of *Casuarina* species (2000 nos.) has been initiated by IFGTB, Coimbatore.

## 3. Restoration of degraded hills, hillslopes, sand dunes, ravines and saline areas through introduction of new genotypes/ varieties/ species and natural resource conservation in different landscape

Extensive survey was done for site selection in forest and Panchayat land for restoration of sand drift reactivated site, degraded hill, forest lands and farmlands (Fig. 3). All sites have been finalised. Seeds of *Acacia senegal*, *Anogiessus sericea*, *Mytenus emarginata*, *Calligonumpolygonoides*, *Ziziphus nummularia*, *Z. mauritiana* and *Cenchrus ciliaris* has been procured/collected and seedling raising activities are in process at AFRI, Jodhpur.

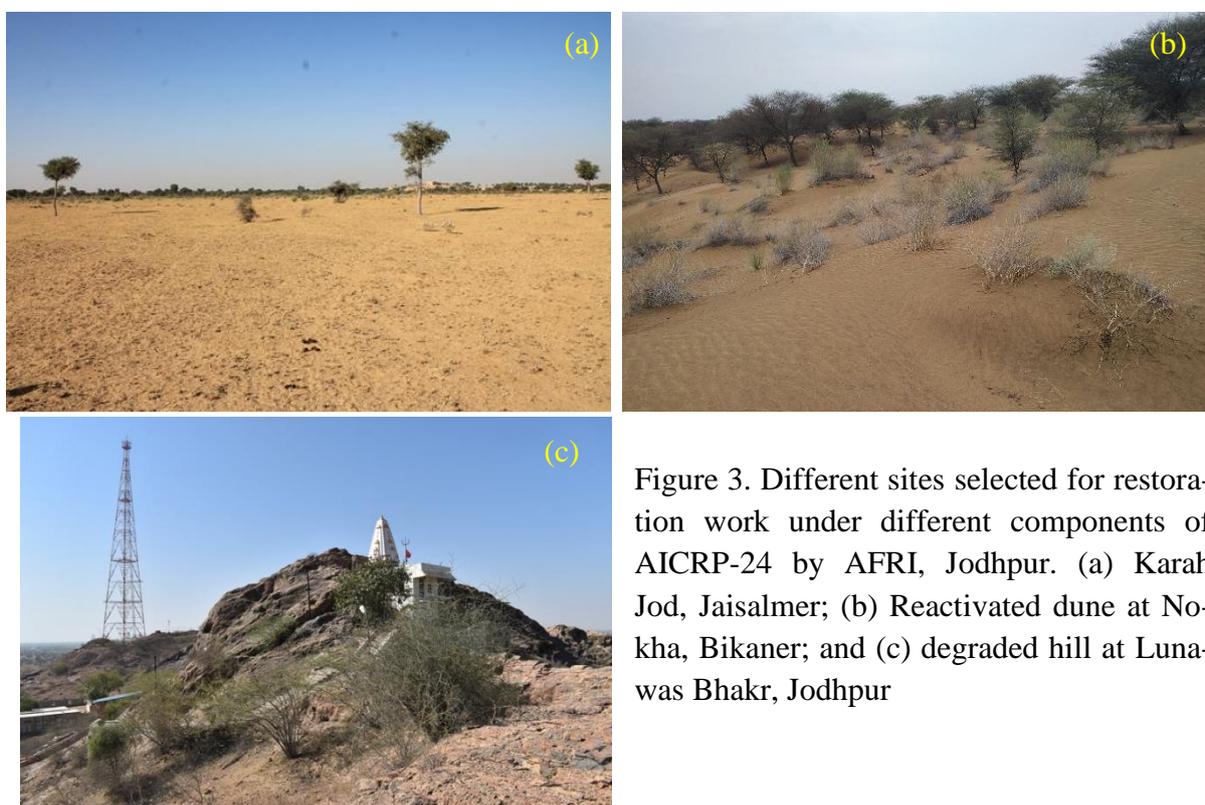


Figure 3. Different sites selected for restoration work under different components of AICRP-24 by AFRI, Jodhpur. (a) Karah Jod, Jaisalmer; (b) Reactivated dune at Nokha, Bikaner; and (c) degraded hill at Lunawas Bhakr, Jodhpur

One ha area for plantation at Badami Bag, Leh and 8 ha at Sushna, Gue and Rama area in cold desert region of Himachal Pradesh has been selected. The area at Badami Bag, Leh has been planted using *Juniperus polycarpus* at HFRI Shimla. An area of 15-ha has been selected in Morena district of M.P. for raising plantation of suitable tree species by TFRI, Jabalpur. IFGTB Coimbatore has identified site in the Western Agro climatic zone of Tamil Nadu for establishment of field trials.

Land acquisition process is completed from Punjab (allocated 5 ha land at Mansa, Punjab), whereas in Haryana, it is in process. Nursery level experimentation is going on to screen out drought and saline land tolerant strains.

Plantation site has also been finalised at Kiriburu (Iron mine of Steel Authority of India) by IFP Ranchi. Nursery area has been prepared for the establishment of seedling and app. About 3000 seedling has been prepared in the nursery of screened in species. Site clearance and leveling has been done. Sowing of seeds in beds and polythene bags has been completed.

#### **4. Assessment of the impact of different species under afforestation/reforestation on vegetation recovery, soil health improvement and carbon storage.**

Initial soil sampling from the selected sites have been done and analysed for finalization of soil amendments at IFP, Ranchi and AFRI, Jodhpur.

**Benefits of the project:** The plantations and models will be developed as a whole will help increase green cover, biodiversity and productivity, enhance people livelihood and combat desertification with co-benefits of carbon sequestration and climate change adaptation and mitigation. This will add to help people better adapt and mitigate the effects of climate change.

#### **AICRP-26: Genetic Improvement of *Azadirachta indica* A. Juss (Neem)**

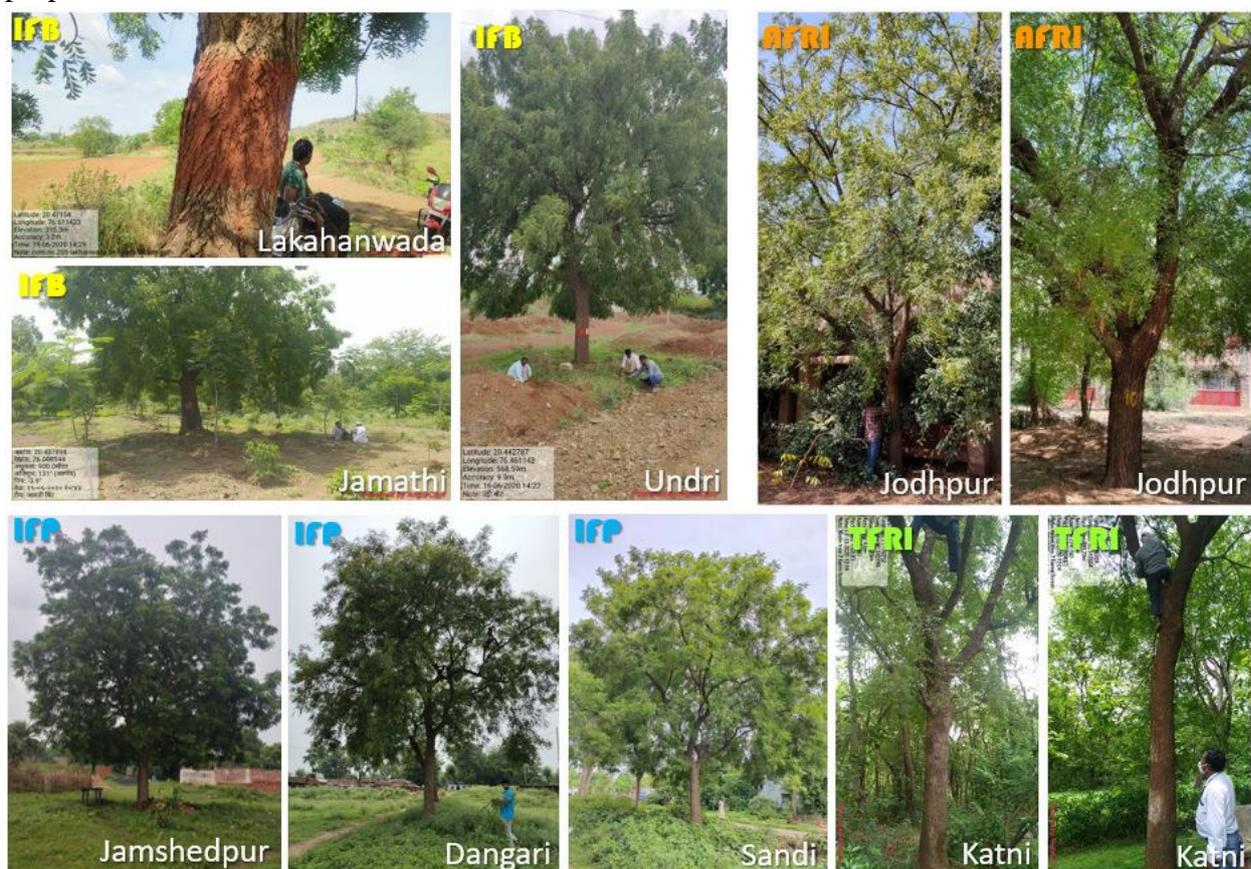
*NPC: Dr Tarun Kant, Scientist-F*

Neem tree is of multifaceted importance. It has tremendous economic importance. The project aims to identify suitable agro-climatic conditions for high Azadirachtin and oil yield and selection of superior genotypes (previously identified and new selections) of neem with repeated measurement of Azadirachtin and oil for at least three consecutive years from 1000 Neem tree selections covering 10 agro-climatic zones (100 trees/zone) along with studies on phenology and reproductive biology from. The project also is having components of developing protocol for gene transfer and for *in vitro* production of Azadirachtin. The project has involved 6 ICFRE institutes, namely – AFRI Jodhpur, TFRI Jabalpur, IFGTB Coimbatore, IWST Bengaluru, IFP Ranchi and IFB Hyderabad.

## Achievements

### A. Neem CPT Selection, Seed Collection and Phenology and Reproductive Biology

Past research project reports on Neemand forest division working plans were consulted by all 6 participating institutes in the project. Information on Neem plantations was collected from forest department and the neem area for survey was marked out. The basis of tree selection was seed bearing capacity of healthy trees above 15 years of age. Surveys were conducted in different agro-climatic zones but in a limited scale only due to pandemic lockdown and restrictions during the seeding time. A total of 387 trees were selected by different participating institutes across different agroclimatic zones (**Fig. 4**). Morphometric data was recorded for the selected trees. Soil type, humidity, temperature of the site was noted. Soil samples were collected from each location and analysis was performed to evaluate soil properties.

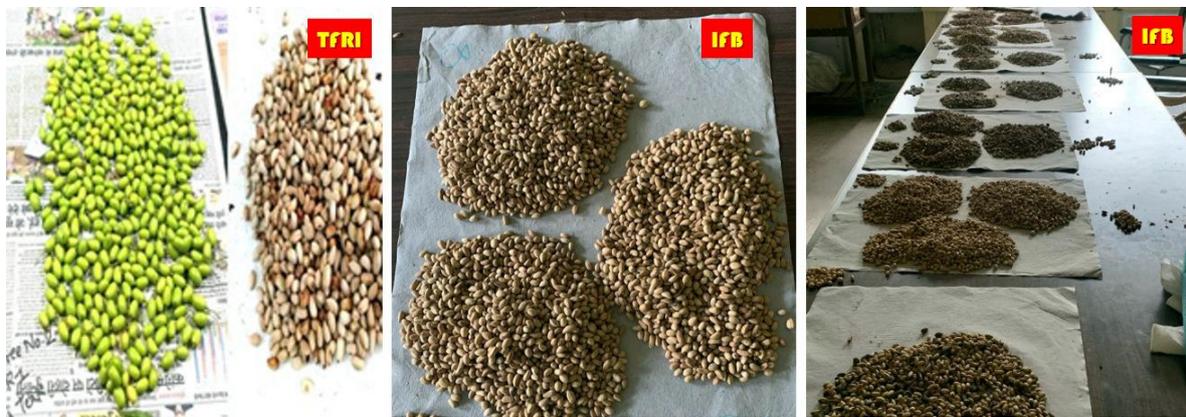


**Figure 4.** (Top L to R): Identified Neem Candidate Plus Trees from different agro-climatic zones.

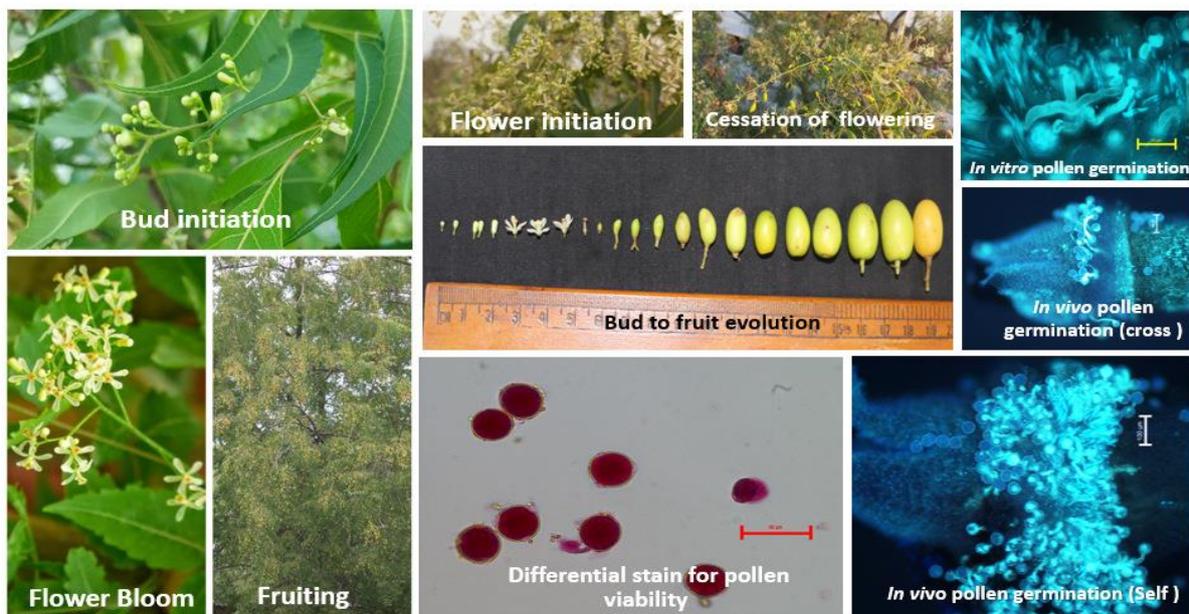
Phenological data (leaf initiation, leaf fall, flowering initiation, peak flowering, etc.), was recorded from a subset of marked trees at three different regions by AFRI, Jodhpur, TFRJ Jabalpur, and IFGTB, Coimbatore (**Fig. 5**). Information on flowering and fruiting phases in different accessions of neem were collected by IFGTB Coimbatore (**Fig. 6**). The data was also collected on flower visitors, morphometric parameters of neem flowers, time of anthesis, breeding system and palynology (**Fig. 7**). Pollen storage technique for long time storage was standardized.



**Figure 5.** Flowering in Neem at full bloom.



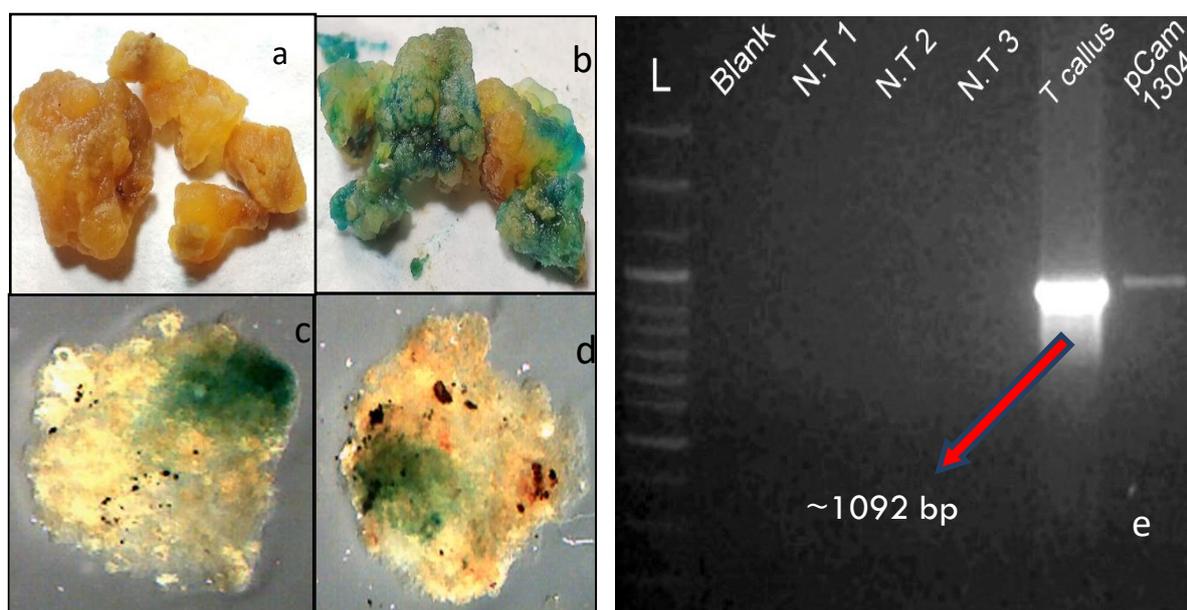
**Figure 6.** Neem seed collection from CPTs and processing



**Figure 7.** Neem Phenology and Reproductive biology study

## B. Gene Transfer Component

*Agrobacterium*-mediated gene delivery, a powerful tool for genetic transformation, was extensively exploited to produce GM-plants. We have developed a protocol for genetic transformation of Neem callus using *Agrobacterium*, utilizing two strains of *Agrobacterium tumefaciens* (GV3101 and EHA105). Both the strains have been successfully transformed with the binary vector pCAMBIA 1304 carrying fused reporter genes *gfp:gus* and a selectable marker gene *hptII*, driven by CaMV35S promoter (**Fig. 8**). Transformation was verified through colony PCR. Presently, selection of transformed cells is poor as hygromycin is not effective for Neem. Efforts are currently underway to work out a higher transformation frequency coupled with a stringent selection of transformant cell lines.



**Figure 8.** *Gus* histochemical staining of transgenic neem calli:(a) Un-transformed callus, (b) Transient Transformation (12th day) (c-d) stable transformation event after 12<sup>th</sup> week of co-cultivation (e) PCR based confirmation of presence of *gusA* gene (~1092 bp) in transformed callus (*T. callus* in lane 6) after 3 months of co-cultivation indicating stable transformation and thus successful gene transfer and integration event in neem callus, whereas N.T represent DNA from Non transformed plain callus.

## C. Production of azadirachtin through cell suspension culture

Different accessions based on the earlier works on neem improvement at IFGTB were collected. Callus induction using flowers, leaf explants and immature embryos in ten different media combination was initiated (**Fig. 9**). The flowers produced good callus (~250mg), while the response from cotyledon and leaf explants was comparatively slow in terms of growth. Suspension cultures were successfully initiated from the induced callus. Azadirachtin content analysis in callus cultures is in progress.



**Figure 9.** Neem callus derived from flower explants (top row) and from leaf explants (bottom row) for production of azadirachtin from cell suspension cultures.

**Benefits of the research project:** Identification of high azadirachtin and oil yielder genotypes and best agroclimatic zones for high oil and azadirachtin will become known through this project. Moreover its reproductive biology will be thoroughly studied giving insight into this aspect. Two applied aspects of genetic improvement through gene transfer and potential of azadirachtin synthesis through *in vitro* suspension cultures will also be developed.

## **B. Plan and External Projects**

### **2.1 Ecosystem Conservation and Management**

#### **2.1.1 Overview**

There is one project in this theme, which is completed. This involved assessment of biological diversity of Raj bhawan areas of Jaipur and Mount Abu. A total of 412 plant species and 39 faunal species were identified from these areas. Tree species richness had been observed beneficial to herbaceous species richness, but it was stronger at Mt. Abu than at Jaipur.

#### **2.1.1.1 Project under the theme**

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2020-21
<b>Plan</b>	-	-	-
<b>Externally Aided</b>	1	-	-
<b>Total</b>	1	-	-

**2.1.2 Climate Change** : Nil

**2.1.3 Ecology and Environment** : Nil

## 2.1.4 Biodiversity

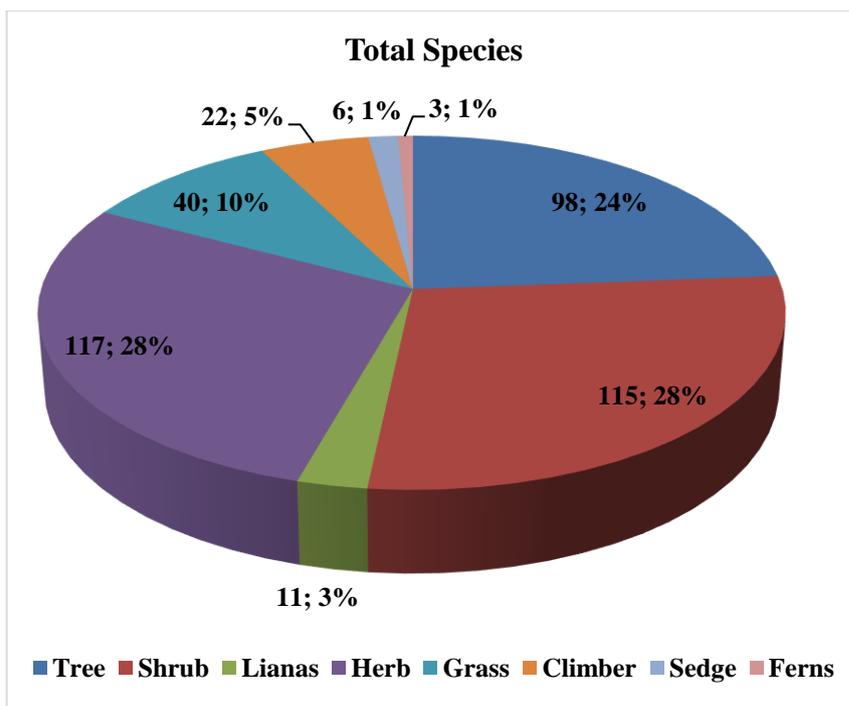
### 1. Study of Flora and Fauna of Raj Bhavans of Rajasthan.

*Principal Investigator: Dr. G. Singh, Scientis-G*

Raj Bhawan areas of Rajasthan at Jaipur and Mount Abu both have lush green lawn with variety of tall trees and flower beds blooming with seasonal flowers. This project was planned to monitor biodiversity and enlisting flora and fauna to document them in the form of a coffee table book and offering possibilities to improve this urban habitat. The objectives of the project were: (i) to survey, identification and enlisting of flora and fauna of Raj Bhawan at Jaipur and Mount Abu area of Rajasthan; (ii) preparation of pictorial information of flora and Fauna of both Raj Bhavans; (iii) develop appropriate signages for the important flora and fauna of both Raj Bhavans; and (iv) publish a coffee table book with photographs and illustration of important species available in these areas.

Jaipur and Mount Abu Raj Bhawan areas were divided into 10 blocks and 11 blocks respectively and populations of different species were counted and growth data recorded. Based on the population of individual species different diversity variables were calculated for each block. Phenology of different species was recorded by visiting the sites four times in a year. Visible faunal diversity focusing on birds was also recorded. Fourteen hundred thirteen and 2438 available plants were enumerated and measured at Jaipur and Mt Abu respectively. At Jaipur, 215 numbers of plant species belonging to 62 families and 57 genera were recorded. This included 68 trees, 87 shrubs, 16 climbers, 29 herbs, 14 grass and 2 sedge species. In Mount Abu, 293 belonging to 71 families and 216 genera with 58 trees, 70 shrubs, 26 climbers, 94 herbaceous, 37 grass, 5 sedge and two ferns species were enlisted. Most dominant families in number of species were Poaceae followed by Fabaceae at both places. Raj Bhawan area of Mount Abu was more diverse in number of herbaceous species as compared to Raj Bhawan area of Jaipur, but an opposite was visible for trees and shrubs. Putting together both the areas, there were 412 species identified from both the Raj Bhavans areas, i.e. Jaipur and Mount Abu (**Fig. 10**). These species belonged to 81 families and 291 genera and included 98 trees, 115 shrubs, 11 lianas (woody climber), 117 herbaceous, 40 grass, 22 climbers, 6 sedge and three ferns species. Eighty five species were common to both the places. Twenty three families had single species representation at these sites.

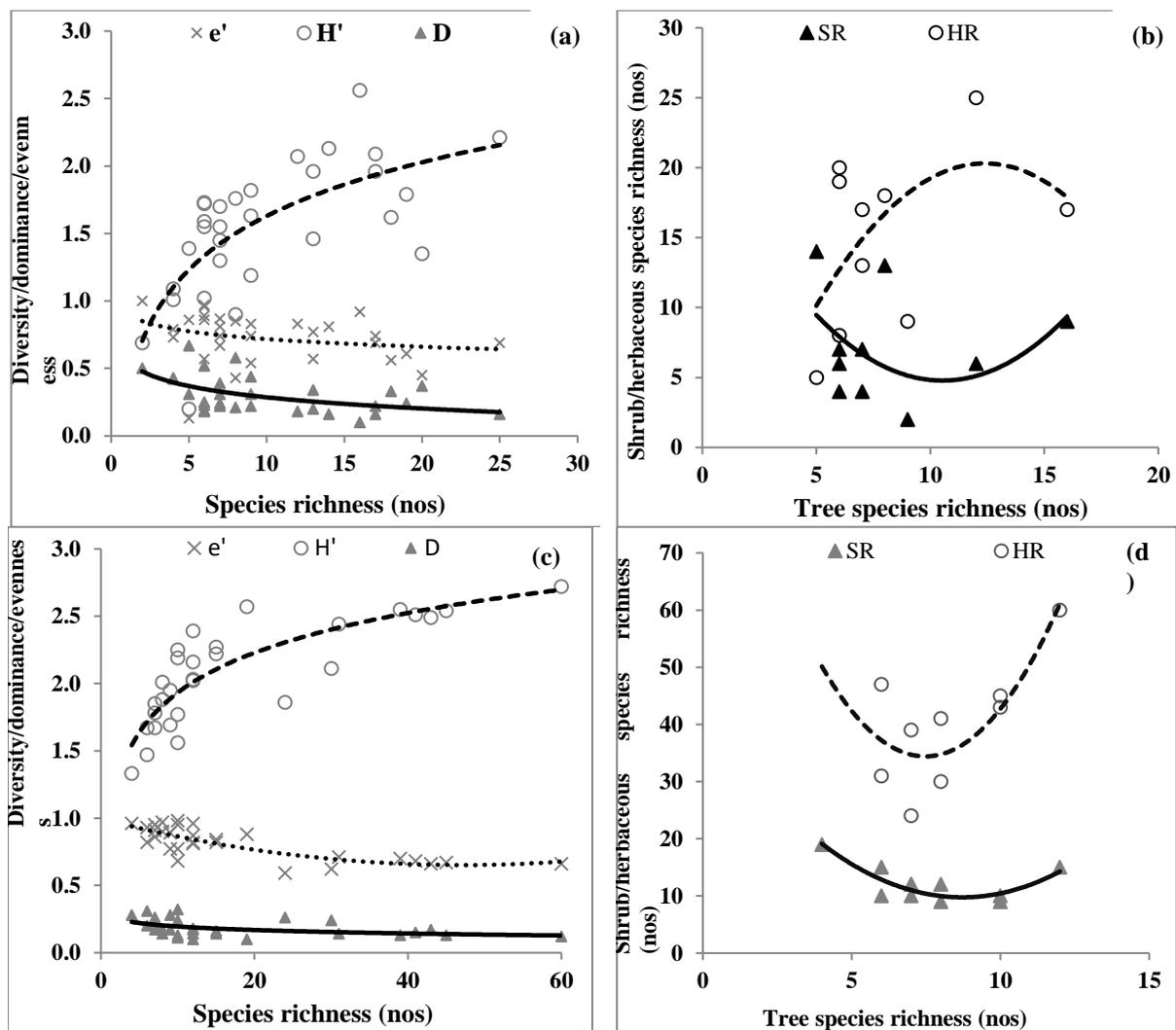
Among diversity indices, species richness ranged from 5-16 and 4-12 for trees, 2-14 and 9-19 for shrubs and 5-25 and 24-60 for herbaceous vegetation; whereas Shannon-Weiner Diversity index ranged from 1.39- 2.56 and 1.33- 2.39 for trees, 0.69-2.13, and 1.63-2.57 for shrubs and 0.20-2.21 and 0.186-2.70 for herbaceous species at Jaipur and Mount Abu respectively. At respective place, Simpson dominance index ranged from 0.10-0.31 and 0.10-0.31 for trees, 0.16-0.52 and 0.10-0.32 for shrubs and 0.16-0.67 and 0.10-0.26 for herbaceous species, whereas species evenness varied from 0.81-0.97 and 0.82-0.98 for trees, 0.57-1.00 and 0.71-0.89 for shrubs, and 0.13-0.74 and 0.62-0.71 for herbaceous species.



**Figure 10.** Number and percent contributions of different plant forms in Rajbhawan areas of Rajasthan.

Variations in species richness, diversity and Simpson index among the blocks was more at Jaipur as compared to the area at Mount Abu. The Raj Bhawan area of Mount Abu was more diverse in shrubs and herbaceous vegetation, whereas Jaipur was more diverse in tree species. Uneven distribution of some of the shrub species had reduced the value of species evenness at Mt Abu. Most dominant tree species at Jaipur area was *Polyalthia longifolia* with population 2.1 trees and basal 676.7 cm<sup>2</sup> per m<sup>2</sup> area, followed by *Putranjiva roxburghii* with density and basal area of 1.37 trees and 263.5 cm<sup>2</sup> per m<sup>2</sup> area. At Mount Abu, *Mallotus philippensis* dominated with highest IVI and availability in 9 blocks with an average density of 0.7 and basal area of 70.5 cm<sup>2</sup> per 100 m<sup>2</sup>. It is followed by *Mangifera indica*. Least dominant tree species are *Ficus benghalensis* var. *krishnae* at Jaipur and *Michelia champaca*, *Crateva adansonii* subspecies *odora*, *Tamarindus indica*, *Eriobotrya japonica*, *Bauhinia variegata* observed in one block with lowest IVI values at Mount Abu. Among shrubs, least dominant is *Citrus limetta* at Jaipur and *Ricinus communis* and *Coffea Arabica* at Mount Abu are. *Peristrophe paniculata* and *Portulaca meridian* at Jaipur and *Cayratia trifolia* at Mt Abu are the least dominant herbaceous species. Increase in tree species richness found beneficial to herbaceous species richness, but it was stronger at Mount Abu area than at Jaipur area as herbaceous species richness attained a maxima. However, impact on shrub species richness appeared detrimental as increase in tree species richness (9 at Jaipur) leads to minimum shrub species richness at both the places (**Fig. 11**).

Among faunal diversity, 39 species of birds and other animals like, langur, cats, reptiles (snake and Chameleons) and varieties of butterflies and insects had been recorded at both the places. Among the bird species, 19 were from Jaipur and 28 species from Mount Abu areas. Eight species of birds were common to both the places.



**Figure 11.** Relationships between species richness and other diversity variables and tree species richness with shrubs and herbaceous species at Jaipur (a & b) and Mt Abu (c & d) respectively.

*Michelia champaca*, *Crateva adsonii* sub-species *odora*, *Tamarindus indica* and *Eriobotrya japonica* were thinly populated species. *Anogeissus sericea* var. *sericea* was rare and endemic to Mount Abu region, whereas *Wrightia tinctoria* and *Dalbergia latifolia* were under vulnerable category. Some of the species like *Cithrazylon indica*, *Eryobotrya japonica*, *Firmiana colorata*, *Girardiana diversifolia*, *Celtis tetrandra*, etc., were thinly populated in the area of Mount Abu. Some of the areas of Mount Abu were heavily infested by invasive species *Lantana camara*. Some invasive species like *Verbesina encelioides* and *Lantana camara* have also been observed in the Jaipur Raj Bhawan area. There is need to conserve significantly low populated species like *Cithrazylon indica*, *Eryobotrya japonica*, *Firmiana colorata*, *Girardiana diversifolia*, *Celtis tetrandra* etc and control of invasive species like *Lantana camara*.

2.1.5 Forest Botany: NIL

2.1.6 Tribals and Traditional Knowledge System: Nil

## 2.2 Forest Productivity

### 2.2.1 Overview

There are three projects in this theme. In which one has been completed and other two are ongoing. The trials of sandalwood plantations at different locations in Gujarat and Rajasthan performed better with *Casuarina* host in Gujarat and with *Embllica officinalis* at Jaipur. Assessment of crop production, gum yield and economic benefits of *Acacia senegal* based agroforestry farmer's lands indicates effects of canopy density on crop yield. Allometric equations of *E. camaldulensis* and *Vachelia tortilis* for estimation of standing biomass and carbon accounting of IGNP plantation have been developed.

#### 2.2.1.2 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year 2020-21
Plan	1	2	-
Externally Aided	-	-	-
Total	1	2	-

### 2.2.2 Silviculture

#### 1. Evaluation of existing Sandal wood (*Santalum album*) plantations and development of agro forestry trials and capacity building to promote cultivation in Gujarat and Rajasthan.

*Principal Investigator: Dr. N.K. Bohra, Scientist-C*

Sandal wood plantation trails were established at AAU, Anand and Rajkot in Gujarat and at Jaipur in Rajasthan. The experiment was laid out in randomized block design with three replications. Initially lalmehendi (*Lawsonia inermis*) was common in host to all treatments and all locations. Secondary host used were different fruits plant at Rajkot, fruit plant with casuarina, tur (*Cajanus cajan*, red gram) and turmeric (*Curcuma longa*) at Anand, and only fruit plants at Jaipur site. At Anand site, average growth were 183.88 cm height, 36.71 mm stem width and 114.92 cm × 100.79 cm crown length and width. The best combination was pigeon pea+casuarina in which average plant height was 375.83 cm, stem width was 76.92 mm and crown size was 283.33 cm length × 226.83 cm width. The control treatment showed 306.22 cm height, 60.98 mm stem width and crown size of 197.16 cm length and 192.43 cm width.

At Rajkot, average plant height was 137.72 cm, stem width was 27.74 mm and crown length and width were 66.99 cm and 73.93 cm respectively. The best host was casuarina, where plant attained 210.83 cm height, 47.97 mm stem width and 111.66 cm and 117.08 cm crown length and width as compared to respective value of 141.88 cm, 25.36 mm and 62.75 cm × 67.38 cm, respectively in control plot. Experimental site Jaipur showed average height of 185.48 cm, stem width of 40.89 and crown length and width of 142.55 cm and 130.11 cm respectively. The best host was Aonla (*Embllica officinalis*) with sandalwood plant height of

223.46 cm, stem width of 56.63 mm and crown length and width of 172.92 cm and 149.79 cm respectively.

### 2.2.3 Social Forestry, Agro-forestry/ Farm Forestry

#### 2. Study on crop yield, soil fertility and gum production in *Acacia senegal* based traditional agroforestry system in arid region of Rajasthan.

*Principal Investigator: Dr. Bilas Singh, CTO*

Sample plots of tree densities 10-20 tree/ha, 20-30 tree/ha and 30-40 tree/ha were laid out at nine sites. These are on farmland at Sheregarh area in Jodhpur, Jakhara (Bayatu) and Lilsar (Chohatan) in Barmer district and farm boundary at three locations in Didwana area of Nagaur district. Height and dbh of *A. Senegal* tree were significantly ( $p < 0.05$ ) greater at 20-30 trees ha<sup>-1</sup> as compared to the other tree densities. Crop yield reduction did not differ between tree densities. When compared with total canopy cover (m<sup>2</sup> ha<sup>-1</sup>), crop yield reduction was significantly low at canopy cover 544 m<sup>2</sup> ha<sup>-1</sup> (10-20 trees ha<sup>-1</sup>) as compared to canopy cover 772 and 1298 m<sup>2</sup> ha<sup>-1</sup> at tree density of 20-30 and 30-40 trees ha<sup>-1</sup> respectively. Gum yield from trees ranged between 90 g and 1050 g per tree. Economic return was highest for Pearl millet (Rs. 28688/ha) under irrigated condition and it was lowest (Rs. 2360/ha) in rainfed condition in Kharif season for the same crop. In Rabi season, economic return was Rs.18742-29581/ha with cumin based system in irrigated condition. Seed production of *A. senegal* was 0.10-1.10 kg/trees.

### 2.2.4 Forest Soils and Land Reclamation

#### 3. Impact of harvesting on soil nutrients and carbon stock in canal side plantations of Indira Gandhi Nahar Pariyojana.

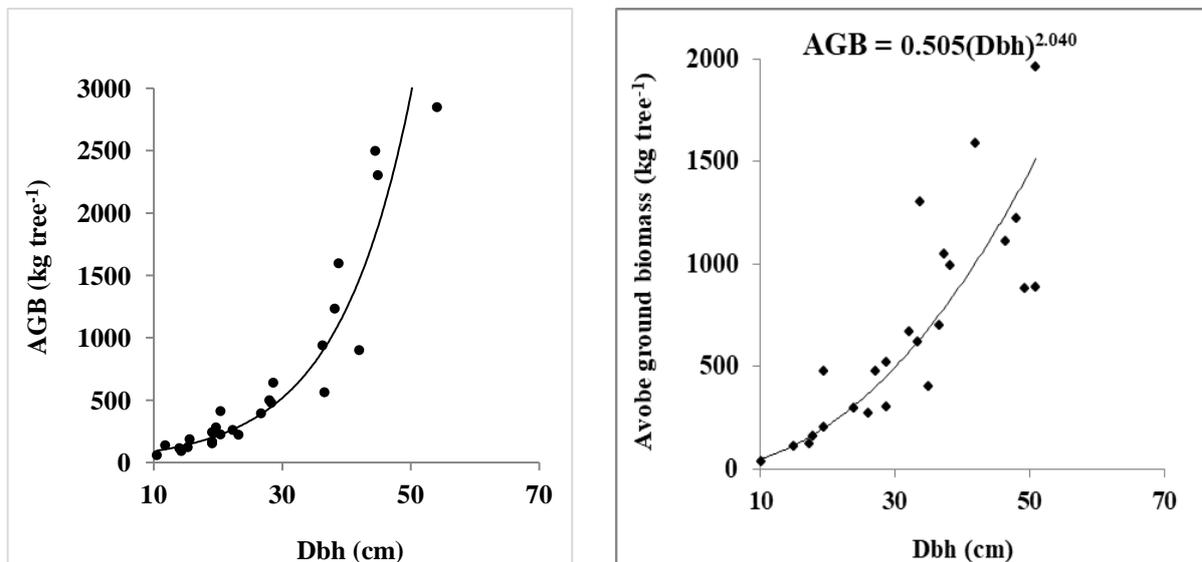
*Principal Investigator: Dr. G. Singh, Scientist-G*

Massive scale plantation of fast growing tree species like *Eucalyptus camaldulensis*, *Dalbergia sissoo*, *Vachelia nilotica* and *V. tortilis* was done along Indira Gandhi Nahar Pariyojana (IGNP) areas in north western Rajasthan to check siltation of the canal to making its flow continuous and to improve environmental condition of the area. This project aimed at studying the impact of tree harvesting on soil nutrients and carbon stock in canal side plantations of IGNP, quantify harvested wood biomass and develop allometric equations based on tree growth parameters and monitor temporal changes in soil parameters brought about by the plantations. Soil samples collected were analyzed for soil available NH<sub>4</sub>-N, NO<sub>3</sub>-N and PO<sub>4</sub>-P. About 30-year old 25 trees each of *V. tortilis* and *Eucalyptus camaldulensis* of different diameter class were selected and felled from the 5 sample plots each along IGNP. *V. tortilis* trees were 6.0-15.6 m tall, 10.50-54.10 cm in diameter, 19.0-773 kg tree<sup>-1</sup> stem biomass (SB), 28.0-2166 kg tree<sup>-1</sup> branch biomass (BB), 1-51 kg tree<sup>-1</sup> leaf biomass (LB) and 58.0-2848 kg tree<sup>-1</sup> total biomass (AGB). Height and dbh of the felled trees of *E. camaldulensis* were 11.0-30.0 m and 10.20-50.90 cm, whereas SB, BB, LB and AGB were 341.3-1278.0 kg tree<sup>-1</sup>, 157.7-616.0 kg tree<sup>-1</sup>, 17.1-69.0 kg tree<sup>-1</sup> and 497.0-1963.0 kg tree<sup>-1</sup> respectively (**Table 1**).

Table 1. Summary statistics of growth variables and dry biomasses of different components of the felled trees of *V. tortilis* and *E. camaldulensis* along IGNP area of Rajasthan.

Variables	Mean	Standard deviation	Minimum	Maximum	Skewness	Kurtosis
<i>V. tortilis</i>						
Height (m)	9.52	2.77	6.00	15.60	0.543	-0.859
Dbh (cm)	26.01	11.82	10.50	54.10	0.663	-0.556
Stem biomass (kg/ tree)	184.73	208.84	19.00	773.00	1.745	2.134
Branch biomass (kg/ tree)	482.22	584.22	38.00	2166.00	1.847	2.606
Leaf biomass (kg/ tree)	8.98	12.23	1.00	51.00	2.986	8.486
Total biomass (kg/ tree)	675.86	788.17	58.00	2848.80	1.755	2.151
<i>E. camaldulensis</i>						
Height (m)	18.30	4.82	11.00	30.00	0.741	0.239
Dbh (cm)	31.96	12.04	10.20	50.90	0.039	0.953
Stem biomass (kg/tree)	484.29	28.00	1278.00	341.30	0.796	0.085
Branch biomass (kg/ tree)	198.13	8.00	616.00	157.66	0.875	0.540
Leaf biomass (kg/ tree)	16.50	1.00	69.00	17.12	1.949	3.290
Total biomass (kg/ tree)	698.50	37	1963.00	496.99	0.816	0.328

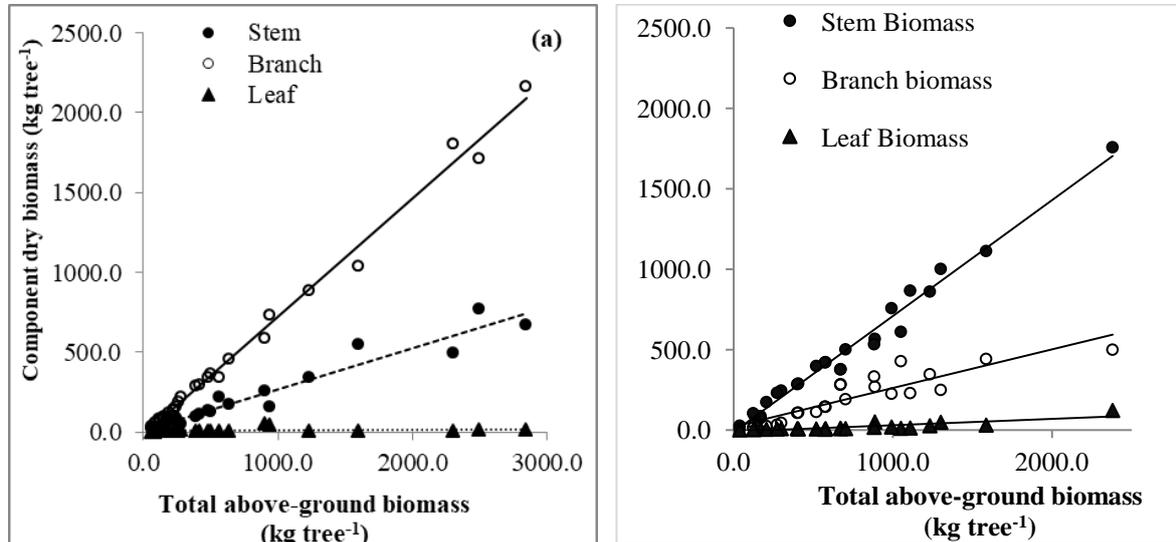
Dbh was better predictor of biomass than height. Model  $Y = a * \exp^{b * dbh}$  was best fit for *V. tortilis*, whereas the models  $AGB = 0.505(Dbh)^{2.040}$ ,  $SB = 0.471(Dbh)^{1.956}$ ;  $BB = 0.044Dbh^{2.353}$  and  $LB = 0.021(Dbh)^{1.841}$  were best fit for biomass estimation of *E. camaldulensis*. These equations fulfilled the validation criteria with highest  $R^2$  and lowest residual error ( $\sigma$ ), Akaike information criteria and root mean square error values (**Fig. 12**). Statistical variables of all components were highly significant ( $p < 0.01$ ) indicating the accuracy and precision of the equations. The developed biomass regression models can be applied as a species-specific equation in predicting standing biomass and carbon sequestration benefits of these species.



**Figure 12.** Predicted vs. measured above-ground biomass (AGB) of *V. tortilis* and *E. camaldulensis* in IGNP area. Dbh = Diameter at breast height.

Contributions of stem, branches and leaves to the total above-ground dry biomass of *V. tortilis* were 29.3%, 68.8% and 2.0%, respectively in case of *V. tortilis*. For *E. camaldulensis*, percentage contribution of stem, branches and leaves were 69.9%, 27.4% and 2.4% of the

total above-ground biomass respectively. Reduction in branch biomass favoured greater biomass accumulation in stem (**Fig. 13**). As compared to AGB of *E. camaldulensis* trees, biomass allocation was greater to stem (slope = 0.72) as compared to branches (slope = 0.24) and leaves (slope = 0.04) with increase in total AGB biomass.



**Figure 13.** Biomass allocation to different components in relation to total above-ground dry biomass of *V. tortilis* (a) and *E. camaldulensis* (b) trees in IGNP area of Rajasthan.

Soil pH and soil bulk density were relatively lower in the plantation area as compared to that in the outside plantation area (control). However, electrical conductivity and availability of PO<sub>4</sub>-P, NO<sub>3</sub>-N and NH<sub>4</sub>-N were greater in plantation area of both *E. camaldulensis* and *V. tortilis* than in the control plots. Soil pH, available PO<sub>4</sub>-P and bulk density were lower under *E. camaldulensis* plantation than under *V. tortilis* plantation. The other soil variables were higher under former species than the latter ones.

## 2.2.5 Watershed Management: NIL

## 2.3 Genetic Improvement

### 2.3.1 Overview

This theme is covered by 5 projects. Out of this, two have been completed, two are ongoing and one is externally aided. Fruits of *Capparis decidua* collected from different locations were categorized into large, medium and small size fruits, in which number of seeds ranged from 16-36, 18-62 and 2-6 respectively. Among three morphotypes, orange colour morphotypes was higher in percentage than yellow and red morphotypes, whereas red flower morphotypes was better in wood quality than other. Guggal plant produced black viable and white non-viable seed and seed yield per plant varied with season and month being highest in December (24.7 seeds) and lowest in May (0.7 seeds per plant). Number of black seeds changed with the period of seed collection and seed sources. Degenerate primers were prepared for cloning of the NHX1 gene from *Prosopis juliflora* and *Salvadora persica* using bioinformatics tools and characterization of salt tolerance conferring vacuolar Na<sup>+</sup>/h<sup>+</sup>

antiporter genes. For non-destructive natural guggulsterone production, vessel conditions have been optimized to obtain contamination free callus and growth of good callus without any contamination was achieved, i.e. increased by 4 folds at the end of 60<sup>th</sup> day of inoculation.

### 2.3.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2020-21
<b>Plan</b>	1	1	1
<b>Externally Aided</b>	1	1	-
<b>Total</b>	2	2	1

### 2.3.2 Conservation of Forest Genetic Resources:

#### 1. Improvement of survival rate in Kair (*Capparis decidua*) under field planting conditions by architecting root biomass and *in situ* moisture management.

*Principal Investigator: Dr. Maheshwar Hegde Scientist-F*

Fruits collection (winter season) from two places namely Khari Khurd village in Jodhpur district and from Experimental field of Forest Ecology & Climate Change division in Jodhpur has been carried out. Fruit weight, diameter and number seeds have been recorded. About 500 g fruits have been collected. Two sites with wild plants of Kair were selected for collection of Kair fruits. Observations were recorded on fruits collected from the selected plants in each location. The data revealed that large, medium and small size fruits varied from 10.50mm to 18.22mm, 9.89mm to 11.68mm and 5.82mm to 9.69mm respectively, whereas the number of seeds ranged from 16 to 36, 18 to 62 and 2 to 6 in respective size class after depulping. Moisture per cent ranged from 42.63 to 69.79 % with mean value of 55.25 %.

### 2.3.3 Tree Improvement

#### 2. Studies on phenology, molecular analysis and wood properties of *Tecomella undulata* with respect to three flower colour morphotypes.

*Principal Investigator: Dr. Desha Meena, Scientist-C*

Based on the survey conducted in eight districts of Rajasthan, i.e. Nagaur, Sikar, Churu, Bikaner, Jalore, Jaisalmer, Barmer and Jodhpur, the percentage ratio of orange colour morphotypes was more in comparison to yellow and red colour morphotypes. For testing mechanical and physical properties of wood of three morphotypes, nine wood logs from Mohangarh, Jaisalmer were collected and supplied to FRI, Dehradun (**Fig. 14**). Wood properties like specific gravity, static bending parameters {Fiber stress at elastic limit (FSEL), Modulus of Rupture (MOR), Modulus of Elasticity (MOE)}, Compression Parallel to grain (N/mm<sup>2</sup>), Compression perpendicular to grain (N/mm<sup>2</sup>), Hardness (N), Shear Strength Parallel to grain (N/mm<sup>2</sup>), Tension Parallel to grain (N/mm<sup>2</sup>) were investigated for all the logs of three sets of each colour morphotypes. Wood of red flower color morphotypes found higher in Specific gravity (0.67 ±0.3), Fibre stress at elastic limit (62.4±11.2N/mm<sup>2</sup>), Modulus of Rupture (93.4±17.5 N/mm<sup>2</sup>), Modulus of Elasticity

( $7830 \pm 976 \text{ N/mm}^2$ ), Hardness (Radial= $7578 \pm 835.5 \text{ N}$ , Tangential= $8189 \pm 913.7 \text{ N}$ ) and Shear Strength Parallel to grain (Radial= $11.2 \pm 1.0 \text{ N/mm}^2$ , Tangential= $12.2 \pm 0.9 \text{ N/mm}^2$ ) as compared to the wood of other flower colour trees. For molecular analysis, 43 shortlisted SCoT primers were used for PCR analysis for differentiating the three flower colour morphotypes against 45 samples of *Tecomella undulata*.



**Figure 14.a)** Preparation of samples from wood logs, and b) Testing of mechanical properties.

Proposed study is first attempt to assess the wood properties and molecular analysis of *Tecomella undulata* with respect to different flower colour variants. Studies on phenology of the species provide useful information about the level of synchrony within and between these three morphotypes. This study will be beneficial in establishing long term breeding programme and establishment of SPAs and seed orchards. Similarly, identification of suitable DNA markers will be useful to differentiate flower colour variants at an early stage. The outcomes of the study will take lead in *Tecomella undulata* improvement programme.

### **3. Development of seed production areas and haploid plants of *Commiphora wightii* (Arnott) a rare and threatened medicinal plant.**

*Principal Investigator: Dr. U.K. Tomar, Scientist-F*

Pooled seed data of March, May and July (summer) and that of November and December (winter) were used to calculate the production of mature seeds per plant. Total mature seed yield per plant in winter was 39.00 seeds, whereas it was 5.23 seeds per plant in summer. Seed data analysis of different months revealed that highest mature seed yield per plant (24.7 seeds) was in December and lowest in May (0.7 seeds per plant). Guggal plant produced two types of seed, i.e. black viable and white non-viable seed. Number of black seeds changed with the period of seed collection and seed sources. The highest black seeds were found in the December and lowest in July. Pollen radius, pollen perimeter and pollen area were recorded. The microscopic study of pollen grain revealed that number of pollen grains per anther was very poor (25-50). Total 7697 guggal germplasm are available in AFRI. Out of these 714 are superior female progenies.

#### **2.3.4 Vegetative Propagation: Nil**

#### 2.3.4 Biotechnology

##### **4. Cloning and characterization of salt tolerance conferring vacuolar Na<sup>+</sup>/H<sup>+</sup> antiporter (*nhx1*) genes from *Prosopis juliflora* (Sw.) Dc. & *Salvadora persica* L.**

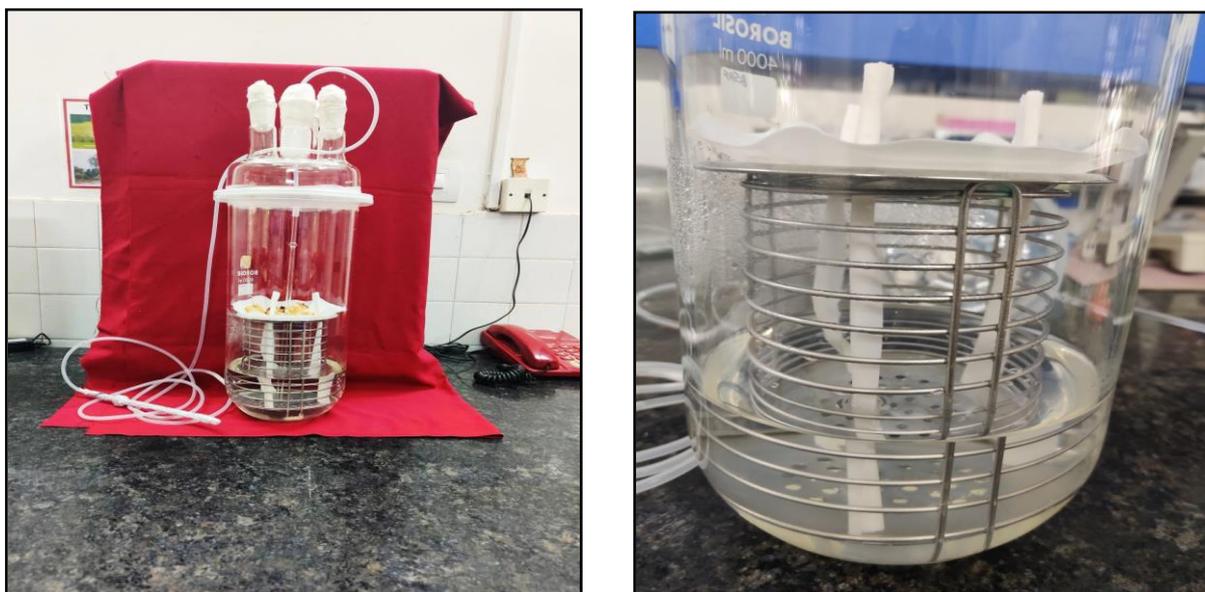
*Principal Investigator: Dr Tarun Kant, Scientist-F*

The Project intends to isolate and clone the vacuolar Na<sup>+</sup>/H<sup>+</sup> antiporter gene – *NHX1* from *Prosopis juliflora* and *Salvadora persica* and to carry out functional validation of the cloned genes via transgenic approach. The antiporter is responsible to maintain Na<sup>+</sup> homeostasis (ion balance) in cytosol in the absence of which the plant cannot survive high salt concentration in soil solution. Using bioinformatics tools, the degenerate primers were prepared for cloning of the *NHX1* gene from the two tree species. This work will lead to deciphering of complete gene sequence of vacuolar *NHX1* antiporter of *Prosopis juliflora* (*PjNHX1*) and *Salvadora persica* (*SpNHX1*). It will lead to development of the binary vector for plant transformation with *PjNHX1* as well as *SpNHX1* gene constructs, which can be used for genetic improvement of crop plants through transformation approach in the future and will aid the ongoing genetic improvement effort to grow plants with higher productivity even under abiotic stresses conditions like salinity.

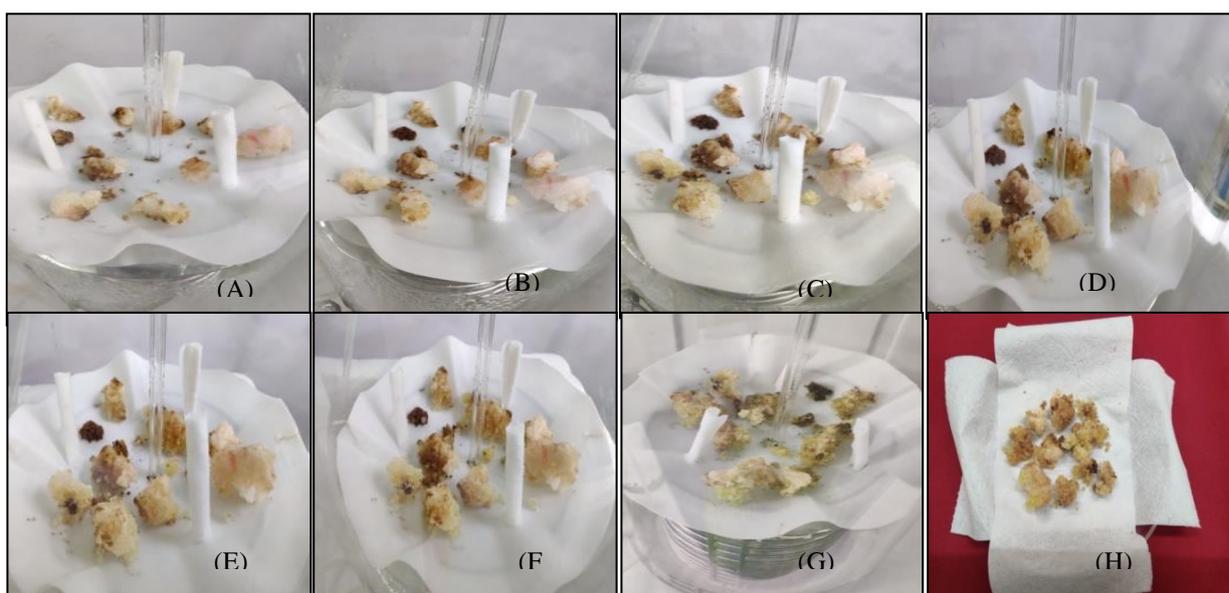
##### **5. Non-destructive *in vitro* production of pharmacologically-active natural extract containing Guggulsterones – a potent cardio-protective and anti-cancer drug from *Commiphora wightii* (Guggul) using bioreactor.**

*Principal Investigator: Dr. Tarun Kant, Scientist-F*

Technology for non-destructive natural guggulsterone production is not yet fully optimized, but has great potential. The project envisages *in vitro* production of guggulsterone-rich cell biomass from plant source in a bioreactor format enabling up-scalability of the technology once standardized. Plant bioreactors are used for the production of therapeutic products, nutritional products, vaccine antigens, biodegradable plastics and industrial products. A prototype of a solid-state batch-fed bioreactor was developed where medium can be added or removed. A 5 litre glass vessel was used as the main culture vessel having a stainless steel stand with a sieve on it. On the sieve, a disc shaped filter paper was placed which was connected to the bottom of the vessel by filter paper wick. A glass tube was added to the main vessel, which was connected to the reservoir bottle by plastic tubing. Callus was initiated on Gamborg's B5 medium containing 0.5mg/l 2,4-D then callus was transferred to hormone free B5 medium to induce embryogenesis. To obtain embryonic callus for guggulsterone production, about 3 g of non-embryogenic callus was placed on circular disc in the vessel containing hormone free Gamborg's B5 medium. Vessel conditions have been optimized to obtain contamination free callus (**Fig. 15**). Growth of good callus without any contamination was achieved. Growth data was recorded. The growth of callus was increased by 4 folds at the end of 60<sup>th</sup> day of inoculation (**Fig. 16**). For the quantification of guggulsterone this callus will be further analysed through HPLC. The project envisages development of a technology that can give natural guggulsterone from the plant. It is for possible commercial exploitation without destroying its dwindling natural populations. And at the same time it will be helpful in conservation of the endangered species.



**Figure 15.** Assembly of culture vessel to develop a prototype of bio-reactor containing medium and callus culture.



**Figure16.** Growth of callus over a period of time: (A) 0 Day (B) 10th Day (C) 20th Day (D) 30th Day (E) 40th Day (F) 50th Day (G) 60th Day and (H) Total callus after 2 months.

## 2.4 Forest Management

### 2.4.1 Overview

#### 2.4.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2019-20
Plan	-	-	-
Externally Aided	-	-	-
Total	-	-	-

2.4.2 Sustainable Forest Management (SFM): NIL

2.4.3 Forest Economics: NIL

2.4.4 Forest Biometrics: NIL

2.4.5 Participatory Forest Management: NIL

2.4.6 Policy and Legal Issues: NIL

2.4.7 Information and Communication Technology (ICT) : NIL

## 2.5 Wood Products

2.5.1 Overview

2.5.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2019-20
Plan	-	-	-
Externally Aided	-	-	-
Total	-	-	-

2.5.2 Wood and other Lignocellulosic Composites: NIL

2.5.3 Wood Processing: NIL

2.5.4 Value Addition and Utilization : NIL

2.5.5 Wood Chemistry: NIL

2.5.6 Pulp and paper: NIL

## 2.6 Non-wood and Forest Products (NWFPs)

2.6.1 Overview

Only one project is in this theme, which is under conclusion. Twelve training cum demonstration programmes were organized on value addition of *Tamarindus indica*(Pods), *Butea monosperma* (flowers), *Diospyros melanoxylon* (fruits), *Momordica dioica* (fruits), *Leptadenia reticulata* (pods) and *Cordia gharaf* (fruits) for building capacity of different SHG members.

2.6.1.1 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2020-21
Plan	1	-	-
Externally Aided	-	-	-
Total	1	-	-

## 2.6.2 Resource Development of NWFPs

### 1. Capacity building of VFPCs/SHGs through value addition of selected underutilized NTFPs for enhanced livelihood opportunities in arid and semi-arid Rajasthan.

Principal Investigator: Smt. Sangeeta Tripathi, CTO

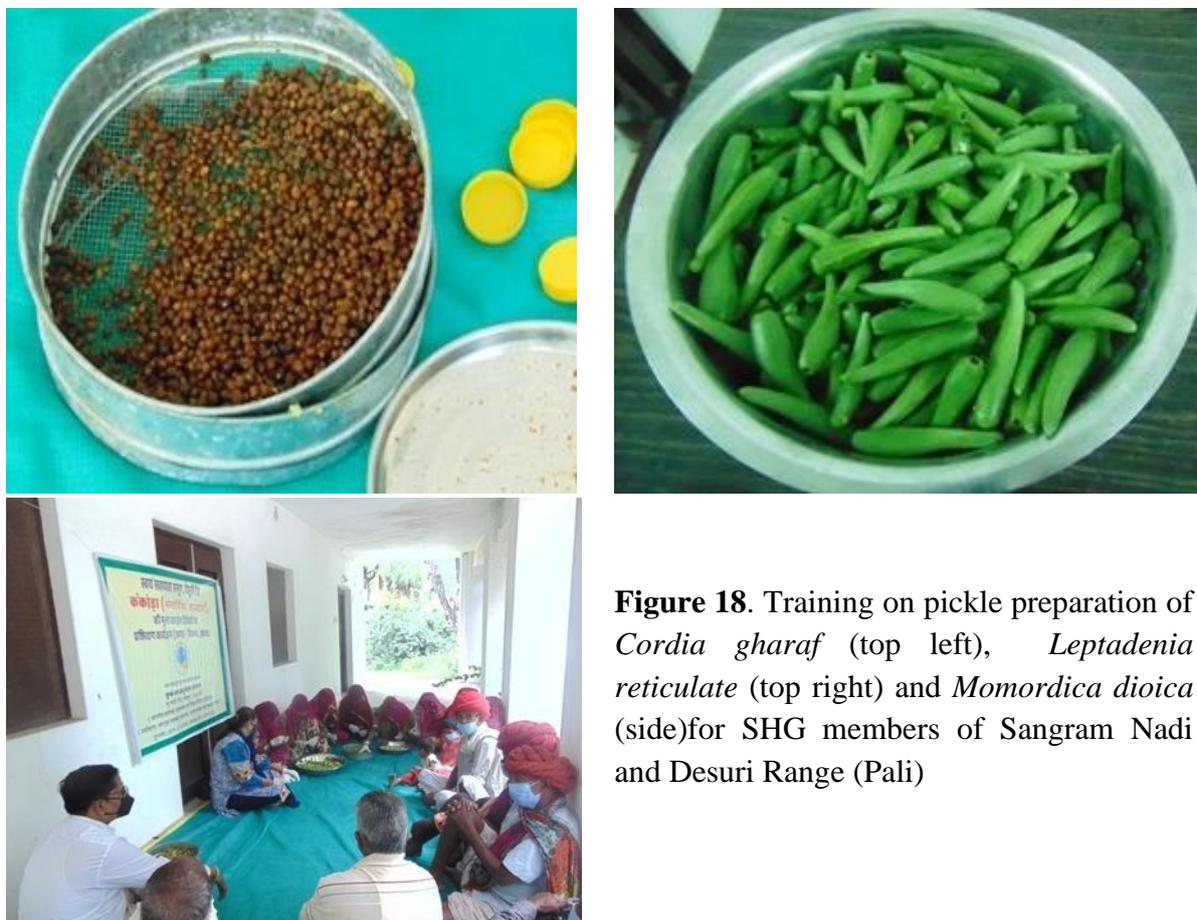
Interactive meetings with VFPC/SHG members in Sirohi district were organized to brief about project objectives. SHG members agreed for taking up value addition activities of different forest produce. Six training cum demonstration programmes for Bhurki Devi Mahila SHG in Jamboori and Mahadev SHG in Surpagla villages (three days each) were organized on value addition of *Tamarindus indica* (Pods-Chutney, Jam & Squash), *Butea monosperma* (flowers-Herbal gulal), *Diospyros melanoxylon* (fruits-Jam). Total 240 members including SHG/VFPC members and Rajasthan State Forest Department officials participated in the programme (**Fig. 17**). Jam, Chutney and herbal gulal were prepared and distributed among the members. Acceptability of these products was tested on 9-point Hedonic scale. A good response of SFD officials, District Administration Officials, Serpanch and other authorities was obtained.



**Figure 17.** Training on value addition of *Tamarindus indica* (top left), *Diospyros melanoxylon* Jam preparation (top right) and *Butea monosperma* herbal gulal preparation (side) for Mahadev SHG, Surpagla and Bhoorki Devi Mahila SHG, Jamboori in Sirohi district.

Interactive meetings and trainings were also organized in Pali district for value addition of *Momordica dioica* (Fruits-Pickle), *Cordia gharaf* (fruits-pickle), *Leptadenia reticulata* (pods-pickle). Total 240 members including SHG/VFPC members and forest officials

participated in the 6 training cum workshop programme (Fig. 18). Jam, Chutney and herbal gugal were prepared and distributed among VFPC/ SHG members. Acceptability of pickle was tested on 9-point Hedonic scale and there was a good response of the members of different government and non-government organizations.



**Figure 18.** Training on pickle preparation of *Cordia gharaf* (top left), *Leptadenia reticulata* (top right) and *Momordica dioica* (side)for SHG members of Sangram Nadi and Desuri Range (Pali)

**Research Benefit:** The activities carried out in the project will be helpful in providing employment opportunities to SHG members for livelihood support.

2.6.3 Sustainable Harvesting and Management: Nil

2.6.4 Chemistry of NWFPs, Value Addition and Utilization: Nil

2.6.5 Biofuels and Bioenergy: Nil

## **2.7 Forest Protection**

### 2.7.1 Overview

There are 4 projects in this theme. Out of this two have been completed, one is ongoing and another one is initiated in the year 2020. Pod setting in Khzri trees was very low in heavily infested trees (0-2 pods per inflorescence) by mites in comparison to un-infested trees with 12-16 pods per inflorescence. To manage it and improve pod formation, integrated approach

was adopted to manage khejri galls using chemical miticide, botanical extracts and biological control agents like entomopathogenic fungi.

A consortium of fungi, PSBs and *Azospirillum* have been developed for enhancing growth and biomass productivity of *D. strictus* and *B. bambosin* both nursery as well as field conditions. Different strains *Rhizobium* isolated from Khejri nodules showed adaptability alkalinity, tolerant to 3% NaCl concentration, solubilise phosphorus and positive chitinase activity. Consortia of *Rhizobium* + *Azotobacter* + *Bacillus* were best as compared to single isolate for raising quality planting material of khejri. Hands on training were also organized for women farmers to empower them on use of biofertilizer and improve crop productivity and household earning. In this four trainings were organized at different places of Jodhpur district involving 72 numbers of women farmers of different villages.

### 2.7.1.2 Project under the theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During 2020-21
<b>Plan</b>	2	1	-
<b>Externally Aided</b>	-	-	1
<b>Total</b>	2	1	1

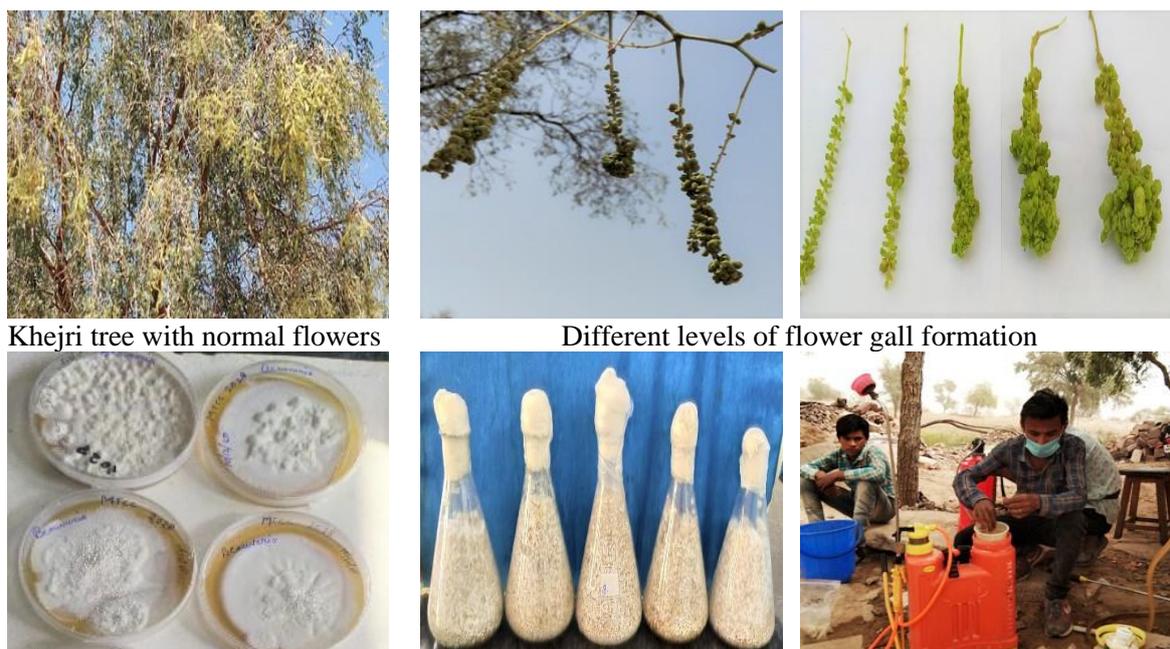
### 2.7.2 Insects pests, diseases and control

#### 1. Development of Integrated management strategy against flower gall inducers of *Prosopis cineraria* (L.) Druce

*Principal Investigator: Dr. Shiwani Bhatnagar, Scientist-D*

Incidence of flower galls of Khejri in different village areas of Baori, Pipar, Phalodi and Lohawat was recorded. Flower galls incidence at Phalodi, Lohawat and Osian areas was more severe in comparison to Baori and Pipar areas. The gall infested trees had large number of unorganized, round, oblong and spindle-shaped galls (**Fig. 19**). Average numbers of flower gall per inflorescence was higher at Phalodi followed by Lohawat in comparison of Osian, Baori and Pipar areas. Pod setting was very low in heavily infested trees (0-2 pods per inflorescence) in comparison to un-infested trees with 12-16 pods per inflorescence. Biochemical analysis (carbohydrate, phenols and protein) of the samples collected from flower gall infested khejri trees and uninfested khejri trees were done. In the infested trees samples, level of phenol and proteins were higher, but level of carbohydrates did not differ significantly between infested and uninfested trees.

Two rounds of management trial was given to the selected khejri trees at bud initiation stage in last fortnight of February and First fortnight of March with botanicals, chemicals and entomopathogenic fungi at an interval of 15 days (**Fig. 19**). To study the influence of lopping on khejri flower gall formation lopping of selected trees were done at the above-mentioned five selected areas.



**Figure 19.** Khezri gall formation influenced by mites and management trials in different areas.

### 2.7.3 Mycorrhizae, rhizobia and other useful microbes

#### 2. Selection of efficient AM fungi, PSBs and *Azospirillum* for productivity enhancement of *Dendrocalamus strictus* & *Bambusa bambos*.

*Principal Investigator: Dr. Neelam Verma, CTO*

Nursery experiment on the selection of efficient AM fungi, PSBs and *Azospirillum* for enhancing growth and productivity of *D. strictus* and *B. bambos* has been completed. 150 plants of each species were shifted from nursery to laboratory and their shoot height, root length, shoot and root fresh weight and dry weight were recorded. Dried and grinded 288 samples of roots and shoots of both the species were digested for estimation of phosphorous content in the plant samples. Results indicated that all AM fungi/PSBs/*Azospirillum* treated plants performed better in terms of enhanced growth and biomass production as compared to the un-inoculated plants of both *D. strictus* and *B. bambos*.

Field trial was established to demonstrate the impact of biofertilizers (AM fungi/PSBs/*Azospirillum*) on *D. strictus* and *B. bambos* plants at Forest Block Khokhriya ki Nal, Near Ghata Nadi nursery in Devla Range of Udaipur (North) division (**Fig. 20**). Total 384 plants (192 plants of each species) were planted under 16 treatments combinations (with Control) in 3 replicate plots. There were 4 seedlings per plot at 4m × 5m spacing. Plants were measured and soil samples were collected from the experimental site. Soil samples were analysed for pH, EC and SOC. Biofertilizer inoculated seedlings performed better with 80% survival in both the species in field condition indicating the utility of the findings for further replications under various afforestation programmes.



**Figure 20.** Mass production of *D.strictus* and *B. bambos* seedlings after inoculation with biofertilizers, field trial at Ghata Nadi and training organized for field forest officials.

One day online training was also organized on "Application/Importance of different Biofertilizers in Bamboo". About 20 participants including Dr. C.P. Shukla, Sr. Scientist, National Medicinal Plant Board, New Delhi, Forest officials, NGOs and progressive farmers from Udaipur Range were participated in the training on 15<sup>th</sup> March, 2021 at AFRI, Jodhpur. The study provides first hand information on AM technology to end users and use of eco-friendly biofertilizer to enhance the productivity of *Dendrocalamus strictus* and *Bambusabambos* in Rajasthan and the related regions.

### 3. Evaluation of plant growth promoting (PGP) activity of *Rhizobium* from native legumes and development of consortia with other PGP Rhizobacteria.

*Principal Investigator: Dr. Sangeeta Singh, Scientist-E*

This project was to isolate *Rhizobium* from root nodules of *Prosopis cineraria* (Khezri) and test the isolates against alkalinity, salinity, phosphorus solubilization, etc and use them either alone or in combination with *Azotobacter* and *Bacillus* for quality seedling production of different species. Eighty four isolates of *Rhizobium* were isolated from Khezri nodules using trapping technique. Characterization experiments showed that most of the strains had adaptability in the pH range of 5 to 11. Some strains can tolerate upto 3% NaCl concentration. Three strains can solubilise phosphorus apart from fixing atmospheric nitrogen, whereas 3 strains showed positive chitinase activity. Phenotypic, biochemical and molecular characterizations of these isolates formed 23 groups based on the similarity index. One isolate from each group was selected and nursery experiment with compatible isolates of *Azotobacter* and *Bacillus* was laid out in isolation as well as in combinations (**Fig. 21**). The results show that consortia of the isolates (*Rhizobium* +*Azotobacter*+*Bacillus*) performed

better as compared to single isolate in raising quality seedlings of tree species including Khezri.



**Figure 21.** Experimentation on use of different isolates of Rhizobium, Azotobacter and Bacillus for improving seedling quality.

#### **4. Training of Rajasthan rural women on use of biofertilizer for crop productivity enhancement (July 2020-December 2021)**

*Principal Investigator: Dr. Sangeeta Singh, Scientist-E*

This is a collaborative project between AFRI, Jodhpur and Amity University, Noida, under TDUPW Scheme of 'Technology Development and Utilization Programme for Women' funded by Department of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India. The main objective of this project is to train Rajasthan rural women farmers on benefits of biofertilizers based on the endophyte *Piriformospora indica* root tonic basically to empower women on use of biofertilizer and improve crop productivity and household earning.

In this four trainings were organized at different places of Jodhpur district. These trainings were organized at Osian, Jodhpur on 29<sup>th</sup> October, 2020; Mathania, Jodhpur on 6<sup>th</sup> January, 2021; Falodi, Jodhpur on 29<sup>th</sup> January, 2021; and Bilara, Jodhpur on 26<sup>th</sup> February, 2021 (**Fig. 22**). The women farmers were interacted and briefed about the techniques of applications of bio-inoculants to different crops as these inoculants increase the yield of the economically important crops and impart value addition to the plants products. A total 72 numbers of women farmers were trained and benefitted by this training.



**Osian**



**Mathania**



**Falodi**



**Bilara**

**Figure 22.** Imparting training to women farmers of different areas on biofertilizers inoculations in Jodhpur district.

2.7.4 Weeds and Invasive species: NIL

2.7.5 Forest Fire and Grazing: NIL

### 3. Education Vistas/Activities

3.1 FRI University (Applicable for FRI Only)

3.2 Training organized:

Sr.	No. of Trainings	Duration (in days)	No. of participants
1	Training on 'Eco-restoration of Desert and degraded areas' organised at AFRI, Jodhpur.	January 27-29, 2020	Scientific and technical staff of ICFRE
2	4 trainings under the project Training of Rajasthan rural women on 'Use of biofertilizer for crop productivity enhancement'.	29 <sup>th</sup> October, 2020, 6 <sup>th</sup> January, 29 <sup>th</sup> January, and 26 <sup>th</sup> February, 2021	72 rural women of different areas of Jodhpur district
3	One Week Compulsory Online Training Program For IFS Officers organized at AFRI Jodhpur from 14th to 18th December 2020.	December 14-18, 2020	IFS Officers from various states
4	Online training on "Application/Importance of different	March 15, 2021	20 participants Sr. Scientist, NMPB, Forest

	Biofertilizers in Bamboo" organized at AFRI, Jodhpur.		officials, NGOs and progressive farmers of Udaipur division
5.	Training cum demonstration programmes were organized by AFRI, Jodhpur in different locations in Sirohi district on <i>Feronia limonia</i> , <i>Tamarindus indica</i> , <i>Butea monosperma</i> , <i>Diospyros melanoxylon</i> .	04.09.20 – 06.09.20 (3 days) 01.02.21 – 05.02.21 (5 days) 22.03.21-26.03.21 (6 days)	Total 240 members participated
6	Training cum demonstration programmes were organized by AFRI, Jodhpur in different locations in Pali district on <i>Momordica dioica</i> , <i>Cordia gharaf</i> , <i>Leptadenia reticulata</i> .	31.08.20– 02.09.20 (2 days) 28.12.20 – 1.1.20 (4 days)	240 members of different SHGs, forest officials and NGOs
7	One day online training on "Application/Importance of different Biofertilizers in Bamboo", was organised at AFRI, Jodhpur.	One day on 15 <sup>th</sup> March, 2021 at AFRI, Jodhpur.	20 participants including Forest officials, NGOs and progressive farmers

### 1. One Week Compulsory Training Programme for IFS Officers

Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India provides for short-term courses of one/two week(s) duration for the Indian Forest Service Officers in the premier institutions in the country for updating the knowledge, skills, and change of the attitude for managing the natural resources of the country by organizing specialized tailor-made courses. Present one-week compulsory training for IFS Officers is one of such courses awarded to Arid Forest Research Institute (AFRI), Jodhpur by MoEF&CC with the theme – “Integrated Approach for Sustainable Development of Fragile Desert Eco-system”. The one-week refresher IFS training course which was in online format this year from December 14 to 18, 2020.

MoEF&CC had nominated 42 IFS officers from different states of India for this refresher training program. However, only 34 IFS officers joined the training as some could not get permission from their respective cadre to attend this training or were on leave. This training programme was aimed to provide knowledge and proper understanding of the fragile desert eco-system to the officers of the Indian Forest Service. The training was inaugurated by Hon’ble Chief Guest Shri G.V. Reddy, Ex PCCF & HoFF, Rajasthan. He addressed the participants and encouraged them to bring the specific case studies of their regions pertaining to the course objectives (**Fig. 23**). The training was completed successfully, concluded after panel discussion and valedictory session and certificates were distributed to the participants both through email as PDF and by post along with the group photo collage (**Fig 24**).

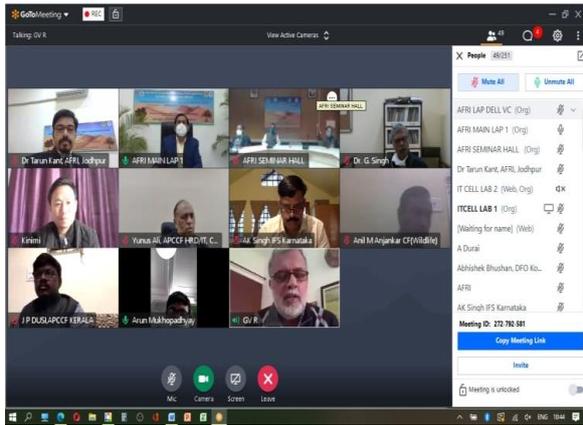


Figure 23. IFS Training: Some Photos of online sessions.

**Compulsory Training Programme (Online) for IFS Officers 2020**



**M. R. Baloch, IFS**  
Director, AFRI



**Dr. G. Singh**  
Scientist G, GCR



**Dr. Tarun Kant**  
Course Director

**INTEGRATED APPROACH FOR SUSTAINABLE DEVELOPMENT OF FRAGILE DESERT ECOSYSTEM**  
Participants, IFS Training (Online), 14<sup>th</sup> - 18<sup>th</sup> December 2020

 T. K. Choubey	 Yunus Ali	 Ajay Srivastav	 D. Jaya Prasad	 Kamal Dutta	 R.K. Gupta	 Ashwani K. Singh	 Kamalika Mohanta	 S. Saravanan
 Naresh Kumar	 Bariand Shangdiar	 A.M. Anjankar	 Kishan Chand	 R. Thanga Pandian	 Arun Kumar Mukhopadhyay	 Prem Naryan Mishra	 Vasanthan B.	 Sudhansu Sekhar Khora
 Naveen Kumar P.	 Manita Priyadarshi	 Neeenu Somaraj	 Ramaswamy P.	 Ram Ratan Nala	 Vijay Singh	 Gaurav Ojha	 Monika Devi Yadav	 Mohan Choudhary
 H. Tokaho Kinimi	 Lalit Kumar Giri	 B.V. Sandeep	 S. V. Pradeep K. Shetty	 Abhishek Bhushan	 Arsalan			



**ARID FOREST RESEARCH INSTITUTE, JODHPUR**



Figure 24. IFS Training: Group Collage of IFS officers (Trainees)

### 3.3 Visit Abroad: Nil

### 3.4 Participation in Seminar/Symposia/Workshop/Trainings

Sr.	No. of Seminars / Symposia / Workshops / Trainings	Duration (in days)	No. of participants
1	Bhatnagar, S. (2020). Participated in Webinar on 'How to Avoid Plagiarism Using-URKUND as a Plagiarism Tool' organized by e-Galactic, Post Graduate Government College for Girls-42, Chandigarh, Birla Institute of Management & Technology, Greater Noida and Ranganathan Society for Social Welfare and Library Development.	May 2, 2020	1
2	Bhatnagar, S. (2021). Environment plays a leading role in emergence of diseases: a review. Presented in National Level E-Seminar on "Evolution of Pathogens", organized at Department of Education, Gokul Das Hindu Girls College, Uttar Pradesh.	May 12-13, 2020	1
3	Kumar, S. (2020). Attended monthly seminar on 'Exploiting Khejri and Lasora as horticultural crops'. Delivered P. R. Meghwal, Pr. Sc. (Horticulture), CAZRI held at AFRI, Jodhpur.	June 26, 2020	1
4	S.R. Baloch (2020). Participated in International Webinar on "Global Climate Change Evidence Causes Effects and Solution" Organized by Department of Botany, Ewing Christian Collage (University of Allahabad), Prayagraj, India.	July 5-7, 2020	1
5	Hegde, M.T. (2020). Participated and delivered lecture on "Issues in red Sanders Cultivation" in one day training organized by Tamil Nadu Forest Academy.	July 10, 2020	1
6	Hegde, M.T. (2020). Atended International seminar on "Sandalwood Workshop by Advanced DNA, Identification and Forensic Facility (ADIFF)" organised by University of Adelaide, Australia.	August 5, 2020	1
7	Kumar, S. (2020). Participated in a National Webinar on 'Faunal Resources of the Great Indian Desert' organized by Zoological Survey of India, Desert Regional Centre, Jodhpur.	August 6, 2020	1
8	Kumar, S. (2020). Participated in the Webinar on 'Forest insect pests & diseases and their management' (Recent advances in integrated management of tree health problems caused by insect-pests and diseases) organized by Forest Protection Division, Forest Research Institute, Dehradun.	August 18, 2020	1
9	Kumar, S. (2020). Participated in the National Webinar on 'Role of insects and fungi in forest ecosystem: challenges & future perspective' organized by Tropical Forest Research Institute, Jabalpur.	August 26, 2020	1
10	Kumar, S. (2020). Participated in the National Webinar on 'Grassland ecosystem of arid zone of India- A faunal	September 18, 2020	1

	diversity perspective’ organized by Zoological Survey of India, Desert Regional Centre, Jodhpur, Rajasthan.		
11	Sharma, B. and Baloch,S.R. (2020). Attended online training on “Statistical methods in forestry” organized by IFB Hyderabad.	October 5-6, 2020 (2 days)	2
12	Baloch,S.R. (2020). Attended virtual Stakeholder Consultations workshop on “Draft Document for Safeguards Information System for REDD+”organized by FRI, Dehradun.	October 15, 2020	1
13	Singh, G. and Kumar, S. (2020). Attended online meeting on ‘Central Asian Flyway Committee’ through VC.	October 20, 2020	1
14	Baloch, S.R. and Sharm, B. (2020).Attended a webinar on ‘Impact of Technology Dissemination on Enhancement of Livelihood Security through Forestry Endeavours’ organized by FRCER Prayagraj & FRCLE Agartala.	October 20, 2020	1
15	Hegde, M.T. and Bohra, N.K. (2020). Attended one day training workshop on ‘Sandal cultivation’, organized by Anand Agricultural University, Anand , Gujarat	November 2, 2020	2
16	Kumar, S. (2020). Attended as nominated Scientist member, online meeting on the Central Asian Flyway Committee through VC at AFRI, Jodhpur.	November 6, 2020	1
17	Kumar, S. (2020). Attended online programmed to commemorating birth Anniversary of Dr. Salim Ali organized by MOEF & CC at AFRI, Jodhpur.	November 6, 2020	1
18	Tripathi, S. and Sharma, H.K. (2020). Attended two days HRD TrainingProgramme on “Research Methodology and Statistical Tools in Forestry for Technical Staff”.	November 19-20, 2020	2
19	Hegde, M.T., Durai, A. and Tripathi, S. (2020). Attended five days training programme on ‘Indian Sandalwood’ organized by IWST, Bangalore.	November 23-27, 2020	3
20	Bohra, N.K. (2020). Aattended a training on ‘Role of Technology in Community Level Disaster Mitigation for Scientist and Technical’, organized by LBSNAA and DST.	November 23-27, 2020	1
21	Sharma, B. (2020). Attended online training on “Community resource management” organized by IIFM,Bhopal	November 23-27, 2020	1
22	Tripathi, S. (2020). Attended three days training on “Networking and Hardware Maintenance” online organized by IFP Ranchi.	November 25-27, 2020	1
23	Kumar, S. (2020). Attended NBA UNDP webinar series 7 on ‘Biodiversity Management Committees’ organized by MOEF & CC, New Delhi.	November 25, 2020 (1 days)	1
24	Kumar, S. (2020). Attended two days training on ‘Integrated Pest and Disease Management for Scientists’ organized by Institute of Forest Biodiversity (IFB),	December 8-9, 2020	1

	Hyderabad		
25	Singh, S. and Bhatnagar, S. (2020). Participated in training on 'Integrated pest and disease management for scientist' organized by Institute of Forest Biodiversity, Hyderabad	December 8-9, 2020	2
26	Sharma, S. (2020). Attended online training on "Agroforestry and land use management system for Scientist" organized by RFRI, Jorhat.	December 14-18, 2020	1
27	Baloch, S.R. (2020). Participated in National Webinar Series Lecture on "Alien Plant Invasion in India: Status and Consequences" Organized by Botanical Survey of India. High Altitude Western Himalayan Regional Centre, Nauni Campus, Solan (H.P.).	December 17, 2020	1
28	Singh, B. (2020). Attended webinar on "Contribution of agro-forestry to achieve additional carbon sink of 2.5 to 3 billion tonnes of CO <sub>2</sub> equivalent through additional tree cover in India by 2030" organized by TERI, New Delhi.	8 <sup>th</sup> July, 2020	01
29	Singh, B. (2020). Attended in Webinar on Ply Reporter e-Conclave -2 on 'Agro-Forestry and Future of Wood Panel Industry – Sustainable Timber for Panel and Furniture' Organised by 'ARCL Organics Ltd.	19 <sup>th</sup> July 2020.	01
30	Singh, B. (2020). परि-पुन-स्थापन वन अनुसंधान केंद्र, प्रयागराज द्वारा आयोजित राष्ट्रीय वेब संगोष्ठी "कृषिवानिकी में शोध एवं नवाचार परिदृश्य के अंतर्गत राजस्थान के शुष्क क्षेत्रों में कुमठ ( <i>Acacia senegal</i> ) आधारित परंपरागत कृषि वानिकी प्रणाली में फसल उत्पादन, मृदा पोषक तत्व और गोद उत्पादन विषय पर चर्चा किया।	25 <sup>th</sup> September 2020	04
31	Singh, B. (2020). Participated in webinar towards the Third Asia-Pacific Urban Forestry Meeting - "Urban forestry innovations to transform landscapes and well-being in the post-Covid-19 era" organized by FAO, Rome.	19 October 2020	01
32	Singh, B. (2020). Participated in a webinar Series on 'Impact of technology dissemination on enhancement of livelihood security through forestry endeavours, organized by FRCER Prayagraj & FRCLE Agartala.	20 <sup>th</sup> October 2020	01
33	Kant, T. (2021) Invited lecture on "Genetically modified (GM) plants for a sustainable future & addressing the controversies" in State Level Training programme on 'Initiatives for teaching-learning excellence in botany' jointly organized by Commissionerate of College Education, Government of Rajasthan, Jaipur and Department of Botany, Raj Rishi (Autonomous) College, Alwar.	January 22, 2021	1
34	Sharma, B. and Baloch, S.R. (2021). Attended online	February 3-5,	2

	training on ‘Assessment of carbon sequestration of different ecosystem/forest ‘organized by IFP Ranchi.	2021	
35	Hegde, M.T. (2021) Attended DST sponsored online training programme on "Environmental Leadership and Life Skills" conducted by IIFM Bhopal.	February 8-12, 2021	1
36	Durai, A., Sharma, H.K. and Jayanth, B. (B). Attended online HRD training programme on ‘Processing and Analysis of Honey, Gum and Resin organized’ organized by Institute of Forest Productivity, Ranchi.	February 9-11, 2021	3
37	Bohra, N.K. (2021). Attended stakeholder and expert consultation Workshops for ‘Capacity Building of State Forest Department of Chhattisgarh for preparation of State REDD+ Action Plan’ organized by ICFRE, Dehradun.	February 17-20, 2021	1
38	Hegde, M.T. and Bohra, N.K.(2021). Attended DST sponsored online training programme on “Natural Resource and Environmental Management” conducted by IIFM Bhopal.	January 18-22, 2021	2
39	Hegde, M.T. (2021). Attended an HRD training program on the topic "Molecular Biology Techniques" organized by IFP, Ranchi	February 25-26, 2021	1
40	Hegde, M.T. and Kumar, S. (2021). Attended a two days training programme on ‘Environment, Biodiversity and Disaster Risk Reduction’ jointly organized by Tropical Forest Research Institute (TFRI), Jabalpur and National Institute of Disaster Management (NIDM).	February 25-26, 2021	2
41	Sharma, B. (2021). Attended online lecture on ‘Empowerment of Women through Spirituality’ organized by Prajapita Brahma Kumaris Ishwariya Vishwa Vidyalaya (PBKIVV), New Delhi.	March 15, 2021 (1 day)	1
42	Hegde, M.T., Tripathi, S. and Garg, S.L. (2021). Attended International conference on ‘Conservation, Management & Sustainable Utilization of Lesser Known Plants’ organised by Forest Research Centre for Eco-Rehabilitation, Prayagraj.	March 18-19, 2021 (2 days)	3

#### **4. Extension Panorama/Activities:**

4.1 Report on Van Vigyan Kendras (VVKs), Demo Village (DV), Tree Growers Mela (TGM), Prakriti and Green Skill Development Programme (GSDP)

##### **4.1.1 State wise locations of established VVKs**

- (a) Bichhwal Nursery, Bikaner, Rajasthan, established
- (b) Chhipardi Beedi, Rajkot, Gujarat, established
- (c) Rudana Nursery, Khanwel (Silvasa), Dadra & Nagar Haveli and Daman & Diu, established

## 4.1.2 State wise locations of proposed VVKs

### A. Environmental Awareness Centre under KVK, Bikaner

A numbers of meetings were organized and discussion held between AFRI, Jodhpur officials and the members of Akhil Bhartiya Bishnoi Mahasabha at Muktidham, Mukam (ABBMS), tehsil Nokha, district Bikaner (Raj). It was to discuss on setting up of an Environmental Awareness Centre at Mukam, Nokha, Bikaner under the jurisdiction of the Indian Council of Forestry Research & Education, Ministry of Forest, Environment & Climate Change. Correspondence was made with the District Collector, Bikaner, Gram Panchayat, Mukam and President, ABBMS Mukam, regarding allotment of land for establishment of the Environmental Awareness Centre at Mukam, under VVK, Bikaner. The proposal is to establish a NIC hall, nursery, and carry out some demonstration plantation on AFRI activities. Meeting was also organized with Tehsildar, Nokha, for allotment of land for plantation activities at Jambheshwar Oran land at Mukam itself. They agreed to in principal to allot the land for the above purposes.

### B. Proposed Demo Village

A MOU was signed on 30.01.2021 between Director, AFRI, Jodhpur and DFO, IGNP, Jaisalmer to establish a new Demo village at 1445 RD, IGNP area, Mohangarh, Jaisalmer.

## 4.1.3 VVK/KVK Networking

(A) E-copy of followings have been prepared and distributed to various centers of KVKs under networking of ICAR- Krishi Vigyan Kendras (KVKs) and ICFRE, Van Vigyan Kendras:

- Organic farming: Importance and method of preparation
- Food obtain from Arid forest region- June, 2020
- Model forest nursery –establishment and management- July, 2020
- Enhancing livelihood Generation through Value addition on non Timber Forest products: NTFPs (अकाष्ठ वनोपजों के मूल्य संवर्धन द्वारा जीविकापार्जन में वृद्धि)-Nov, 2020).
- Farmer's Guide for white sandal wood cultivation- December, 2020
- AFRI DARPAN (A quarterly magazine -January–June 2020, Nos. 02)- January, 2021
- Red sandal (Lal Chandan): A Green Gold- February, 2021
- *Tecomella undulata* (Rohida): Marwar Teak of Rajasthan- March, 2021

(B) During feedback received from KVKs in charge, they mentioned that material send by AFRI is beneficial for farmers and other stake holder- August, 2020

## 4.1.4 Prakriti

Prakriti programme of ICFRE is to provide platform for school children to learn practical skills in sustainable use of resources. It also aims to promote awareness among the students of Kendriya Vidyalaya and Jawahar Navodaya Vidyalaya about forests and environment and stimulate interest in maintaining the nature balance. Details of the activities carried out by AFRI, Jodhpur under this programme are provided below:

S. No.	Name of KV/JNV	Date	Participants	Activity
1	KV No. 1 Air force, Jodhpur	25.02.21	Principal of School	On 25.02.2021, AFRI officials visited KV No.1 AFS Jodhpur and met with Sh Vivek Yadav, Principal and discussed about signing of MoU between ICFRE and Kendriya Vidhyalaya Sanghathan. AFRI team provided extension promotional material to Principal Shri Yadav for study and reference to students and staff ( <b>Fig. 25 left</b> ). Team also apprised about plantation technique.
2	KV, Tivari, Jodhpur	05.03.21	Principal, Teachers and students of class 6 to 7	Delivered a lecture on planting techniques and soil and water conservation. Extension material was given to Principal Shri Mahendra Singh ( <b>Fig. 25, right</b> ). AFRI team also apprised about plantation techniques by planting seedlings at school premises.



Figure 25. Distribution of extension materials to different schools under Prakriti programme.

#### 4.1.5 Participation in “Atamnirbhar Bharat 2021”

AFRI participated in “Atamnirbhar Bharat 2021” from 11<sup>th</sup> -12<sup>th</sup> January, 2021 organized by Friendz Exhibitions & Promotions Pvt. Ltd. New Delhi. It was a Mega Event titled “Atamnirbhar Bharat 2021” at Inder Residency Udaipur (Rajasthan). Focus of the event was to disseminate information about Atamnirbhar Bharat. In this conference, a stall of AFRI was installed by Extension Division of AFRI by electronic posters, a sample of Khejari diseases, different pamphlets/leaflets, and seedling of important forestry tree species in root trainers. Different published material related to research activities and technical details of the institute and other important information were also distributed to the visitors. Visitors acquired the knowledge about the plants of desert ecosystem, sand dune stabilization, and reasons for Khejari mortality and remedies for it. Visitors from Rajasthan as well as different part of the country visited the stall and got impressed by the research work and displayed information of AFRI, Jodhpur (**Fig. 26**). Queries of the visitors were replied by the Senior Technical Officers of AFRI, Jodhpur.



Figure 26. Stall of AFRI, Jodhpur in Atamirbhar Bharat 2021 organised at Udaipur

#### 4.2 Technologies transferred

- Six clones of *Dalbergia sissoo*, 4 clones of *Casuarina junghuniana* and 4 clones of *Casuarina* hybrid have been short listed for release in Gujarat. The clonal trials were revisited and growth data were collected. Detailed report has been submitted to the “Implementation Committee for Varietal Release’ constituted by AFRI, Jodhpur.
- Tree transplantation has been employed and some trees of desert species were transferred as preliminary technique for monitoring and further improvements.
- 81 visitors in 02 groups visited Extension and Interpretation Centre of AFRI (Fig. 27).

Sl No.	Name of Visitors/Group	Date	No. of Visitors
1	A team of 40 female farmer of Bavadi tehsil under Project of “Aatma 2020-21” visited Arid Forest Research Institute, Jodhpur on 08.02.2021. At the beginning of the tour, participants were explained about the research activities of AFRI and Extension and Interpretation centre was shown to them. The participants visited the experimental nursery of the Institute where they were apprised about nursery technique.	08.02.21	40
2	A team of 41 RFO’s along with their Officer In-charge Dr.C.K.Kavidayal from Uttarakhand Forestry Training Academy, Haldwani (Nainital) visited Arid Forest Research Institute, Jodhpur on 12.03.2021. At the beginning, team was welcomed and addressed by Dr. G. Singh, Director in Charge, AFRI. It was followed by detailed presentation about AFRI research activities by Dr. Tarun Kan, Head Extension Division. Team also visited Extension & Interpretation centre and modern nursery of the Institute. Nursery techniques were also explained to the RFO’s team.	12.3.21	41



**Figure 27.** Visitors in Exhibition and interpretation Centre and interaction in Conference hall of AFRI, Jodhpur.

#### 4.3 Intellectual Property - Patents Granted/Applied (during the year), any other information regarding IP

Nil

#### 4.4 Research Publications: Please provide information in the table given below:

Books	Booklets/Broc hure /Bulletins/ Pamphlets	Article in Seminar/ Conference/ Workshops,etc		Popular Article	Research Papers in Journal		Chapters in Books / Proceedings
		Article	Abstracts		Foreign	Indian	
3	13	2	8	3	3	9	1

##### 4.4.1 Books/Booklets

1. Model Nursery AFRI
2. आफरी आदर्श पौधशाला (हिन्दी)
3. AFRI booklet both in Hindi and English

##### 4.4.2 Pamphlets

Following thirteen pamphlets have been prepared and pulished during 2020-21.

1. Farmers' guide for white sandalwood cultivation(English)
2. किसानों के लिए सफ़ेद चन्दन की खेती हेतु मार्गदर्शिका(हिन्दी)
3. Red Sanders (Lal Chandan)A Green gold(English)
4. लालचन्दन(रक्तचन्दन) एक हरा सोना(हिन्दी)
5. Enhancing livelihood generation through value addition of Nontimber Forest Products: NTFPs
6. अकाष्ठ वनोपजों के मूल्यसंवर्धन द्वारा जीविकोपार्जन मे वृद्धि(हिन्दी)
7. Casuarinas: Multipurpose Nitrogen Fixing Plants
8. Marwar Teak of Rajasthan: *Tecomella undulata*(Rohida)

9. मारवाड़ का सांगवान: रोहिड़ा
10. Khejri (*Prosopis cineraria*) mortality: Causes, severity & remedies In north-western Rajasthan
11. mÙkj&if'peh jktLFkku esa [kstM+h ¼izkslksfil flusjsfj;k½ eR;Zrk%dkj.k] rhozrk vkSj mipkj ds mik;
12. रोहिड़ा: मारवाड़ का सांगवान(एक कदम आनुवंशिक सुधार की ओर)
13. *Tecomella undulate* (Rohida): Marwar Teak of Rajasthan (A Step towards Genetic Improvement).

#### 4.4.3 Article in Seminar/ Conference/ Workshops

1. Bhatnagar, S. (2021). Environment plays a leading role in emergence of diseases: a review. In: National Level E-Seminar on the Evolution of Pathogens, May 12-13, 2020, Department Of Education, Gokul Das Hindu Girls College, Uttar Pradesh.
2. Bhatnagar, S., Singh, S., Khan, A.U., Sharma, N., Bhoi, T.K. and Kumar, B. (2021). Biochemical changes in *Prosopis cineraria* due to infestation by *Eriophyesprosopidis* (Eriophyidae: Acarina). In: National Conference on Priorities in Crop Protection for Sustainable Agriculture, 16-18 March, Organized by Central Agricultural University, Imphal, Manipur and ICAR-National Bureau Of Agricultural Insect Resources, Bengaluru.

#### 4.4.4 Abstracts published

1. Verma, N., Singh, S., Jedia, K.C., Sharma, B., Choudhary, N. and Basu, B. (2021). Arbuscular Mycorrhizal (AM) Diversity in *Dendrocalamus strictus*(Roxb.) Nees in Rajasthan. In: Online seminar on “Propagation, Management and Development of Value Chain in Bamboos” held on 10th February, 2021 at TFRI, Jabalpur.
2. Singh, S., Nirwan, B., Bhatnagar, S., Vyas, V., Shrama, K. and Chaudhary, S. (2021). Eco-friendly management of root rots pathogen of *Prosopis Cineraria*. In: Souvenir-cum-Abstract Book: National Conference on ‘Priorities in Crop Protection for Sustainable Agriculture’, 16-18 March, Organized by Central Agricultural University, Imphal, Manipur and ICAR-National Bureau of Agricultural Insect Resources, Bengaluru. Pp203.
3. Bhatnagar, S., Singh, S., Khan, A.U., Sharma, N., Bhoi, T.K. and Kumar, B. (2021). Biochemical changes in *Prosopis cineraria* due to infestation by *Eriophyesprosopidis* (Eriophyidae: Acarina). In: National Conference on ‘Priorities in Crop Protection for Sustainable Agriculture’, 16-18 March, Organized by Central Agricultural University, Imphal, Manipur and ICAR-National Bureau Of Agricultural Insect Resources, Bengaluru. Pp152.
4. Tripathi, S., Rathore, M. and Sharma,H.K. (2021). Capacity building of VFPC/SHG through value addition of some lesser known NTFPs of Rajasthan. In: International webinar on Conservation, Management & Sustainable Utilization of Lesser Known Plants (LKPs), 18-19th March 2021 organized by FRCER, Prayagraj. Pp. 72.

5. Tripathi, S. (2021). Kum upyogmeinlayejaanewale jangle falonkiadivasiarthvyavasthameinbhoomika. RajbhashaVagyanikSangoshthi, 15-16 March, 2021, organized by DRDO, Jodhpur. Pp 42.
6. Tripathi, S., Rathor, M. and Sharma, H.K. (2021). Capacity building of VFPC/SHG through value addition of some lesser known NTFPs of Rajasthan. In: International conference on “Conservation, management and sustainable utilization of lesser known plants (LKPs), 18-19 March, 2021 organised at Forest Research Centre for Eco-Rehabilitation, Prayagraj (UP).
7. Verma, N., Singh, S., Jedia, K.C., Sharma, B., Choudhry, N. and Basu, B. (2021). Arbascular Mycorrhizal (AM) diversity in *Dendrocalamusstrictus* (Roxb.) Nees in Rajasthan. Presented in Seminar on ‘Propagation Management and Development of Value Chain in Bamboos’ held on 10th Feb. 2021 at TFRI, Jabalpur.
8. Ravi. K., Baloch, S.R., Kumar, N. and Yadav, J.M. (2021). Assessment of populations of some FGR species of Barmer and Jalore districts of Indian Desert. Presented in national seminar on ‘Plant Taxonomy and Traditional Knowledge in the Himalayas and North-East India and Annual Conference of the East Himalayan Society for Spermatophyte Taxonomy

#### 4.4.5 Popular articles

1. Bhatnagar, S., Khan, A.U. and Sharma, N. (2020). Khejrivrikshameinphoolonkigathokisamasaya. AFRI Darpan. Jan. –June Issue no., Pp4-5
2. Sharma, N., Moolchand, Suman, R.K., Sankhla, M., Khan, A.U. and Bhatnagar, S. (2020). Amaltaskifaliyonmein *Trachylepidiafructicassella* ka sankraman. AFRI Darpan. Jan. –June Issue no. 2, pp6-7
3. अमित कुमार बाना, अंकुश गोदारा एवं शेराराम बालोच (2020). अकाल का दानव टिड्डी . तरुचिन्तन. 18-20.

#### 4.4.6 Research Paper / Scientific Journals

1. Sharma, B., Verma, N. and Tomar, M.S. (2020). Evaluation of antifungal potential of *Solanum xanthocarpum* Schrad. and Wendl., an important medicinal plant of arid region. International J Advanced Research in Biological Sci., 7(II), 163-168.
2. Sharma, B. and Verma, N. (2020). *In vitro* evaluation of antifungal activity of *Balanites aegyptiaca* Del. Indian J. Pure & Applied Biosciences, 8(6), 130-136.
3. Bhatnagar, S., Singh, S., Khan, A.U., Kumar, B., Goran, P., Ahmed, S.I. and Rathore, T.S. (2020). Antifeedant effects of some botanical extracts against cerambicid *Acanthoporous serraticornis*. J. Entomology and Zoology Studies, 8(1):1656-1658.
4. Bhatnagar, S., Suman, R.K., Sharma, N., Sankhla, M., (2020). Infestation of greater wax moth *Galleria mellonella* in *Apis mellifera* colonies in Jodhpur (Rajasthan). J Entomol. Zool. Stud., 8(5):1194-1197.
5. Bhatnagar, S., Sharma, N., Suman, R.K. and Sankhla, M. (2021). Seasonal abundance of oriental hornet in *Apis mellifera* L. colonies. J Entomol. Zool. Stud., 9(1), 1550-1553.
6. Baloch, S.R. and Singh, G. (2020). Standing carbon stock assessment of woody perennials grown in AFRI, campus, at Jodhpur, Rajasthan. Int. J. Adv. Res. Biol. Sci.,

7(10): 156-167.

7. Mehra, S. and Tarun Kant (2020). Pharmaceutically active cell biomass growth pattern under cell suspension culture of *Commiphorawightii* - A critically endangered medicinal plant. J. Plant Develop., 27: 71-81
8. Tarun Kant (2020). *In silico* identification of cross-talking abiotic stress-tolerance conferring candidate gene-orthologs in *Arabidopsis* and *Populus* using gene co-expression network analysis and comparative genomics. J. Phytol. Res., 33(2), 41-69.
9. Rathore, M. and Sharma, H.K. (2021). Nutritional evaluation of *Ceropegia bulbosa* tubers from different regions of Rajasthan. Ind. J. Pure App. Biosci., 9(1), 527-530
10. Sharma, B. and Verma, N. (2021). Evaluation of antifungal potential of *Tephrosia purpurea* (L) pers an important medicinal plant of arid region. International J Multidisciplinary Res. Dev., 8(1), 36-39.
11. Sharma, B. and Verma, N. (2021). Evaluation of antifungal potential of *Argemone Mexicana* L. an important medicinal plant of arid region. International J. All Research Education and Scientific Methods, 8(12), 1979-1983.
12. Iqbal, A., Dave, N. and Tarun Kant (2021). Comparative analysis of different nutrient media for growth of *Agrobacterium tumefaciens* under small volume cultures. J. Appl. Life. Sci. Intl., 24(2), 27-33

#### 4.4.7. Book Chapters

1. Singh, B. (2020). Agroforestry in Western Dry Region. In: Agroforestry Models developed by Indian Council of Forestry Research and Education, Dehradun, 2020. Pp53-58.

#### 4.5 Seminars/Symposia/Workshops Organized

Sr. No.	No. of Seminar / Symposia / Workshops/ Trainings/ Meetings	Duration (in days)	No. of participants
1	Regional Research Conference Webinar on 'Forestry Research in Western and Central India' jointly organized by Arid Forest Research Institute, Jodhpur, and Tropical Forest Research Institute, Jabalpur.	August 25, 2020	Officers, Scientists and Staff of AFRI, TFRI, Forest Dept. of Rajasthan, Gujarat, M.P., Maharashtra, Chhatisgarh and Dadra & Nagar Haveli.
2	RAG meeting was organized at AFRI, Jodhpur on 8 <sup>th</sup> October 2020.	October, 8 2020	Officers, Scientists and Staff of ICFRE/AFRI, NGOs, Progressive farmers, HoDs from JNVU university, Representative from BSI etc.
3	One day virtual Stakeholder Consultations workshop on "Draft Document for Safeguards Information System for REDD+" organized by AFRI, Jodhpur.	October 15, 2020 (1 day)	State forest departments of Rajasthan and Gujarat
4	Monthly webinar on topic 'Forest hydrology: Emerging issues and futuristic directions' by Dr.	January 12, 2021	25 (Scientists and Technical staff of AFRI)

M.L. Gaur, Professor & Head, Soil and Water Engineering Dept, Anand Agricultural University, Anand, Gujarat organized at Arid Forest Research Institute on 12th January, 2021 at AFRI, Jodhpur	(1 day)	
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#### 4.6 Consultancies

1. Preparation of Detailed Project Report (DPR) on Rejuvenation of Luni River through forestry intervention.
2. Designing, Developing and performance of Urban Forestry model for RSJA new building campus.

#### 4.7 Technical Services

- G. Singh (2020). Documentation and finalization of report on Mount Abu Eco-sensitive zone area related to Master plan of Mt Abu as committee member. Technical Report was submitted to NGT, Delhi.
- G. Singh (2020). Delivered different lectures related to soil, climate change, biodiversity and forests to Ph. D. Student in AFRI-FRIDUC under Ph.D. Course 2021
- G. Singh (2020). Delivered a lecture on ‘Research and achievements of AFRI in Forestry Sector, in Gyan Ganga programme of Botany, Government College, Bundi, on 16<sup>th</sup> February 2021.
- Bhawana Sharma (2021). Delivered a lecture on ‘Role of Botanicals in plant disease management’ during one week state level training programme on Environmental Studies Jointly organized by Commissionerate College Education Rajasthan and M.S. College for women Bikaner on 24th February 2021.
- Bhawana Sharma (2021). Delivered a lecture on ‘Role of Botanicals in management of plant disease’ during one week state level training programme (Gyan Ganga Programme) Jointly organized by Commissionerate College Education Rajasthan and Dungeer College Bikaner on 11th January 2021.
- S.R. Baloch (2021). Delivered lectures to Ph. D. Student in AFRI-FRIDUC under Ph.D. Course 2021
- S.R. Baloch (2021). Being a member attended the Vidhlya Management Committee meetings at Kendriya Vidhalaya No. 1, Air force, Jodhpur on dated 23th February, 2021.
- Kumar, S. (2020). Submitted information in respect of study by Principal Scientific Adviser (PSA) at the behest of the Prime Minister’s Office on 9<sup>th</sup> September, 2020.
- Kumar, S. (2020). Submitted suggestion as committee member with ToR to prepare a comprehensive action plan/strategy and to suggest appropriate actions and interventions on Control and Management of Invasive species to the Nodal Officer on 20 October, 2020.
- Kumar, S. (2020). Delivered two lectures to PhD scholars on ‘Introduction to Forest Protection-Its Need & Scope and Agencies Causing Forest Damage viz. Man, Fire,

Cattle, Wildlife, Insects and Pathogens, Nature of Their Damage, Cause, Prevention, Remedial Measures and Benefits on 06/10/2020.

- Singh, S. (2020). Delivered a lecture on 'Integrated pest & disease management in arid zone forestry' during one week refresher course of IFS officers at AFRI on December 14, 2020.
- Hegde, M.T. (2020). Delivered a lecture on "Prospects of improving the income of farmers in arid and semi-arid regions of Rajasthan and Gujarat through cultivation of high value trees like Sandalwood and Red sander" during one week refresher course of IFS officers at AFRI from December 14-18, 2020.
- Kant, T. (2020). Delivered a lecture entitled "Transgenic Plants - Pros and Cons and the GM Debate" during one week refresher course of IFS officers at AFRI during December 14-18, 2020.

#### **4.8 Activities of Rajbhasha:**

शुष्क वन अनुसंधान संस्थान, जोधपुर में हिन्दी सप्ताह- 2020 का आयोजन

शुष्क वन अनुसंधान संस्थान, जोधपुर में हिन्दी सप्ताह (14 से 21 सितंबर, 2020) का आयोजन हुआ। दिनांक 14/09/2020 को 'हिन्दी दिवस' पर हिन्दी सप्ताह-2020 का समारंभ हुआ। इस अवसर पर संस्थान के सहायक निदेशक (राजभाषा) श्री कैलाश चन्द गुप्ता ने माननीय गृहमंत्री, भारत सरकार तथा मंत्रिमंडल सचिव के संदेशों को पढ़ा तथा 14 सितंबर (हिन्दी दिवस) को भारतीय भाषाओं के सौहार्द के रूप में महत्ता दिये जाने का जिक्र करते हुए संविधान में राजभाषा संबंधी किए गए प्रावधानों की जानकारी दी साथ ही सरकारी कामकाज में सामान्य शब्दों की जगह पारिभाषिक शब्दों के प्रयोग के संबंध में प्रावधान की जानकारी दी। श्री गुप्ता ने इस अवसर पर हिन्दी सप्ताह के दौरान आयोजित होने वाली प्रतियोगिताओं राजभाषा बोध, हिन्दी टिप्पण- आलेखन, हिन्दी टंकण सामान्य व सारांश (यूनिकोड), स्वरचित कविता-पाठ की जानकारी दी।

हिन्दी सप्ताह-2020 का समापन समारोह दिनांक 21/09/2020 को आयोजित हुआ जिसमें मुख्य अतिथि हिंदी तथा मारवाड़ी के जाने माने कवि श्रीसत्यदेव संवितेंद्र रहे। संस्थान निदेशक ने मुख्य अतिथि का स्वागत किया तथा इस अवसर पर मुख्य अतिथि ने संस्थान के पदाधिकारियों की जानकारी वाले हिंदी बोर्ड का भी अनावरण किया। समापन समारोह पर संस्थान के कर्मचारियों हेतु स्वरचित कविता पाठ प्रतियोगिता का आयोजन किया गया। इस अवसर पर हिंदी सप्ताह के दौरान आयोजित हुई प्रतियोगिताओं के विजेताओं को मुख्य अतिथि ने सम्मानित किया। वर्ष 2020-21 के दौरान विभागीय राजभाषा कार्यान्वयन समिति की निर्धारित 04 तिमाही बैठके आयोजित हुई तथा 02 हिंदी कार्यशालाओं का भी आयोजन किया गया।

#### 4.9 Awards and Honours:

Dr. G. Scientist Scietint G, Dr. Bilas Singh, CTO and Dr. T.S. Rathor Ex Director AFRI, awarded Brandis prize of the year 2018 for the best paper on Forest Management, published in 'The Indian Forester', i.e. "The effect of woody hosts on *Santalum album* L. tree growth under agroforestry in semi-arid region of Gujarat"

#### 4.10 Special Activties (such as Van Mahotsava, Forestry Day and Other occasion)

##### 4.10.1 Report on Vigilance Awareness Week - 2020

सत्यनिष्ठा व पारदर्शिता की जवाबदेही को बढ़ावा देने के लिए प्रतिबद्ध शीर्ष संस्था केन्द्रीय सतर्कता आयोग के निर्देशानुसार हर वर्ष की भांति इस वर्ष भी सभी अधिकारियों एवं कर्मचारियों को किसी भी प्रकार के भ्रष्टाचार को रोकने और उस पर नियंत्रण के लिए सहभागी बनाने हेतु 27 अक्टूबर, 2020 से 02 नवम्बर, 2020 तक सतर्कता जागरूकता सप्ताह का आयोजन शुष्क वन अनुसंधान संस्थान (आफरी), जोधपुर में किया गया। सप्ताह की शुरुआत में दिनांक 27.10.2020 को आफरी के सतर्कता अधिकारी डॉ. जी. सिंह ने संस्थान के समस्त अधिकारियों एवं कर्मचारियों को सतर्कता संबंधी शपथ दिलायी। इस वर्ष शपथग्रहण ई-प्रतिज्ञा के रूप में संपन्न हुआ। जिसमें संस्थान के अधिकांश अधिकारियों एवं कर्मचारियों ने भाग लिया। कोविड-19 के घ्यानान्तर्गत कुछ कर्मचारियों ने वर्चुवल सपथ ग्रहण लिया। जो अधिकारी अथवा कर्मचारी किसी कारणवश उक्त ई-प्रतिज्ञा में शामिल नहीं हो पाये तो उन्होंने अपना निजी ई-प्रतिज्ञा लिया। उपरोक्त क्रम में दिनांक 28.10.2020 व 31.10.2020 व 01.11.2020 को दो पोस्टर प्रतियोगिताएँ "सतर्क भारत" विषय पर आफरी अधिकारियों/कर्मचारियों एवं विद्यालयों के छात्र/छात्राओं हेतु आयोजित की गयी। दिनांक 29.10.2020 को निबंध प्रतियोगिता "सतर्कता एवं समृद्धि का आपसी संबंध" विषय पर आयोजित की गयी। जिसमें संस्थान के कर्मचारियों एवं शोधार्थियों ने भाग लिया। इसी क्रम में दिनांक 29.10.2020 को ही "भारत की समृद्धि में सतर्कता का महत्व" विषय पर वाद विवाद प्रतियोगिता का आयोजन किया गया (Table 2), जिसमें संस्थान के कर्मचारियों एवं शोधार्थियों ने भाग लिया।

दिनांक 02.11.2020 को "सतर्क भारत-समृद्ध भारत" विषय पर एक व्याख्यान भी रखा गया। विभिन्न प्रतियोगिताओं के विजेताओं को पारितोषिक वितरण का कार्यक्रम भी रखा गया। श्री आई.आर. गेंवा, निदेशक/प्रिंसीपल, आई.टी.आई, जोधपुर इस कार्यक्रम के मुख्य अतिथि एवं वक्ता थे। इस कार्यक्रम के दौरान सतर्कता अधिकारी डा.जी.सिंह ने सतर्कता संबंधी नियमों, क्रियाकलापों एवं दिशा निर्देशों के बारे में विस्तृत जानकारी देते हुए इस संबंध में समय समय पर विभिन्न जानकारियों के प्रेषण एवं पारदर्शिता, सतर्कता तथा सुशासन संबंधी जानकारी प्रदान की। डॉ. आई. डी. आर्य, वरिष्ठ वैज्ञानिक, आफरी, जोधपुर ने इस अवसर पर कहा कि शिक्षा स्तर को बढ़ाना जरूरी है जिससे सतर्कता के साथ ही समृद्धि भी बढ़ेगी।

मुख्य अतिथि महोदय द्वारा विभिन्न प्रतियोगिताओं के सभी विजेताओं को पारितोषिक वितरण किया गया। इस अवसर पर संस्थान निदेशक श्री एम.आर.बालोच, भावसे ने भी संस्थान के अधिकारियों एवं कर्मचारियों को संबोधित किया एवं अपील की कि सभी लोग अपना कार्य पूर्ण, मेहनत, लग्न व निष्ठा से संपादित करें तथा सभी कार्यों में सतर्कता बरतें एवं जागरूक रहें (Fig. 28)।

मुख्य अतिथि द्वारा सतर्क भारत-समृद्ध भारत पर संस्थान के अधिकारियों एवं कर्मचारियों को संबोधित किया गया । मुख्य अतिथि महोदय ने यह बताया कि हमें अपने जीवनकाल में हमेंषा ही सतर्क रहने की जरूरत है जिससे हमें अपने चारो तरफ घटने वाली घटनाओं की सही समय पर जानकारी प्राप्त हो सकें जिससे अपने आपको संस्थान एवं देश को सुरक्षित रखा जा सकें । इसके साथ ही उन्होने बताया कि आजकल पूरे भारत में विभिन्न प्रकार की परियोजनाएँ भी चल रही है । सतर्क रहकर ही इन परियोजनाओं का लाभ उठाया जा सकता है एवं पारिवारिक समृद्धि को बढ़ाया जा सकता है। व्याख्यान के शीर्षक को उन्होने कई उदाहरणों द्वारा भी समझाने का प्रयत्न किया । कार्यक्रम का धन्यवाद ज्ञापन श्रीमती भावना शर्मा, वैज्ञानिक-डी, आफरी, जोधपुर द्वारा दिया गया ।

**Table 2.**Conduct of competitions during Vigilance Awareness week 2020.

Name of State	City/ Place	Specify program (Debate/Elocution/ Panel discussion etc.)	Name of first two winners	No. participants	Whether copy of award winning Activities attached
Rajasthan	Jodhpur	Poster competition 'सतर्क भारत'	1. Shri Jyoti Prakash 2. Ms. Neha Purohit 3. Shri Prem Prakash	05	Yes (1& 3)
Rajasthan	Jodhpur	Essay competition on 'सतर्कता एवं समृद्धि का आपसी संबंध'	1. Sh.Sawai Singh Rajpurohit 2. Sh. Kailash Choudhary 3. Smt. Meeta Singh	08	Yes (1)
Rajasthan	Jodhpur	वाद विवाद प्रतियोगिता 'भारत की समृद्धि मेंसतर्कता का महत्व'	1. Shri Kailash Choudhary 2. Shri Sawai Singh Rajpurohit 3. Shri Ameen Ullah Khan	04	Yes (1)





Figure 28. Different activities conducted during vigilance awareness week 2020.

#### 4.10.2 Van Mahotsav - 2020

Van mahotsav was celebrated at Arid Forest Research Institute, Jodhpur on 10 / 07/2020. On this occasion a plantation ceremony was organized and Jamun (*Syzigium cumini*) seedlings were planted in AFRI main campus (Fig. 29a).

#### 4.10.3 International Biodiversity Day

On 22/05/2020 World Biodiversity Day was celebrated at Arid Forest Research Institute, Jodhpur. On this occasion plantation of Jamun tree was done (Fig. 29b)

#### 4.10.4 World Environment Day

World Environment day was celebrated on 05/06/2020 at AFRI, Jodhpur. On this occasion, the online virtual celebration organized by the Ministry of Environment, Forest and Climate Change. On this occasion, three competitions were organized through WhatsApp to take care of social distance due to Covid-19 and to raise awareness about the environment. The winners of the competition were awarded on this occasion (Fig 29c).

#### 4.10.5 World day to combat desertification

World Desertification Day was celebrated on 17/06/2020 at AFRI, Jodhpur. On this occasion plantation program was organized on the side of the playground of the residential colony of the main campus. Different plant species like Karanj and Kachnar were planted (Fig. 29d).



Figure 29. Celebrations of different days and plantation ceremony organized on these occasions.

**4.11 Extension Activities performed under CAMPA Extension** (this information is different from the information provided in the Chapter as above)

- A short film about AFRI history, activities and achievement was prespered.

**5. Administration and Information Technology**

**5.1. Information Technology**

The existing IT infrastructure was maintained properly. The leased line provided by the National Knowledge Network (NKN) was maintained and 24x7 internet connectivity was provided to the users. Several video conferencing sessions were organized during the year. The Hindi and English website of the institute was updated regularly throughout the year. The reports of the important events held at the institute were uploaded on the institute as well as on the ICFRE website. The PIMS and payroll modules of the IFRIS were run successfully throughout the year. Four new computers with UPS and printers were procured. Aadhar based Biometric Attendance System with CCTV was maintained at the institute. An online portal for new recruitments for various posts at AFRI was developed with the help of RISL, a Government of Rajasthan owned company. Other routine tasks related to the Information Technology were performed during the year.

## **5.2 Administration: A brief note on general administration activities along with information on the following:**

### **5.2.1 Sevottam: Activities relating to the Citizens/Clients Charter:**

#### **5.2.1.1 Action taken to formulate the Charter for the Department and its subordinate formation**

The charter has been prepared based on the seven steps mentioned in Sevottam. Considering the ICFRE's mandated mission "To generate, preserve, disseminate advance knowledge, technologies and solutions for addressing issues related to forests and promote linkages arising out of interactions between people, forests and environment on a sustained basis through research, education and extension", AFRI is enduring its forestry research for conservation of biodiversity and enhancement of bio-productivity in Rajasthan, Gujarat and Dadra & Nagar Haveli and Daman & Diu with special emphasis on arid and semi-arid regions. Keeping the National Forestry Research Plan (NFRP) in view, AFRI has identified its thrust areas based on the inputs and active participation of different stakeholders. The institute is implementing its research endeavors after duly recognizing the user's needs provided to us during time to time interaction including Research Advisory group meeting.

Main research focus of the institute includes:

1. Soil, water and nutrient management,
2. Development of technologies for afforestation of stress sites,
3. Seed handling, nursery, plantation techniques and management,
4. Planting stock improvement and biotechnology,
5. Biofertilizers and biopesticides,
6. Phytochemistry, non-wood forest products
7. Biodiversity conservation and climate change,
8. Agroforestry and JFM,
9. Forestry education & extension.

Different procedures have been formulated for identifying the research problems of the dry areas; formulating the projects based on the problems; and dissemination of the research results and technologies to the end users. In order to identify the research problems, institute level interaction workshops were organized involving various stakeholders like officials of state forests departments of Rajasthan and Gujarat, scientist of other sister organization like CAZRI and University, progressive farmers and NGO's. Based on the research problems highlighted during the discussions concepts are development. The concepts are then screened based on priority in the area, novelty and importance of the works both in terms of scientific and social benefits involving external experts. Screened in concepts are then developed into details projects by the scientists after thorough review of scientific literature.

The formulated projects are then sent to the external experts for evaluation and their suggestions. After incorporating the suggestions/modifications, the projects are presented

before the Research Advisory Group (RAG) meeting. After including suggestion of RAG members, if any, revised projects are prepared and progress of the ongoing projects are presented in the Research Policy Committee (RPC) meeting for approval. After the approval of projects, the funds are allotted and the projects are executed by the scientists.

The technologies developed through the projects are extended/ demonstrated to the end users with the help of demonstration trials, extension trainings, Van Vigyan Kendras, Demo villege, printed material, radio talk, workshops, conferences and uploading of the publications published in national and international journals, reports, proceeding, etc., to the website of the institute.

#### **5.2.1.2 Action taken to implement the Charter**

To fulfill the charter, research projects were prepared addressing the research mandate of the institute and submitted for funding to various donor agencies for implementing the Charter. One new projects were approved for initiation in the next financial year by RPC held on 25<sup>th</sup> August, 2020. Several extension trainings were held during the year for dissemination of the research results of the various projects executed in the institute. The research results of the projects, the technologies developed by the institute and the events held at the institute were continuously updated on the website of the institute. In addition to these, environmental awareness programs were organized by the institute in the form of World Environment Day, Biodiversity Day and World Day for Combating Desertification and Van Mohotsava. The details of these have been mentioned above in this report.

#### **5.2.1.3 Details of Training Programmes, Workshops, etc. held for proper implementation of Charter:**

Details mentioned above under point No. 3.2 & 4.10.

#### **5.2.1.4 Details of publicity efforts made and awareness campaigns organized on Charter for the Citizen/Clients**

Various events were organized, manuscript published and talks delivered by AFRI scientists and officials during different events, conferences, workshops helped in publicity of efforts made and awareness campaigns organized on Charter for the Citizen/Clients. The details are given under point No. 4.9 & 4.10.

#### **5.2.1.5 Details if internal and external evaluation of implementation of Charter in the Organization and assessment of the level of satisfaction among Citizen/Clients:**

All the new projects and progress made in the ongoing research projects were presented before internal and external experts of RAG and the RPC, who gave their comments on the quality of the new projects and the progress made in the ongoing projects. The experts prioritized the new projects and expressed their satisfaction on the progress made in the ongoing projects.

### 5.3 Welfare measures for the SC/ST/Backward /Minority communities

To promote the general interest of SC/ST/OBC employees and to work for their collective betterment, development and upliftment, aAFRI SC/ST/OBC Employees Welfare Association was formed. As per the DOPT's guidelines for various social groups, Liaison Officers had been nominated as below:

Sl.No.	Name of officer & Post	Liasion Officer
1.	Sh. S.R. Baloch, Scientist-C	Liasson Officer for SC
2.	Ms. Desha Meena, Scientist-C	Liasson Officer for ST
3.	Sh. Karna Ram Choudhary, CTO	Liasson Officer for OBC
4.	Under Secretary	Member

## 6. Annexures

### 1. RTI

Names and addresses of public information officers and appellate authorities under the right to information act 2005 In ICFRE and its institutes

Headquarters/ Institutes	Appellate Authorities	Public Information Officer	Subject Matter Allocated
Arid Forest Research Institute	Sh. M.R. Baloch, IFS Director, AFRI Email: <a href="mailto:dir_afri@icfre.org">dir_afri@icfre.org</a> Phone: 0291-2742549	Sh. K.C. Gupta Email: <a href="mailto:guptake@icfre.org">guptake@icfre.org</a> Phone: 0291-2729122	All matters related to AFRI Jodhpur

During 2020-21, a total 63 applications were received offline u/s 6(3) and directly to PIO as well as online under RTI Act 2005. Opening balance of application as on 01-04-2020 was 01. During the year, the appellate authority received 12 appeal regarding RTI and same were replied as per the norms of RTI Act 2005. Quarterly returns of RTI have been furnished regularly to the PIO, ICFRE, Dehradun.

### 2. Information on Vigilance cases: NIL

### 3. Information on Audit objections: NIL

### 4. E-mail and Postal Address):

#### Sh. Shivalal Chauhan, ACTO

P.O. Krishi Upaz Mandi, New Pali Road, Jodhpur, 342005,

Arid Forest Research Institute,

Email: [groupco\\_afri@icfre.org](mailto:groupco_afri@icfre.org), [dir\\_afri@icfre.org](mailto:dir_afri@icfre.org)

Phone: 0291-2742549, 2729104, Mob: 9414110722, FAX: 0291-2722764

### 5. Intellectual Property

#### 5.1 Patent Property - NIL

#### 5.2 Others-NIL

## 6. List of Abbreviations

AAU	Anand Agricultural University
ABBMS	Akhil Bhartiya Bishnoi Mahasabha at Muktidham
AFRI	Arid Forest Research Institute
AICRP	All India Co-ordinated Research Project
AM	Arbuscular Mycorrhiza
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CAZRI	Central Arid Zone Research Institute
CPT	Candidate plus tree
DBH	Diameter at breast height
DFO	District Forest Officer
DNA	Deoxy Ribonucleic acid
DST	Department of Science & Technology
DV	Demo Village
EC	Electrical Conductivity
FGR	Forest Genetic Resources
FR CER	Forest Research Centre for Eco Rehabilitation, Prayagraj
FR CLC	Forest Research Centre for Livelihood Extension, Agartala
FRI	Forest Research Institute
FSEL	Fiber stress at elastic limit
FYM	Farmyard Manure
GBH	Girth at Breast Height
GM	Genetically Modified
GSDP	Green Skill Development Programme
HFRI	Himalayan Forest Research Institute
HoFF	Head of Forest Forces
HP	Himachal Pradesh
HRD	Human Resources Development
ICAR	Indian Council of Agriculture Research
ICFRE	Indian Council of Forestry Research & Education
IFB	Institute of Forest Biodiversity
IFGTB	Institute of Forest Genetics and Tree Breeding
IFP	Institute of Forest Productivity
IFRIS	Indian Forestry Research Information System
IFS	Indian Forest Service
IGNP	Indira Gandhi Nahar Pariyojana
IIFM	Indian Institute of Forest Management
IT	Information Technology
IWST	Institute of Wood Science and Technology
JFM	Joint Forest Management
KV	Kendriya Vidyalaya
KVK	Krishi Vigyan Kendra
LBSNAA	Lal Bahadur Shastri National Academy of Administration

MOE	Modulus of Elasticity
MoEF&CC	Ministry of Environment, Forest & Climate Change
MOR	Modulus of Rupture
MoU	Memorandum of Understanding
MP	Madhya Pradesh
NFRP	National Forestry Research Plan
NGO	Non Government Organization
NIDM	National Institute of Disaster Management
NKN	National Knowledge Network
NMPB	National Medicinal Plants Board
NPC	National project Coordinator
NPK	Nitrogen Phosphorous Potassium
NTFP	Non-Timber Forest Product
NWFP	Non-Wood Forest Product
PBKIVV	Prajapita Brahma Kumaris Ishwariya Vishwa Vidyalaya
PCCF	Principal Chief Conservator of Forest
PCR	Polymerase Chain Reaction
PGP	Plant Growth Promoter
PSB	Phosphorus Solubilizing Bacteria
RAG	Research Advisory Group
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RFD	Rajasthan Forest Department
RFO	Range Forest Officer
RIMS	Research Management Information System
RPC	Research Priority Committee
RTI	Right To Information
SHG	Self Help Group
SOC	Soil Organic Carbon
TDUPW	Technology Development and Utilization Programme for Women
TFRI	Tropical Forest Research Institute
TGM	Tree Growers Mela
UNDP	United Nations Development Programme
VAM	Vesicular Arbuscular Mycorrhiza
VFPC	Village Forest Protection Committee
VFPMC	Village Forest Protection & Management Committee
VMG	Vegetative Multiplication Garden
VVK	Van Vigyan Kendra