Annual Report 2011-12

AFRI, Jodhpur,

Executive Summary

To address forestry research needs of the mandated area of Rajasthan, Gujarat, Dadar & Nagar Haveli, AFRI has taken up projects under various thrust areas and themes, organized training programme under three VVKs, one demo village for the field functionaries, farmers and NGOs. In addition to these, the institute has organized two trainings under SLEM project and one week compulsory training for IFS officers. Out of the 39 Projects executed, 5 projects were completed and 8 new projects were initiated during 2012-13. Carbon stock was estimated in forests of six districts in Rajasthan and it varied from 18.3 ton/ha in Jhalawar to 41.5 ton/h in Kota in 0-90 cm soil layer. Inorganic carbon stock ranged from 2.9 ton/ha in Bundi to 57.2 ton/ha in Karoli. Biomass contribution of *Prosopis cineraria* varied from 0.2 ton/ha in Sikar to 53.0 ton/ha in Jalore. Vegetation studies in Banskata & Motimori in Gujarat and Banswara, Rajsamand & Pali in Rajasthan revealed that *Wrightia tinctoria, Tectona grandis, Lanea coromondalica* and *Anogeissus pendula* are dominated species and total number of trees, shrubs and grass species were 85, 100, 109, 95 and 97, respectively. Soil of Jodhpur district were found to be moderately deep to very deep at most of the site, however, 30 percent of the area have shallow soil with calcareous hard pan. It has been observed that $CaCO_3$ content was high in Barmer soil.

In agroforestry trial of five fodder and fruit tree species, highest survival and biomass (dry weight) was found in *Prosopis cineraria* minimum in *Zizyphus mauritiana*, whereas, the root biomass was found to be highest in C*olophospermum mopane.* At Bhuj in Gujarat, *Cordia graf* with *Cenchrus ciliaris* agroforestry system perforemd the best in sandy hill pediment land. In the plantation trail on highly saline silty clay soil, *Salvadora persica* proved to be the best species, followed by *Acacia ampliceps* in little run of Kutch. In rehabilitation of salt affected area, it was observed that the fertilizer treatments significantly influenced fruit yield in *Salvadora persica* and *Acacia ampliceps*. Among the fertilizers, potassium favoured maximum fruit yield during good monsoon year and $ZnSO_4$ in deficient of average rainfall in Gangani, Jodhpur.

Variation in 100 seed weight and germination was observed in *Acaica nilotica, Acacia catechu* and *Dalbergia sissoo* collected from the various sources. Seed of SSO and CSO have higher (2-5%) seed weight and percentage of germination as compared to seed stand. 105 candidate plus plant (CPPs) of *Commiphora weightii* were identified in 29 districts in Rajasthan, cuttings were collected and plants

were raised for the *ex situ* germplasm. 15 CPTs were selected from Gujarat and Rajasthan and evaluated growth performance of the progeny trials of teak. For genetic improvement of *Prosopis cineraria*, 21 plus trees were selected from various locations in Rajasthan and variation in pod parameters were observed. Selected the best performing three clones each of *Eucalyptus camaldulensis* and *Dalbergia sissoo* from the multilocational trails laid in Gujarat. Evaluated progenies trail of 17 CPTs of high azadirachtin (> 5000 ppm) and oil content (> 40%) and idenfieid progenies of the 7 CPTs based on growth and other parameters. It was also observed that frost tolerance and growth characteristics are genetically independent. On the basis of growth performance, of clonal trials selected 14 accessions and progenies of the 5 CPTs for the deployment of *Jatropha curcus*. Two seed yield equations were developed for the *J. curcus.* Protocols were standardized for seed germination and clonal propagation using micro cuttings of *Commiphora wightii*. Hardening procedure was developed for the somatic embryo derived plants of *Jatropha curcus*. Low cost gelling agent was identified as replacement of agar-agar in plant tissue culture of *Jatropha curcus*. Low cost hydrophonics system was developed for the short cycle plants for salinity studies. Physio-chemical conditions were standarized for *in vitro* shoot multiplication of *Salvadora persica* and *Capparis decidua*.

Field trials were laid in the farmer's field in five districts in Rajasthan using different combination of chemicals for the management of khejri (*Prosopis cineraria)* mortality and recovery was in 25-35% trees attacked by root borer (*Acanthophorus seraticornis*) or *Ganoderma lucidum* or attack of both the organisms. Collected four strain of *G. lucidum* and also carried out rearing of larval instars of *A. serraticornis* on artificial/khejri wood diet for bio-ecological studies. It was established through Koch postulates that *Brusaphelenchus theobrome* and *Acremonium*sp caused canker disease in Rohida (*Tecomella undulata*). In mycorrhizal studies on *Acacia nilotica* and *Ailanthus excelsa*, it was found that six species of *Glomus* were found associated with these tree species and *G. fasciculatum* association was at all the site and observed in nurseries and field plants.

Significant achievements:

- *Prosopis juliflora* has significant bearing in carbon sequestration in Rajasthan.
- In addition to soil organic carbon stock soil of Rajasthan have significant carbon in inorganic form.
- *Tectona grandis* found associated with acidic (low) pH soil and low soil pH was also found associated with greater number of herbaceous species and their population.
- Decreasing trend in soil organic carbon was observed from Sirohi to Ganganagar.
- Forest blocks of Jodhpur are moderately deep to very deep in soil depth and 30% forest blocks

showed shallow soil with calcarious hard pan.

- In agroforestry trial, among the five tree species, *Prosopis cineraria* was found the best on the basis of survival rate and dry biomass with agriculture crops in Bilara near Jodhpur.
- Based on the survey in 61 forest fringe villages in Udaipur and 14 villages in Pali, it was revealed that majority of the farmers have land holding of about 0.25 ha., grows wheat, maize and chick pea in major crop under rain feed and using well, each house hold has 4-5 live stock and majority of the villages have primary school.
- In sandy hill pediment land, *Cordia graf* and *Cenchrus ciliaris* based silvipastoral system produced maximum biomass, followed by *Zizyphus mauritiana* with *C. ciliaris* at 38 months age at Bhuj in Gujarat.
- In plantation trial on highly saline black silty clay soil of little run of kuchh, *Salvadora persica* proved the best in terms of survival rate (83.7%) and growth, followed by the *Acacia ampliceps*.
- In rehabilitation of salt affected area, fertilizer treatments significantly influenced the fruit yields in *Salvadora persica* and *Acacia ampliceps.*
- Fifteen new candidate plus trees of *Tectona grandis* were selected from different locations of Gujarat and Rajasthan.
- Genetic analysis of teak half sib progenies was carried out in Rajasthan for the first time.
- Twenty one CPTs of *Prosopis cineraria* were selected from the different intensity of mortality areas in Rajasthan and carried out genetic variation and inheritance of pod characteristics which was not known earlier.
- It was revealed from the study that population density of Guggal varied in different districts and correlation studies indicate that density increased with increase of altitude up to certain level and after that again decreases.
- Significant differences in percentage rooting from stem cuttings of guggal was observed in different genotypes as well as location of the source of the cutting.
- Based on growth (height & girth) three clones, each of *Eucalyptus camaldulensis* and *Dalbergia sissoo* were selected in multilocation clonal trials in Gujarat.
- Progeny trial of 17 CPTs having high aza content (>5000 ppm) and oil (>40%) revealed that progenies of the CPT 4 & 7 were better based on the growth parameters as well as frost tolerance.
- In demonstration trial of male and female plants of *Ailanthus excels,* female plants exhibited superiority in terms of overall growth as compared to male plants at age of 3 years.

- Using gene expression omnibus in combination with PLEX database, one putative gene having role in salinity stress tolerance was identified.
- DNA marker studies on genetic fidelity of micropropagated plants of *Commiphora wightii* revealed genetic uniformity in the plants, hence protocol developed can be used for large scale cloning.
- Three to four folds shoot multiplication was achiefed in *Capparis decidua* by standardizing pH, sucrose and cytokinin concentrations in MS medium, whereas in *Salvadora persica* standardized plant growth harmones and additives and achieved 3-4 fold shoot multiplication.
- Two seed yield equations have been developed in *Jatropha curcus.*
- Based on clonal trial of *Commiphora wightii*, two clones were identified for highest biomass.
- In multilocational clonal trial across the country, 14 superior accessions of *Jatropha curcus* were identified under CSIR network project.
- In multilocational progeny trial of *J. curcus,* progenies of 5 CPT under DBT project and 3 CPT under ICFRE projects have performed better based on the growth.
- Developed protocols for the seed germination and vegetative propagation using micro cuttings (2.5 mm) of *Commiphora wightii.*
- Laid field trials using various combinations of different chemicals for the management of khejri mortality in six places in five districts of Rajasthan and results revealed recovery in 25-35% trees.
- It was established through Koch's postulate that *Bursaphelenchus theobrome* and *Acremonium sp* are casual organism of canker disease in *Tecomella undulata.*
- In field survey and laboratory studies, it was found that six species of *Glomus* associated in rhizosphere of *Acacia nilotica* and *Ailanthus excels* and *G. fasiculatum* was commonly found in nursery and field plant of both the species.

Summary of projects

Projects	**Completed Projects**	**Ongoing Projects**	**New Projects Initiated During the Year**
Plan	4	19	5
Externally Aided	1	7	3
Total	5	26	8
		TOTAL PROJECTS	**39**

	Contents
1.	**Introduction:** Information about respective institute and centers (in one para only), Map showing institutes, Centers and their jurisdiction.

Institute- At a Glance

- Arid Forest Research Institute, Jodhpur (Rajasthan), is one of the eight institutes of the Indian Council of Forestry Research & Education (ICFRE), an autonomous organization of the Ministry of Environment & Forests, Govt. of India. The objectives of the institute are to carry out scientific research in forestry & allied fields to enhance the productivity & vegetative cover, to conserve the biodiversity and to develop the technologies for the end-users in Rajasthan, Gujarat and Dadra & Nagar Havelli.

- The main emphasis in areas of research of the institute are 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, JFM & extension, phytochemistry & non-timber forest products, integrated pest & disease management and forestry education and extension. During 2011-12, thirty eight projects were executed including ten externally funded projects from the Rajasthan Forest Department, Gujarat Forest Department, Department of Biotechnology, Government of India, New Delhi, National Medicinal Plant Board, New Delhi and CSIR, New Delhi. Three consultancy projects were also executed.

Mandated states of AFRI, Jodhpur

2.1 Ecosystem Conservation and Management

2.1.1 Overview

Industrial wastes are major sources of pollution in all environments and require on-site treatment before discharge into sewage system. In western region of Rajasthan, a number of textiles based industries namely dyeing, printing, steel rolling and chemical processing units have been established, which are generating considerable waste water, which has caused degradation of water quality in this water scarce arid and semi arid region of the country. The high price and insufficient effectiveness of techniques like; sedimentation, flotation, ionic exchange, reverse osmosis has led to the search for more economical and simple procedures for the primary and (or) final removal of heavy metals from wastewater. Among these, promising techniques is the phytoremediation of industrial wastewater, which involves the removal of heavy metals by adsorption, accumulation, or precipitation using higher aquatic and terrestrial plants. Since, the production of waste water is a continuous process; hence it can cater substantial irrigation requirements. This alternative use of waste water will not only prevent the waste from becoming an environmental hazard, but also will serve as a potential source of fertilizer if used rationally and at appropriate concentration.

2.1.1.1 Summary of the achievements under the Theme

- Six district in Rajasthan were surveyed for carbon stock assessment, and in 0-90 cm soil layer, it was 41.5 ton/ha (highest) in Kota to 18.3 ton/ha (lowest) in Jhalawar.
- Inorganic carbon stock ranged from 57.2 ton/ha in Karoli to 2.9 ton/ha in Bundi forest division.
- Biomass contribution of *Prosopis juliflora* ranged from 53.0 ton/ha in Jalore to 0.2 ton/ha in Sikar.
- Conducted survey of Salawas, Pali, Jasol and Balotra for vegetation studies and collected soil, water and plant samples from the vicinity of the effluent disposal area at the river sites for phytoremediation studies.
- Studies on the utilization aspect of exotic tree species revealed that *Prosopis juliflora* is widely spreaded as green cover in the arid condition of the Thar Desert, which provides fuel wood and fodder during severe summer and winter.
- Floral diversity associated with *P. juliflora* represented by 29 species (including herb, shrub and trees) and faunal diversity of 22 species of arthropods and 42 species of vertebrates.
- Butterflies were collected from Gir National Park, Gujarat and four species of Nymphalidae, two species of Danaidae, three species of Peridae, two species of Papilionnoidae and one species of Sphingidae have been identified under biodiversity studies.

2.1.1.2 Projects under the Theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	0	2	1
Externally Aided	0	0	1

2.1.2 Climate Change

Project-1: Studies on carbon sequestration in different forest types of Rajasthan (AFRI-88/EED/ 2008-12). (Request for one year extension i.e. 2012-2013)

Principal Investigator: Dr. G. Singh, Scientist E

Project was started with the objectives; (i) to estimate carbon stock in forest soils, (ii) to estimate carbon stock in forest litters, and to estimate carbon stock in aboveground and below ground biomass; with broader objective 'to provide an estimate of carbon stock of forests in Rajasthan' for its utilization in planning and execution of afforestation/ reforestation programme in this region. In the year 2011-12, six districts namely; Jhalawar, Bundi, Karauli, Sawaimadhopur, Jodhpur and Kota covering 239 forest blocks and 466 sampling plots were surveyed in 2011-12 and growth of trees and shrubs measured and vegetation studied. 680 soil samples, 300 Coarse Woody Debris (CWD) samples and 240 litter samples were collected for carbon analysis. Biomass of 90 plants recorded 103 trees recorded and carbon estimation carried out. In this, some important forest types are *Anogeissus pendula* scrub, *Acacia catechu* and *Boswellia serrata* type. In Kota and Bundi forest divisions, most of the forests are infested by *P. juliflora*. In the forests of these division, soil organic carbon content (0-90 cm soil layer) was highest in Kota (41.46 tone ha^{-1}) and lowest in Jhalawar (18.27 tone ha^{-1}), whereas, soil inorganic carbon was highest in Karauli (57.72 tones ha^{-1}) and lowest in Bundi (2.88 tones ha^{-1}) forest division. Average soil organic carbon was highest in 0-30 cm soil layer in Kota, 30-60 cm soil layer in Sawaimadhopur and in 60-90 cm soil layer in Karauli, Jhalawar and Bundi forest division.

Data compilations on *P. juliflora* reveal that about 38% of forest blocks are infested by *P. juliflora* in Rajasthan. Above ground biomass of *P. juliflora* was highest (53007.83 kg ha^{-1}) in Jalore, followed by Bhilwara (40415.68 kg ha^{-1}) and Jhunjunnu (7167.20 kg ha^{-1}). The lowest above ground biomass (126.38 kg ha^{-1}) was recorded in Sikar district. Below ground biomass showed similar trend as in the case of aboveground, biomass was highest in Jalore (20872.78 kg ha^{-1}) and lowest (94.04 kg ha^{-1}) in Sikar forest area. If all the districts categorized into 3 ecological zone i.e., arid, semi arid and sub-humid, then *P. juliflora* showed highest above ground biomass of 6552.83 kg ha^{-1} and below ground biomass of 2611.10 kg ha^{-1} in sub-humid zone, 2658.65 kg ha^{-1} and 1048.78 kg ha^{-1} in semi-arid zone and 1169.25 kg ha^{-1} and 502.37 kg ha^{-1} in arid zone, respectively.

Fig 1. Pit opening for soil carbon in *Anogeisus pendula* scrub type forest in Kota division

Fig 2. *Acacia catechu* forest in Kota division

Fig 3. *Boswellia serrata* forest in Darra sanctuary, Kota division

Fig 4. *Phoenix savannah* forest type in Chitorgarh

2.1.3 Ecology & Environment

EXTERNALLY AIDED NEW PROJECT INITIATED

Project-2: Phytoremediation of soil for productivity enhancement during land disposal of effluent (AFRI/FED/13(2)/Phyto/2011-2015, Externally funded by the SFD, Rajasthan).

Principal Investigator: Dr. Abha Rani, Scientist D

A survey was conducted of Balotra , Salawas and Pali in January, 2011 in which vegetations in of vicinity of effluent disposal area at Luni, Jojri and Bandi river, respectively were studied. Plant and tree species like; *Acacia nilotica, Acacia tortilis, Prosopis juliflora (Swartz.), Aerva pseudotomentosa, Sacharum munja, Echinops echinatus* were observed at Salawas, whereas, *Prosopis cineraria (Linn.), Salvadora persica Linn., Aerva pseudotomentosa, Argemone mexicana* at Balotra and *Pakinsonia acculeata, Blumea oblique, Euphorbia hirta, Calotropis procera* and *Chenopodium album* were recorded at Pali.

Fig 5. ***Parkinsonia acculeta at Bandi river Pali***

Fig 6. ***Prosophis juliflora*** **at CETP plant Balotra**

Water and soil samples were collected from river basins and parameters like; pH, EC, Dissolved Oxygen, Chloride, Total Dissolved Solids (TDS), Suspended Solids, Soil Organic, Soil Inorganic and Soil Moisture Level etc were analysed in the laboratory. Water samples collected from Balotra showed high pH, very high Electrical Conductivity and Total Dissolved Solids. Water samples collected also showed high pH , very high Electrical Conductivity, high Chloride, high Total Dissolved Solids and very low Dissolved Oxygen. Whereas, soil samples when analysed showed low pH and high Electrical Conductivity.

Fig 7. Affluent water sample collected at Jojri river Salawas

Many sites were considered for the study, but a favorable site for the field experimentation has been identified at Salawas village in vicinity of Salawas Tretment Plant (STP) Jodhpur. The proposal for the land has also been sent to Jodhpur Development Authority, which under consideration.

2.1.4 Biodiversity

ICFRE FUNDED ONGOING PROJECTS

Project-3: Impact of *Prosopis juliflora* on biodiversity, rehabilitation of degraded community lands and as a source of livelihood for people in Rajasthan State (104/AFRI- 2010-2013).

Principal Investigaor: Smt. Seema Kumar, Scientist D

Survey was carried out in and around Jodhpur, Pali and Bharatpur districts of Rajasthan and associated floral and faunal diversity were recorded of the selected sites in grazed and ungrazed areas. *P. juliflora* density was worked out in *orans*, *gochars*, protected areas, revenue lands, wastelands, wetlands, saline lands, agriculture fields and urban forestry models. The floral diversity was represented by 29 species of herbs, shrubs and trees belonging to 16 families. The most dominant family recorded was Fabaceae, followed by Salvadoraceae and Poaceae among the associated floral diversity.

Studies on dependant or associated faunal diversity revealed that 22 species were of soil arthropods and entomofaunal invertebrates. 42 species of vertebrates were also found directly or associated with *P. juliflora*. The inflorescence of *P. juliflora* attracts large number of bee species and numbers of bee-hives were also observed. One species of homoptera (*Cicada*) and two species of coleoptera (*Myllocerus*) were reported for the first time from *P. juliflora* from India.

Studies on utilization aspects revealed that *P. juliflora* tree has given a wide spread green cover to the xeric environment of the Indian Desert, besides providing fuel, fodder and food for the human, cattle and wildlife especially during severe summer and winter months. Studies on utilization of other exotic species associated with *P. juliflora* revealed that *Acacia auriculiformis* leaves were extensively used for amelioration of *mehndi* quality for commercial use and its bark for tanning purposes, whereas *Acacia tortilis* was used mainly as fuel wood and *Parkinsonia aculeata* as an ornamental tree.

ICFRE PLAN NEW PROJECTS INITIATED

Project-4: Screening, identification and preparation of a comprehensive check- list of the Lepidopteron fauna of Sasan Gir National Park of Gujarat state (AFRI-108/GCR/2011-14).

Principal Investigator : Dr. Meeta Sharma, Research Officer

Aim of the study was to study the Lepidopteron fauna of Sasan Gir Forest. The experimental sites have been selected viz; Chodiya Vistaar, Babulwala Chowk, Dhadoria,Kamleshwar Dam,Valodra , Adodia , Ratanguna , Didarkri river , Peripite site and Kareli. The butterflies and moth species were collected from the Gir National Park, Junagarh, Gujarat, and identified, preserved and augmented in the insect collection boxes. All the specimens were photographed. The preparation of slides of wings and genetalia were carried out. The butterflies species, collected from the Gir National Park, Junagarh, Gujarat have been identified up to species level. The four species of Nympalidae, two species of Danaidae , three species of Pieridae, two species of Papilionidae and one species of Sphingidae have been identified.

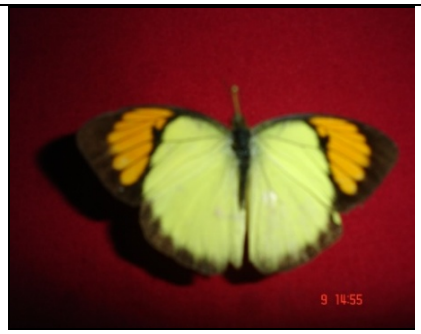
***(A) Junonia lemonias* (L.) Nymphalidae**

***(B) Junonia orithya* (L.) Nymphalidae**

***(C)Junonia almana* (L.) Nymphalidae**

(D) Male (ventral)
Hypolimnas missipus **(L.)**
Nymphalidae

(E) Catopsilia crocale
Pieridae



(F) Ixias pyrene evippe **(Drury)**
Pieridae

Fig 8 (A-F) Butterfly species of sasan Gir Forest.

2.1.5 Forest Botany

Nil

2.1.6 Tribal and Traditional Knowledge System

Nil

2.2 Forest Productivity

2.2.1 Overview

The effective planning and implementation of afforestation programmes depends on the availability at all times of sufficient quantities of seeds with right physiological stage and improved genetic quality. The seed must be collected from a genetically proven superior source. Secondly, there must be a continuous checking by testing the physical and physiological characteristics of the seeds. Finally, it is important that seed should be stored until required without losing its germinative capacity and viability. Gujarat state Forest Department has selected seed stands, established several seed production areas, seedling seed orchards, CSOs under planting stock improvement programme. The seeds obtained from these have not been tested so far and study was undertaken in consultation with SFD, Gujarat to evaluate their established seed sources of important species.

Azadirachta indica, *Prosopis cineraria* and *Tecomella undulata* are very important species in arid and semi arid regions of western India and play an important role in greening the wide areas of the region. Though, many of these are often regarded as the life line of this dry region, so far no systematic study and protocol has been developed to standardize nursery techniques aim at producing quality seedlings. Similarly, standardization of biofertilizer requirements for several important forest tree species of arid and semi arid areas is lacking. In addition to this, seedling parameters viz seed germination, collar diameter, seedling length etc which not only determine the quality of seedlings, but also affect on overall production, need to be studied. The study would be helpful in developing a complete protocol from seed collection to production of quality seedlings and their field performance with quality seedling parameters for selected tree species.

2.2.1.1 Summary of the achievements under the Theme

- Total 365 seedlots of four species viz; *A. nilotica, A. catechu, Dalbergia sissoo* and *Tectona grandis* have been collected for the seed trait studies.

- Variation in hundred seed weight and germination variation was observed in *Acacia nilotica, Acaica catechu* and *Dalbergia sissoo,* collected from the various sources from Gujarat

- Seeds of SSO and CSO have higher (2-5%) seed weight percentage of germination as compared to seed stand.

- Developed infrastructure facilities for the raising quality seedling in nursery.

- In agroforestry trial at Bilara, Jodhpur, *Ailanthus excelsa* attained maximum height (318 cm) and collar diameter (10.86 cm), whereas *Zizyphus mauritiana* exhibited minimum height (184 cm) and *P. cineraria* showed minimum collar diameter (6.54 cm).

- Highest total dry weight biomass was maximum in *P. cineraria* (14.0 kg/tree) and minimum in *Zizyphus mauritiana* (2.0 kg/tree). Whereas root biomass was highest in *C. mopane* (3.87 kg) and lowest in *Z. mauritiana* (0.97 kg/tree) in agroforestry trial.

- In Agroforestry trial fodder production was highest in *Colophospermum mopane* (3.0 kg/tree) and minimum in *Ailanthus excelsa* (1.0 kg/tree).

- Survey in 61 forest fringe villages in Udaipur, 14 villages of Pali district have been surveyd based on the information of three categories of household viz; Affluent, medium affluent and non-affluent on the basis of income of family, number of live stock, agriculture land holding and type of house.

- Majority of farmers of forest fringe village have about 0.25 ha land holding, grows wheat, maize and chickpea as major crops under rainfeed agriculture or using open well, each house hold has 4-5 live stock and majority of villages have primary school.

- In sandy hill pediment land, *Cordial graf* and *Cenchurs ciliaris* based silvipastoral system produced maximum biomass, followed by *Zizyphus mauritiana* with *C. ciliaris* at 38 months age at Bhuj in Guajrat. Dense grass sowing adversely influenced the tree growth, while scatterd grass promoted growth.

- In the plantation trial on highly saline black silty clay soil of little of ran of kuchh, *Salvadora persica* proved to be the best species with 83.7% survival after 50 months, followed by *Acacia ampliceps*. Application of FYM and wheat husk favored better survival and growth.

- Soils of Jodhpur district were moderately deep to very deep at most of the sites however, 30% sites have shallow soil with calcareous hard pan.

- $CaCO_3$ content was very high in soils of Barmer (380 mg kg-1 at Bandra forest block).

- Vegetative studies in Banskanta and Motimori in Gujarat, Banswara, Rajsamand and Pali in Rajasthan indicated that *Wrightia tinctoria, Tectona grandis, Lanea coromandelica* and *Anogeissus pendula* are

dominated species, and total number of trees; shrubs and grass species were 85, 100, 109, 95 and 87, respectively.

2.2.1.2 Projects under the Theme

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	**2**	2	**2**
Externally Aided	**1**	**0**	**1**

2.2.2 Silviculture

ICFRE PLAN CONCLUDED PROJECTS

Project-1: Studies on seed traits of seeds collected from seed stands / SPAs / SSOs / CSOs of important species of Gujarat state (AFRI/JU/SILV/2007-2012).

Principle Investigator: Dr. D.K. Mishra, Scientist E

Seeds of *Azadirachta indica* (15kg), *Prosopis cineraria* (10kg), *Acacia nilotica* (5kg), *Acacia nilotica* var. *cupressiformis* (2kg), *A. tortilis* (2kg), *Ailanthus excels*a (15kg), *Tecomella undulata* (1kg), *Pongamia pinnata* (2kg), *Salvadora oleoides* (2kg), *Cassia fistula* (5kg), *Capparis decidua* (0.2kg), *Acacia senegal* (5kg), *Lasirus sindicus* (100g), *Cenchrus cilliaris* (4kg) and *C. settigerus* (1kg) were collected for seed bank and supply to AFRI-Model Nursery for raising seedlings to be used in research projects and supply to end users. Seeds of *Tectona grandis (95)*, *Acacia nilotica* (2), *Acacia catechu* (10), *Dalbergia sissoo* (34) sources have been collected during 2011-12 from Gujarat.

A total of 365 seedlots of four target species (*Acacia nilotica*, 14, *A. catechu*, 50, *Dalbergia sissoo*, 83 and *Tectona grandis* 200 seedlots) have been collected over five year period and significant differences have been observed in 100 seed weight/stone weight and percent germination studies. Seeds collected from seed production area, SSOs and CSOs have higher 2-5% seed weight/percent germination in comparison to seed stands. In *A. nilotica*, 100 seed weight varied from 12.60-16.70g and % germination from 80-96%, in *A. catechu* it varied from 3.79-5.66g and 25-84%. In *D. sissoo*, it varied from 1.81-3.75g and from nil to 63% germination. In teak 100 stone weight varied from 17-60g.

ICFRE PLAN NEW PROJECTS INITIATED

Project-2: Refinement of modern nursery practices for raising quality seedlings of selected important forest tree species of arid and semi arid areas (AFRI-109/Silvi/2011-16).

Principle Investigator : Dr. N.K. Bohra, R.O.

Surveyed and selected morphological superior seed trees of *Azadirachta indica* (Neem) and *Prosopis cineraria* (Khejri) in and around Jodhpur. Seeds were collected from the selected trees of *P. cineraria* and *A. indica* and depulped and dried for nursery studies. 100 seed weight of neem and Khejri varied from 11.80gm to 19.88 gm and 4.47 to 4.66 gm, respectively. Different potting mixtures were prepared. Seed sowing of *P. cineraria* was carried out in the mother beds. Infra-structures (Root trainers/shade house with sprinkler facilities) were developed.

2.2.3 Social Forestry, Agro-forestry/ Farm Forestry

ICFRE PLAN CONCLUDED PROJECTS

Project-3: Development of economically viable and integrated Agroforestry models for arid region (AFRI-55/Silvi/2006-12).

Principal Investigator: Dr. Bilas Singh, RO

Agroforestry model was maintained at farmer's field at village Harsh, Bilara, District - Jodhpur. *Sesbania aculeata* (Dhaincha) was grown during the year in the field for green manuring. Survival, growth and biomass production data were recorded, compiled and analysed. Performance of *Cordia mixa* was found the best as a horticultural species and *Prosopis cineraria* was the best as silvicultural species.

Ailanthus excelsa plants attained maximum height (318 cm), followed by *Colophospermum mopane* (293 cm), *P. cineraria* (256 cm) and *Cordia mixa* (251 cm), whereas, *Z. mauritiana* attained minimum height (184 cm). Similarly, collar diameter was maximum in *A. excelsa* (10.86 cm), followed by *C. mixa* (8.39 cm), *C. mopane* (7.22 cm) and *P. cineraria* (6.54 cm). The plant height and collar diameter of *C. mopane* and *P. cineraria* and height of *Ailanthus excels and Cordia mixa* were significantly ($P<0.05$) higher in agroforestry plots as compared to the control (without crop). Wheat crop could not grown by farmers due lack of irrigation water at site in the year.

One trees of the each species in agroforestry and control plots were felled and uprooted for biomass and root study at the age of 6 years. *P. cineraria* tree exhibited highest total dry biomass (14.018 kg per tree), followed by *C. mopane* (13.277 kg per tree), *A. excelsa* (11.378 kg per tree) and *C. mixa* (7.114 kg per tree in the agroforestry plot. The lowest biomass production was obtained in *Z. mauritiana* (2.067 kg per tree), in the agroforestry plot. The total biomass was reduced by 51%, 78%, 91%, 52% and 64% in *P. cineraria, C. mopane, A. excelsa, Z. mauritiana* and *C. mixa*, respectively in control plots as compared to agroforestry plots. Fodder production (leaf dry biomass) was the highest in *C. mopane* (3.046 kg per tree), followed by *P. cineraria* (1.077 kg per tree) and *A. excelsa* (1.038 kg per tree) in agroforestry plots, whereas, fodder production of these species in control plots was reduced.

Root dry biomass was the highest in *C. mopane* (3.875 kg per tree) and the lowest in *Z. mauritiana* (0.957 kg per tree) in agroforestry plot. Root biomass was less in control plot of each species as compared to agroforestry plots. The primary and secondary roots of *P. cineraria*, penetrated vertically deep layer of soil. In *P. cineraria* an interesting and prominent feature was that secondary roots were initiated below 50 cm depth as compared with just below the soil surface in other species. The primary and secondary root of *A. excelsa and Z. mauritiana* extended in umbrella shape, whereas, roots of *C. mixa* and *C. mopane* expended on the long distance around each direction below the soil surface of 25 cm in agroforestry plots as well as control plots. Large variation in rooting depth was observed in various species.

EXTERNALLY AIDED NEW PROJECT INITIATED

Projec-4: Identification of extent of forest lands in forest fringe villages (AFRI/FED/2011-2013 Funded by the NRAA)

Principal Investigator: Mr. Manish Kumar Singh, Scientist B

This NRAA funded project started in the month of October, 2011 with objective of Socio-economic survey and ecological studies in forest fringe villages situated within 1 km range of forest. Complete survey work has to be carried out in 24 district of Rajasthan & Gujarat (12+12) and in each district 61village and within each village 12 household are to be surveyed. To carry out this survey work, questioner was made and printed. Tours for survey work started in January, 2012 and 61villages of Udaipur district and 14 villages of Pali district have been surveyed. For the selection of household in a village, three different categories were made; affluent, medium affluent and non-affluent on the basis of income of family, number of livestock, agriculture land holding, type of house etc. and from each categories household were surveyed in a fixed ratio and for vegetation study three different sizes of square plots (31.62×31.62m, 3×3m, 1×1m) were laid out in forest, its GPS location were noted and observation on trees, shrubs, and sapling and herbs and seeding were recorded. Following observations were coming from the survey work: majority of farmers have approx 0.25 ha land holding, grow wheat, maize and chickpea as major crop, source of irrigation is rainfall or well, having approx 4-5 livestock, majority of villages have primary school. Regarding ecological study mainly; *Butea monosperma, T. grandis, P. juliflora, P. sylvestris* were found whereas, among understorey plants *Cassia torra, Euphorbia caducifolia and Zizyphus numularia* were observed commonly.

Fig 9. Forest near Khachan village in Kotra tehsil (Udaipur)

A. Dob village in Jhadol Tehsil Central Udaipur

B. Bitta vilaage in Jhadol Tehsil

C. Boslathi village in KherwaraTehsil

D. Khachan Village in Kotra Tehsil

Fig 10 (A-D). Socio-economic survey and vegetation studies in Udaipur district of Rajasthan

2.2.4 Forest Soils & Land Reclamation

EXTERNALLY AIDED CONCLUDED PROJECT

Project-5: Enhancing productivity of saline wastelands in Kachchh- through improved tree planting techniques and silvipastoral study (AFRI-77/NWFP/SFD/AFRI-2006-12, Gujarat SFD sponsored project)

Principal Investigator: Dr. Ranjana Arya, Scientist E

Sub Project-A: **improved tree planting techniques**

The Little Rann (5,300 sq km/2,045 sq mile) of Kachchh is a flat, saline waste land having extensive saline mudflats, lies in the hinterland of the Kathiawar Peninsula, between the gulfs of kachchh and Khambat in Gujarat. Much of the Little Rann is a wild ass sanctuary (WAS). *Prosopis juliflora* has invaded areas of WAS. Research trials were laid in July, 2007 to find out suitable exotic and indigenous fodder plant species with appropriate planting practice.

Research trials were laid with *Acacia ampliceps, Acacia bivenosa* (exotic) and S*alvadora persica* (indigenous) on black highly saline silty clay (medium), soil depth: 40-75 cm at Kordha, Sami Range in Patan, Gujarat. Trials of *Acacia ampliceps* and *A. bivenosa* were laid with control, Wheat Husk (1/2 kg) , FYM (5kg) , WH + FYM, Bajara Husk (250g) and FYM + BH treatments. *A. ampliceps*, called the salt wattle, is a very fast growing shrub/small tree from of northwestern Australia that has considerable importance as fodder on alkaline/saline soils, especially where its roots have access to a shallow brackish water table. *A. bivenosa* (two nerved wattle) makes a complex with *A. ampliceps* (salt wattle). Trial of *S. persica* was laid with control, Wheat Husk (1/2 kg) , FYM (5kg) , WH + FYM and FYM + Urea (20g). Randomised block design with three replication was followed for all the trials. Spacing was 4 m X 4 m for *A. bivenosa (12 plants/ treatment)* and *S. persica* (16 plants/treatment) and 3m x 3m for *A.ampliceps* (16 plants/ treatment).

S. persica proved to be the best plant with 83.7% mean survival after 50 months in the extemely harsh conditions of high salinity, heat stress after two consecutive summers (2009 &2010) and one drought year (2009) and eratic monsoon after wards. Treatments improved the growth; height, crown and collar diameter after 50 months. Ttreatment consisted FYM+Urea was the best for maximum height 158.5cm, crown dia 140.3 cm and collar dia 7.0cm as compared to control 136, 118.5 and 5.6 cm for height ,crown and collar dia, respectively.

Above ground biomass study was done on the basis of the mean height, crown and collar diameter as selection criteria, one tree was selected from each treatment for destructive sampling in all the three replications at the age of 50 months Thus, a total of 15 trees were felled for biomass study. Above ground green biomass as 2.5 kg/tree in control to 7.1 kg/tree in T5 (FYM + urea) treatment . Although, all the treatments enhanced the biomass growth, but increment was maximum (2.5 fold) for T5, followed by 2.4 fold in T3 treatment indicating the positive influence of FYM application.

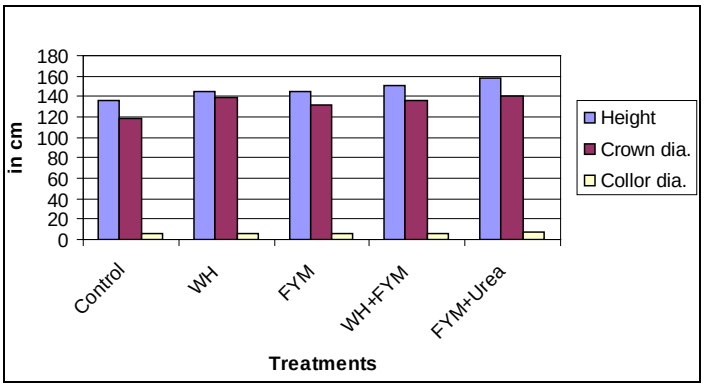


Fig 11. growth parameters (cm) of *S. persica* with different fertilizer treatments at age of 50 months

A.bivenosa was at second place, survived in one summer and one drought year with 10.2 % decrease in mean survival, 77.3% at 30 months compared to 12 months (86.1%). However, second consecutive summer effected the species and the survival was significantly reduced (40.0%) in summer 2010 and recorded as 46.3 % at 36 months. It attained significantly high growth and biomass estimation.

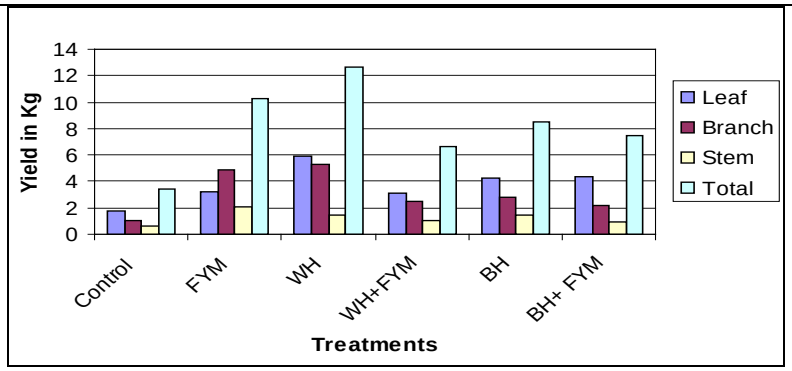


Fig 12. Above ground green biomass yield (gm/tree) of *A.bivenosa* at 36 months of age

Treatment influenced the biomass yield and all the treatments recorded higher biomass (Fig 16) as compared to control (3.43 Kg). Maximum 12.68 kg biomass yield was obtained for T_3 (wheat straw) treatment, followed by 10.22 kg for T_2 (FYM) treatment. A combination of FYM and wheat straw did not yield much.

Acacia ampliceps suffered the maximum damage in summer of 2009 and after the second successive hot summer, mean survival was further reduced to only 12.7% ranging from 6.0% in control to 18.7% in T3 (wheat husk) in different treatment and thus survival of *A.ampliceps* was poor. However, some of the surviving trees attained good growth. Based on average growth (height and crown diameter) one tree per treatment was cut and aboveground green biomass was estimated in field, it was ranging from 5.5 kg to 13.01 kg per tree in different treatments.

Results indicate that all the three plant species have the potential to revegetate the bare salt affected soils. They maintain good survival, attained significantly higher growth than sandy soils. Management practices enhanced the growth of all the three species under arid conditions on black soils. *A. ampliceps* and *A. bivenosa* flowered and produced viable seeds within a year, while on sandy soil they took three to five years. *S. persica* also flowered and produced fruits in second year. Plantation activities has improved the soil conditions and reduction in pH and EC and improvement in percent SOC inside the plantation area. Weed biomass estimated every year indicated that rainfall influenced the number of species and in high rainfall year even glycophytes appeared in significant number.

Thus, it can be concluded that *S. persica* is the best plant with maximum survival, but due to halophytic nature, its fodder acceptability is less. However, *A.ampliceps* and *A. bivenosa* can be introduced in Wild Ass sanctuary and with management practices which will enhance fodder yield.

Sub Project B : Silvipastoral Study

Trials with four tree species, namely, *Cordia garaf*, *Prosopis cineraria*, *Zizyphus mauritiana* and *Colophospermum mopane* and three grass species, namely; *Cenchus ciliaris* and *C. cetigerus* were laid in RBD in three replication at Mochirai, Bhuj in July, 2006. The area was undulating, and soils were loamy sand textured. Soil pH and EC was 7.3 to 7.5 and 0.49 to 0.89 dSm-1 for 0-25, 25-50 50-75 cm soil layers, respectively. Organic carbon in 0-25 cm, 25-50 and 50-75 cm soil layer was 0.34, 39 and 0.36 %, respectively. Area is hilly pediment. Soil depth is less and an underlying rocky impermeable calcium

carbonate layer was 25-75 cm at different places. Area was deep ploughed in summer to facilitate moisture conservation. In summer, temperature goes up to 47° C and in winter around 4°C. The rainfall during the experimental period was 596 mm in 2006, 663 mm in 2007, 247 mm in 2008, 419 mm in 2009, 896 mm in 2010 and 742 mm in 2011.

***Cenchrus setigerus* based Silvipastoral trial**

In this experiment, *C. setigerus seed* was sown manually at high seed rate 8-10 kg /ha (very dense) where soil depth was medium 40 -75 cm. After 64 months the mean survival was 96.3%, for control and 90.6 % with grass treatment Although, control trees recorded higher mean percent survival than control throughout the study period, however, the difference was not significant. Species wise, all the species recorded more than 90% survival, *C. gharaf* recorded maximum 96.3% survival, followed by *Z. mauritiana* (93.5%) and *P. cineraria* (91.6%). Survival of C. *mopane* was less than 50%.

In this experiment, initially C. gharaf was the best performing species, but after 52 months, *Z. mauritiana* took over in height and crown diameter. *P. cineraria* was at third place and *C. mopane* did not perform and discontinued from experiment. Dense grass sowing adversely influenced (p 0.00) the growth and biomass of tree species, treatment wise, the mean height was 202.8 cm , crown diameter176.5cm and collar diameter 7.1 cm for control as compared to 162.3 cm height, 153.7cm crown diameter and 5.5 cm collar diameter with grass treatment. Species wise, the mean height and crown diameter for *Z. mauritiana* was 237.5 cm & 210.9, followed by *C. gharaf* 208.4 & 197.9 cm and *P. cineraria* 102.0 cm & 86.5 cm respectively at 64 months of age.

Effect of grass growth was more adverse on collar girth and control trees (without grass) attained 30.7% more collar girth (7.15cm) as compared to with grass treatment (5.47cm). Species difference continued to be highly significant (p-0.00) and now with 9.67cm mean collar diameter, C. *gharaf* attained 1.89 and 2.42 times more collar dia as compared to Z. *mauritiana* (5.3cm) and *P. cineraria* (4.0cm), respectively.

Biomass

Based on mean height and crown diameter, component wise aboveground biomass estimation was done for *Z. mauritiana* and *C. gharaf* in control and with grass treatments at 38 months. Control trees recorded significantly higher biomass for both the species. It was 1.6 fold more for *C. gharaf* (7.5 kg in contorl to 4.8 kg in with grass treatments for green biomass. For *Z. Mauritiana,* the yield was 2.5 fold high (4.0kg to 1.9kg). Same trend continuned in dry mass, where *C. gharaf* recorded 1.7 and *Z. mauritiana* 2.3 times more in control trees.

Green biomass of *P. cineraria* was estimated at 64 months and it was 4.28 kg /plant in control tretment as compared to 2.27 kg/plant in with grass treatment.

***Cenchrus ciliaris* based Silvipastoral trial**

In this experiment, grass sowing was done at low seed rate (1.0 m strip at a distance of 3 m), where soil depth was shallow 25-40 cm only. Survival at 64 months for control treatment was 87.6% , while with

grass recorded 97.5% There was no change between 52-64 months growth period. Contrary to *C. setigerus,* mean percent survival with grass was higher in case of *C.ciliaris* as compared to control trees throughout the study period however, the difference was not significant.

At 64 months, both control and with grass treatment, recorded same mean height (173.8 cm), which is less than mean height at 52 months. Between 52 to 64 months, many *Z mauritiana* trees fall down due to poor root development failing to support the tree in shallow soil depth resulting in 7.1% decrease of mean height (from 225.2 to 209.2 cm) (indicating that in shallow soil depth, pruning should be done to maintain the plants in shrubby form. Height difference among species was significantly different, but it is due to very less height for *P. cineraria* (58.1 cm) the difference between *C. gharaf (257.2 cm)* and *Z. mauritiana*(209.1 cm) was also significant at this stage. Same is the trend for crown diameter.

Biomass was estmated at 38 months . Green biomass yield was 4.5 to 5.3kg/tree for *Z. mauritiana* and 8.0 to 8.6 kg/tree and1.76 to 1.89 kg/tree for *C. gharaf* with grass and control treatments, respecitively suggesting that at low seed rate grass sowing promote tree growth. Here, *P. cineraria* did not attain enough growth to estimate biomass.

Thus, it can be concluded that in shallow soil grass sowing in scattered manner promoted tree growth due to better moisture availability and dense grass sowing adversely affected the tree growth. *C. gharaf: C. ciliaris* was the best silvipastoral system, followed by *Z. maritiana: C. ciliaris*. Growth of *P.cineraria* was slow in medium soil and poor in shallow soil. *C. mopane* did not survive due to site conditions. Among grass species, *C. cilaris* was the best, closely followed by *C. setigerus*. *D. annulatum* took time for establishment, but spread fast after establishment. Rainfall influenced the grass yield, and in a well distributed monsoon year *C.ciliaris* recorded 1.94 kg/m^2 yield, followed by *C. setigerus* 1.51 kg/m^2.

ICFRE FUNDED ONGOING PROJECTS

Project-6: Identification of soil-vegetation relations and indicator species for assessment and rehabilitation in lower Aravalli of Rajasthan (AFRI-101/EED/ 2010-14).

Principal Investigator: Dr. G. Singh, Scientist F

A study was carried out at five different locations with varying rainfall of 988 mm, 961 mm, 950 mm, 568mm and 424 mm in Banaskantaha (Trisulia), Motimori (Sabarkantha), Banaswara (Bara Nandra kho), Rajasmand (Sabalia) and Pali (Borvad forest block), respectively (i) to study on physical properties and nutrient status of soil derived from different parent material, and (ii) to study on vegetation structure and indicator species on dominant soil types. Based on IVI values, these sites were dominated by *Wrightia tinctoria, Tectona grandis, Lanea coromadelica* and *Anogeissus pendula* tree species, respectively. Among the shrubs, *Nyctanthes arbor-tristis* at first two sites of Gujarat, whereas *Lantana camara* was dominated at Banswara, *Rhus mysorensis* at Rajasamand and *Euphorbia caudicifloia* at Pali sites. Among herbs and grasses, *H. suaveolense, A. lanceolatus, Aristida mutabilis* and *Apluda mutica* dominated the respective site. Total numbers of species (tree, shrubs, herbs and grasses) were 85, 100, 109, 95 and 87 numbers at the sites in Banaskantha, Sabarkantha, Banswara, Rajasamand and Pali, respectively in 2011. Height of the

herbaceous vegetation was in the order of Rajsamand >Sendra >Banswara >Sabarkantha >Banaskantha, where number of herbaceous species were 8.6, 8.4, 9.9, 18.2 and 10.1 number, respectively. Production of herbaceous biomass was highest at Sabalia site of Rajasamand and the lowest biomass production was at Pali site. The order of sites in terms of herbaceous biomass production was Rajsamand>Banswara>Sabarkantha>Pali>Banaskantha. Soil water content (SWC) was lowest at Pali site throughout the year. SWC was highest at Banswara in June, 2011 and February, 2012 and at Sabarkantha site in October, 2011. In October, 2011, soil pH was lowest at Sabarkantha and was associated with the lowest electrical conductivity, NO_3-N and highest SWC in October, 2011, number of species and their populations. Concentration of NH_4-N was highest at Trisulia forest in Banaskantha, whereas it was lowest in Motimori forest in Sabarkantha division. The highest NO_3-N concentration at Rajsamand was related to lowest number of species and highest quantity of herbaceous biomass.

Fig 13. Observation recording on vegetation in Sabalia forest block in Rajasamand

Fig 14. Vegetation growth in Motimori forest block in Sabarkantha

Fig 15. Vegetation growth in Baranandra kho forest block in Banswara

Fig 16. Vegetation growth in Borwav forest block in Pali

Project-7: Characterization and classification of forest soils of Rajasthan (AFRI-85/FED/ 2007-2012).

Principal Investigator: Mr. N. Bala, Scientist E

The project was initiated in September, 2007 with the objective to characterize and classify forest soils of

Rajasthan following the USDA classification system. During the reporting period, soil and vegetation survey was conducted in Bundi, Jhalawar, Kota, Karauli, Swai Madhopur, Udaipur, Churu and Jodhpur districts. 146 soil profiles in 146 forest blocks were studied and field observations recorded on vegetation status, regeneration, litter, aspect, drainage, soil structure, consistency and colour. Physico-chemical characterization of the soils has been done in the field as well as in laboratory. Soil samples were collected and analysed for soil texture, structure, consistency, colour, pH, electrical conductivity, organic carbon, NO_3 and NH_4 – nitrogen and phosphorus.

Soils were moderately deep to very deep at most of the sites in Jodhpur, however, 30% sites have shallow soil with calcareous hard pan. Soils in Churu district are deep to very deep in nature with sandy texture. In Udaipur, soil depth varied from 60 cm to 180 cm in different blocks. Colour of soils showed a wide range of variation too. Whereas, most of the soils were dark brown to brown in colour, at some places soils were pink and yellowish red in Udaipur. Soils were mostly gravelly. Only 10% soil samples had < 20% gravels. Among the soils tested, soils of Barmer district have high $CaCO_3$ (380 mg kg^{-1}at Bandra forest block).

Fig 17. Very deep soil at Taranagar range, Churu

Fig 18. Shallow gravelly soil at Kurabad, Udaipur

Fig 19. *Prosopis juliflora* in Bandra forest block, Barmer having high $CaCO_3$ content in deeper soil layer (380mg kg^{-1})

ICFRE PLAN NEW PROJECTS INITIATED

Project-8: Carbon stock and soil classification mapping for Rajasthan forests (AFRI/FE/2011-14).

The project was initiated in November, 2011 with the aim to develop digitized maps of forest carbon stock,

forest soil types and soil nutrient status for Rajasthan and to determine relationships (if any) between in situ biomass density, soil parameters and remote sensing characteristics. GIS laboratory has been fabricated using one-time grant.

Fig 20. GIS Lab

2.2.5 Watershed Management

Nil

2.3 Genetic Improvement

2.3.1 Overview

Variability in the base population is the prerequisite for any successful genetic improvement programme based on selection and breeding. In the states of Rajasthan and Gujarat, Candidate Plus Trees have been selected from different locations, and some of these trees have been used to establish clonal seed orchards and also few seedling seed orchards.

Though, selection of phenotypically superior trees is done very carefully and with high selection intensity their genetic worth per se cannot be guaranteed. Selection can be successful only when the variability in the population is due to genetic causes. The clonal seed orchards available in Western Indian states are established from the first generation selection. These trees, needs to be tested to ascertain their genetic worth by estimating genetic parameters like; heritability, genetic gain and combining ability. Estimation of genetic parameters is a very useful tool in predicting the amount of gain envisaged from clonal and progeny material. The variation among progenies and clones is commonly used as an estimate of total genetic variation and to calculate the degree of genetic control for a particular trait. Heritability is the measure of how strongly a particular trait is influenced by genotype and how much by the environment, whereas combing ability estimate gives the indication of the breeding values of selected parents.

2.3.1.1 Summary of the achievements under the Theme

- In 141 sites in 29 districts were surveyed covering 10294 ha for the mapping distribution and density of *Commiphora wightii* (Guggal) and collected germplasm for *ex situ* conservation from identified 105 Candidate plus Plant (CPPs). Collected 1284 stem cuttings of Guggal with source details (GPS locations) and differential response in sprouting and rooting was observed.

- Seeds were collected from six sources and 26 CPPs of Guggal few genotypes have potential to produce high percentage of viable black seeds and found that location of genotype also playing impotent role in black and white seed ratio.

- Selected 15 phenotypically superior trees of Teak and genetic variation among half sib families was studied and estimates of heritability and genetic gains were computed and investigated inheritance of growth traits.

- Two progeny trials of teak comprising 28 families and 9 families established during 2010 at Sajjangarh and Jodhpur were evaluated.

- In the progeny trial of *Tecomella undulata* established in 2008 from 40 CPTs of Bikaner and Jodhpur, the growth performance evaluation indicated better performance of progenies in Jodhpur

- Potential clones for the operational planting on the basis of height and girth have been selected in *Eucalyptus camldulensis* and in *Dalbergia sissoo.* Clone No. 42, 15 & 35 showing better performance across the all the four sites. In *Eucalaptus camaldulensis,* clone No. A3, 10 and 105 were found suitable in all the four test sites

- Neem progeny trial was established in the year 2002 at Govindpura, Jaipur with seedlings of selected 17 CPTs for high Aza content (above 5000 ppm). Progenies of CPT 7 was superior on many parameters, similarly progenies of CPTs 4, 11 & 12 also performed better on growth parameters.

- Progenies of CPT 3, 4, 5, 6 and 7 were not affected by frost whereas, progenies of CPT 4 & 7 are superior in growth parameters as well as frost tolerant, whereas, two other good progenies (11 & 12) on growth parameters were badly affected by frost.

- Under *in* vitro conditions, the best shoot multiplication in *Salvadora persica* was 2.5 fold on MS medium supplemented with BAP (5.0 mg/l) and IAA (0.1 mg/l)

- In *Capparis deciduas* on MS medium supplemented with BAP (4 mg/l), NAA (0.1 mg/l) and additives favoured multiple shoot induction whereas, the best shoot multiplication was on MS media supplemented with BAP (2.0 mg/l) and IAA (0.5 mg/l).

- For genetic improvement of *Prosopis cineraria,* 21 new candidate plus trees were selected from different locations in Rajasthan and variation in pod parameters were studied.

- Developed hardening procedure for somatic embryo derived plants of *J. curcas*

- Identified low cost gelling agent (Isabgol) that may be used as a replacement of agar for

micropropagation of *Jatropha curcas*

- Developed and scaling-up of hydroponics system that is cost-effective and the plant can completes its life cycle and one putative gene was identified that may have role in abiotic stress physiology

- Somatic embryo derived plants were produced from 3 years old (long term maintained) cultures of *Commiphora wightii* and were found genetically uniform based on six RAPD markers found genetic stability.

2.3.1.2 Projects under the Theme (in table as given at 2.1.1.2)

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	0	9	0
Externally Aided	0	1	0

2.3.2 Conservation of Forest Genetic Resources

EXTERNALLY AIDED ONGOING PROJECTS

Project-1: Assessment of Guggul germplasm for studying population density, diversity, female-male plant's ratio for *in situ* and *ex situ* conservation in Rajasthan (AFRI- 106/FGTB /SFD-RAJ/ 2010-13, Funded by SFD, Rajastha).

Principal Investigator: Dr. U.K. Tomar, Scientist E

Survey of *Commiphora wightii* (Guggul) was conducted in 29 districts of Rajasthan namely; Ajmer, Banswara, Baran, Barmer, Bharatpur, Bhilwara, Bikaner, Bundi, Chittorgarh, Churu, Dungarpur, Hanumangarh, Jaipur, Jaisalmer, Jalor, Jhalawar, Jhunjhunu, Jodhpur, Karauli, Kota, Nagaur, Pali, Pratapgarh, Rajsamand, Sawai Madhopur, Sikar, Sirohi, Sri Ganganagar and Udaipur. A total of 2660 sample plots in, 141 sites in 29 districts were surveyed covering 10294 hectare where Guggul occurrence has been recorded. GPS data were loaded on Rajasthan map using software with colour codes for population densities viz white (average population density below 1 plant per plot), blue (1-3 plants per plot), green (4 to 6 plants per plot), (dark green 7 to 9 plants per plot), red (10-14 plants per plot) and dark red (15-35 plants per plot). The Rajasthan state map generated with the data collected by AFRI along density colour code which is given below (Fig. 21).

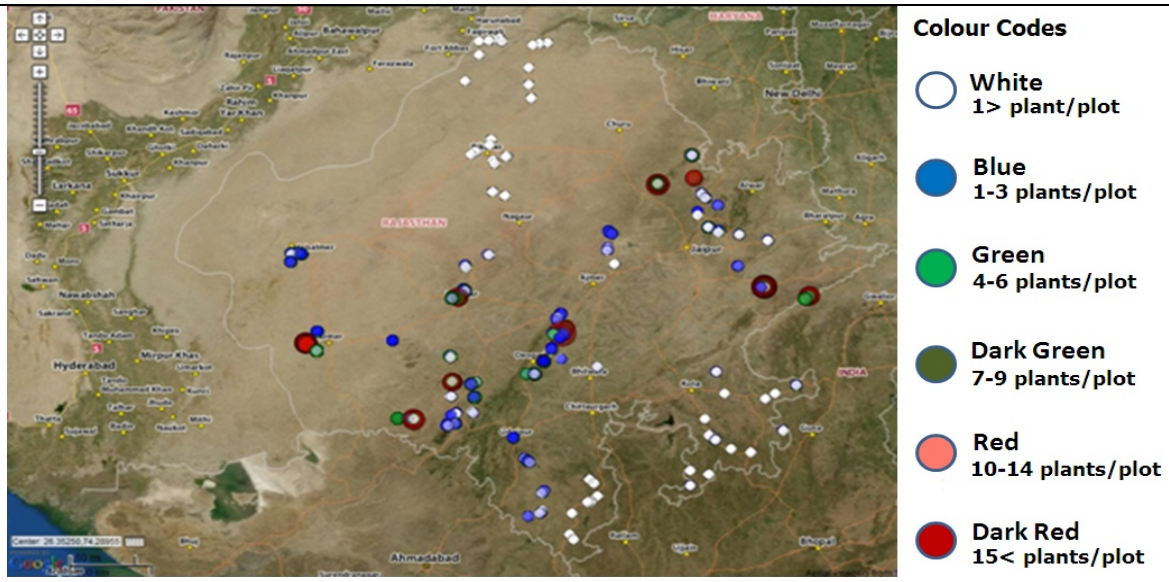


Fig 21. Population density of Guggul plants shown by color code on Rajasthan map

2.3.3 Tree Improvement

ICFRE FUNDED ONGOING PROJECTS

Project-2: Investigations on genetic variation and inheritance of Western Indian Teak (*Tectona grandis* L.f) (AFRI-94 /Silvi/2010-2015).

Principal Investigator: Mr. Pravin H. Chawhaan

Teak (*Tectona grandis*) is the chief source of high quality timber valued all over the world. In India, it is widely distributed in central and south regions and represents about 14.37% of total forest area. The Western Indian region harbours ecologically diverse forests of teak; it includes dry teak forests (5A/C 1b) to very dry teak forests (5A/C 1a). The extent of teak forest of Western Indian states together harbours about 6,192 sq. km. of teak forests. Amongst the states of the region, Gujarat have the largest teak forest amounting to 5,637 km2, followed by Rajasthan (426 km2) and Dadra and Nagar Haveli (129 km2). The extent of these forests, account for about 46, 3.2 and 63 percent of the total forest cover of these states and UT, respectively. At present, information on the inheritance of teak and estimation of the genetic parameters in western Indian teak is lacking and the endeavours of genetic improvement have not been continued beyond the first cycle of improvement.

This project is planned for ascertaining the genetic worth of the selected trees besides understanding the inheritance pattern of different economically important traits of Western Indian teak, which hitherto remained uninvestigated. This study would help in genetic rouging of the existing seed orchards and identification of good general combiners and as well as selection of transgressive sergeants for establishing advance generation seed orchards and breeding populations.

Statistical analysis of progeny trial and investigation on inheritance of growth traits in teak and selection of phenotypically selected trees. The materials for this investigation came from three progeny trials

established with 16, 28 and nine half-sib families of teak at Shivrajpur, Sajjangarh and Jodhpur, respectively. The Shivrajpur trial was established in 2008, at under the jurisdiction of Silviculture Division, Rajpipla by the SFD, Gujrat, while the other two trials were established in 2010. Individual tree data from these trials was collected during 2011–2012 in addition to another trial at Rajpipla. Analysis of variance of these trials revealed that variation due to families was highly significant for height and collar girth indicating scope for family selection, except in case of Jodhpur trial, where these differences were non significant at one year, but was significant at nine month growth.

Availability of variation in the population is a prerequisite to make selection effective; similarly the information on extent and nature of genetic variation is of almost importance to develop effective breeding strategy. While heritability values express the proportion of variation in the population that is attributable to genetic differences among individuals, genetic advance indicates average improvement in the progeny over the mean of the parents. Genetic advance is realized by selection in the parental generation and its magnitude depends on selection intensity, parental variation and heritability. The detailed genetic analysis to compute variance components, genetic parameters was performed for Sajjangarh trial according to Zobal and Talbert (1984). Computation on of genetic advance was done using selection intensity of 5 %. In the present material, individual and family heritability values for height were 25 and 40, whereas, that for collar girth was 14.2 and 24 percent. Height and collar girth exhibited high to moderate estimates of narrow sense heritability, respectively at individual as well as family level. Family heritability values were considerately higher for both the traits suggesting effectiveness for family selection. Genetic advance estimates for these traits also followed similar trend and ranged from 6.41 to 24.32 percent. In addition to this, 15 new phenotypically superior trees were selected from different locations of Rajasthan and Gujarat. Open pollinated seeds from 70 trees from Gujarat and other areas of the country were collected, weathered and seedlings were raised in the nursery.

Fig 22. General view and close up view of Sajjangarh progny trial of teak

Fig 23. CPT of teak selected in Gujarat

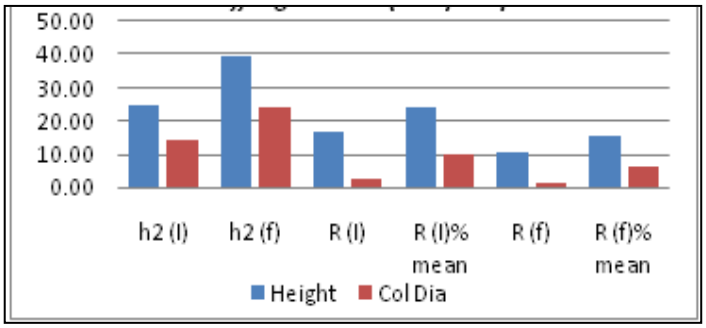


Fig 24. Heritability and Genetic gain estimate Sajjangarh Trail (1st year)

Project-3: Genetic improvement of *Tecomella undulata* (AFRI-33/FGTB/ 2002-2013)

Principal Investigator : Dr. Sartia Arya, Scientist F

Under the tree improvement programme of *T. undulata*, 47 CPT's were selected from various district of Rajasthan, which are natural growing area based on the quantitative traits (height, girth, clear bole and crown diameter) and qualitative traits (straightness, roundness and health). Seeds were collected from CPT's for establishment of progeny trials. Progeny trials were established using seedling of 40 CPT's at Bikaner and Jodhpur in August, 2008. Survival percentage was high at Jodhpur (90%) as compared to only 59% at Bikaner at the age of $3^1/_2$ years. An average height of plants at Jodhpur was 110 cm, where as average height of progenies was 64.54 cm at Bikaner. An average collar diameter at Jodhpur was 1.14 cm, whereas at Bikaner it was 0.87 cm.

The progenies of CPT-23 from Chohtan (Barmer) exhibited best growth at Jodhpur, attaining height of 143 cm and minimum in progenies of CPT-4 (Mohangarh) of 87 cm (at Jodhpur). At family level, highest survival (97.2%) was found in progenies of the CPT-15 (Daichu) and minimum (75%) in progenies of CPT-23 (Chohtan) at Jodhpur, whereas at Bikaner progenies of CPT-3 (Mohangarh) exhibited highest survival rate of 73% and minimum (36%) in progenies of CPT-4 (Mohangarh). Considering collar diameter, progenies of CPT-37 (Jodhpur) proved the best and exhibited 1.43 cm and progenies of CPT-18 (Chohtan) exhibited minimum collar diameter (0.9 cm) at Jodhpur. At Bikaner, highest collar diameter was 1.09 cm in progenies of CPT-24 (Chohtan) and least collar diameter (0.70 cm) was of progenies of CPT-2 (Mohangarh). In general, growth performance was poor at Bikaner as compared to Jodhpur.

Fig 25. Overview of progeny trial of *Tecomella undulata* at the age of $3^1/_2$ years at jodhpur

Fig 26. Close up view of progeny trial of *Tecomella undulata* at the age of $3^1/_2$ years at jodhpur

Project-4: Multilocational trial of *Eucalyptus camaldulensis* and *D. sissoo* clones in Gujarat (AFRI-41/FGTB/2002-2012).

Principal Investigator: Dr. U.K. Tomar, Scientist E

Multilocational trials of *E. camaldulensis* and *D. sissoo* clones were established in 2003 at four locations in Gujarat namely; Deesa, Gandhinagar, Kheralu and Rajpipala. Data were collected on growth parameters annually since establishment. But data on physiological parameters as photosynthesis and transpiration rate and qualitative parameters were also collected once from all the sites for both the species. Data collected so far from 2004 to 2012 were analyzed. The data collected on girth of *D. sissoo* clones from 2004 to 2012 is presented as site wise performance of all the clones (average of all clones girth at each year) in Fig 27. *D. sissoo* clone No. G2, 15, 35 and *Eucalaptus camaldulensis* clones Nos. A3, 10, 105 showed stable performance across the sites as demonstrated by their better growth (height and girth parameters).

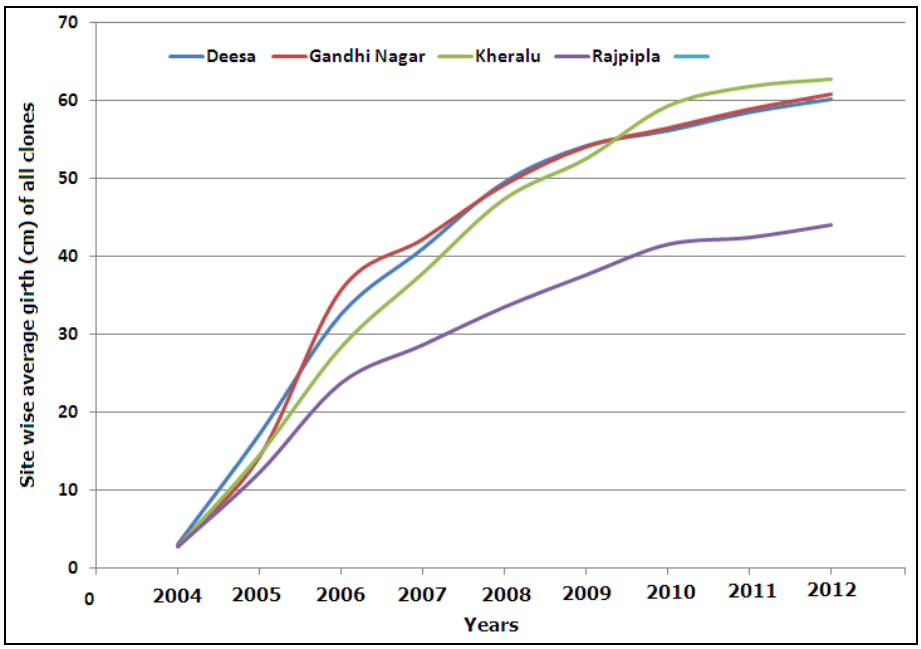


Fig 27. Effect of site on girth parameter of *D. sissoo* clones

Project-5: Screening of high oil and Azadirachtin in Neem (AFRI-45/FGTB-8/2002-2013).

Principal Investigator: Dr. U.K. Tomar, Scientist E

Neem progeny trial was established in year 2002 at Govindpura, Jaipur with seedlings of selected 17 CPTs for high Aza content (above 5000 ppm). This trial is almost now 9 year old and significant variation in flowering and fruiting was reported. Overall fruiting and flowering was very poor. Moreover, conversion rate of flowers into fruit was also very poor. Therefore, sufficient seeds were not available for chemical analysis.Progeny of CPT No. 4 & 7 are superior in growth parameters as well as frost tolerant, whereas, two other good progenies (11 & 12) on growth parameters were badly affected by frost. This study also indicates that frost tolerance and growth characters are independent genetically. This progeny trail is still progressing to assess the performance of progenies for their azadirachtin and oil properties. Seed collected from 33 trees belonging to 10 families showed high oil content (above 40%). Azadirachtin estimation is in progress.

Project: A Coordinated project on integrated management of Khejri mortality for socio-economic upliftment in Rajasthan (AFRI-1/FPD/2010-2014).

Component Principal Investigator: Dr.P. H. Chawhaan

Component - Genetics and Biotechnology

Genetics: Survey has been conducted in various districts of Rajasthan like; Nagaur, Sikar, Churu and Jhunjhunu and 21 more CPTs were selected from these sites. Pods have been collected from selected CPTs and parameters from individual pods of these CPTs like; length, width and weight has been taken. Cutting and layering experiments has been done on mature plant of *Prosopis cineraria* using different concentrations of plant growth hormone (IBA) like; 500ppm, 1000ppm and 1500ppm

The data from collected pods was statistically analyzed (shown graphically in this report). Cutting experiments were done by using growth hormones (IAA, IBA, and NAA) with different concentrations (100ppm to 1000ppm), rooting mixture and environments (open, shad house, polytunnel and mist chamber). Sprouting has been seen in these cuttings. Budding experiment has been done with khejri seedlings. Nursery root stock is maintained in AFRI model nursery for grafting works.

Fig 28. Estimates of genetic parameters in Pod characters of *P. cineraria*

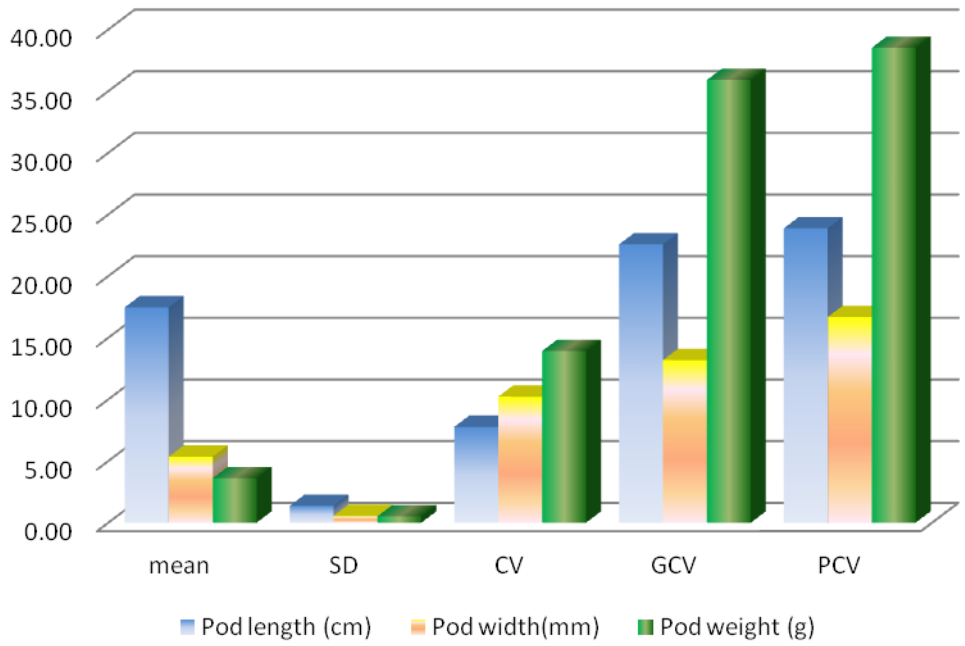


Fig 29. Estimates of genetic parameters in Pod characters of *P. cineraria*

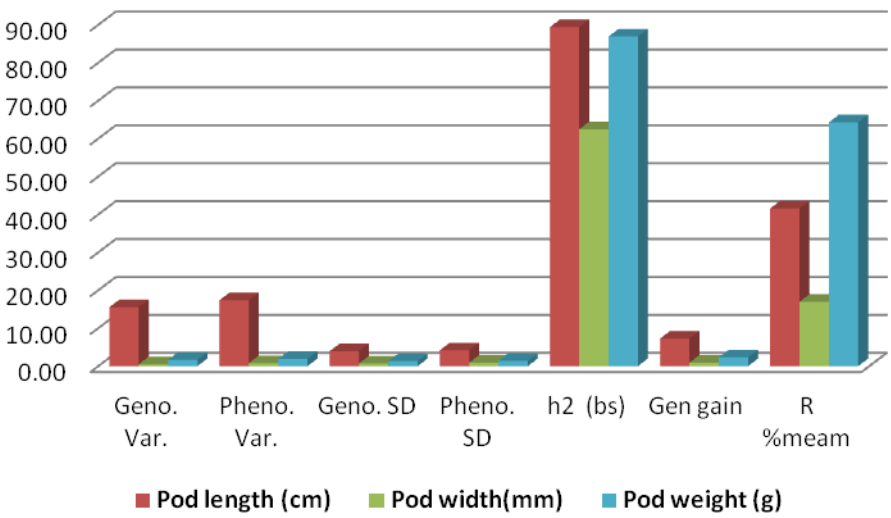


Fig 30. Selected CPTs of Khejri in farmer's field

Fig 31. Pods of CPTs of Khejri

2.3.4 Vegetative Propagation

ICFRE FUNDED ONGOING PROJECTS

Project-6: Demonstration trial of male and female *Ailanthus excelsa* plants raised through grafting (AFRI-79/FGTB/2006-2013).

Principal Investigator: Dr. U.K. Tomar

Grafting technique for *Ailanthus excelsa* mature trees developed (grafting success ≈ 50%). At present, this grafting method is more efficient over any other clonal technique. Wedge grafting gives better success than patch grafting. Clonal propagation of Male and Female plants was achieved successfully by using grafting technique, which is easy and economic. This technique can be handled easily by farmers and field staff of SFDs. Last year female plants exhibited about 10% superiorly in height and girth parameters over male plants and this year female plants are showing 16.7% in height and 23% in girth superiority over male plants. Therefore, both the parameters female plants are taking lead and difference is also increasing gradually as shown in Fig 32.

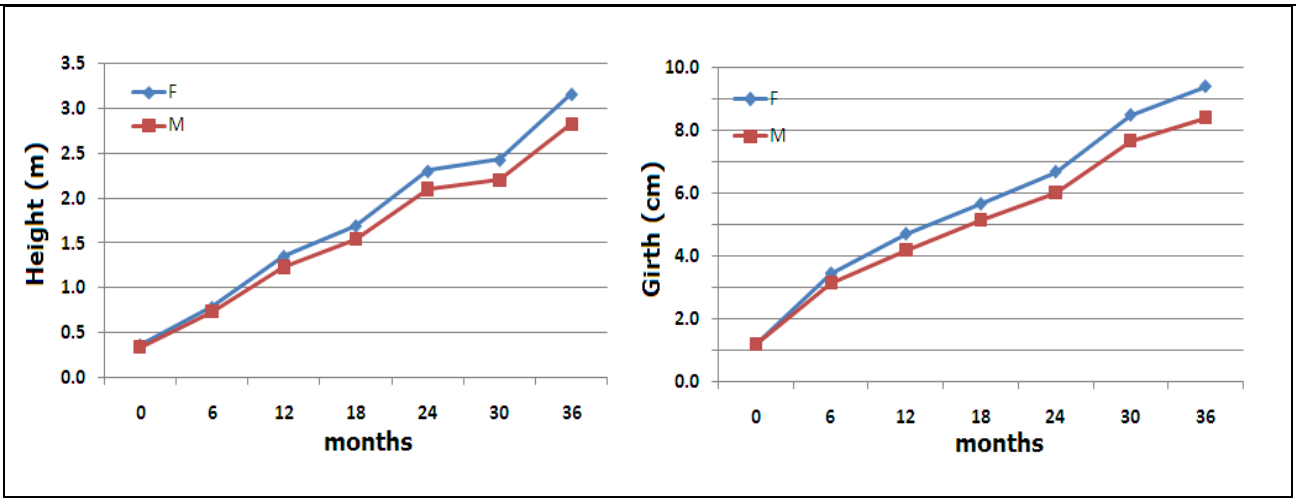


Fig -32. Demonstration trial of male and female *Ailanthus excelsa* grafted plants

EXTERNALLY FUNDED ONGOING PROJECT

Project: Assessment of Guggul germplasm for studying population density, diversity, female-male plant's ratio for *in situ* and *ex situ* conservation in Rajasthan (AFRI- 106/FGTB /SFD-RAJ/ 2010-13, Funded by SFD, Rajastha).

Component Principal Investigator: Dr. U.K. Tomar

Component II

It is reported in literature that guggul stem cuttings can be rooted successful (80% rooting). Undoubtedly, this species is easy to propagate vegetatively, but like other species in this species also rooting is influenced by source material (location, age of plant and genotypes). Stem cuttings collected from different sources exhibited differential response in sprouting as well as rooting. Sprouting of stem cuttings starts within 20 days, but rooting is not synchronised with sprouting and it takes relatively longer time (about 30-40 days). Proper package of simple vegetative propagation methods are still lacking in literature and SFD Rajasthan has sponsored the above project to develop package and practice which can be used by field officials with some thumb rules.

Annual pattern of rooting: Stem cuttings raised in mist-polyhouse in different months (except July-August months) of a year to study the annual pattern of sprouting and rooting and to find out the ideal period for rooting of stem cuttings with maximum success. Maximum rooting (about 48%) was recorded in January to February, though sprouting was maximum (above 70%) in the months from March to June. It indicates that sprouting is not a good indicator of rooting and bud break and initial growth of shoots is an independent process.

Rooting behaviour of stem cutting collected from different sources: Stem cutting collected from different 14 sources exhibited high variability in sprouting and rooting. Maximum rooting (60%) was recorded in Jalore and Bhilwara sources, when stem cuttings were raised in Januray, 2011 and April, 2012, respectively. Whereas, rooting was poor (below 20%) in stem cuttings collected from Udaipur (June), Jaisalmer (Dec), Nagaur (Feb), Barmer (Nov) and Jhunjhunu (Feb).

Genotype Response: Data analysis of cuttings exhibited tremendous differences in sprouting and rooting responses in different Candidate Plus Plants (CPPs) belonging to same locations. It is difficult to rule out the effect of age. Determination of age of individual genotype is difficult in natural population. However, above 90% rooting as well as sprouting was recorded in seven genotypes viz; PAL2, PAL3, PAL9, JLR1, JLR2, JLR7 & BLW2. Some of the genotypes of same location did not root well in spite of raised at same time and in similar conditions viz. PAL 1, PAL 4 & PAL 8 & JLR3, JLR4, JLR6 & BLW 3. The influence of age factor in present studies cannot be ruled out.

2.3.5 Biotechnology

ICFRE FUNDED ONGOING PROJECTS

Project-7: Development of tissue culture technology for multiplication of economically important desert plant *Salvadora persica* (AFRI-92/FGTB/2009-2014).

Principal Investigator: Dr. I.D. Arya, Scientist F

Macro propagation:

Cuttings were collected from the selected CPT's of *Salvadora persica* from Rohat, Sanderav, and Balotra. Among the different concentrations of auxins (500-4000 ppm) tested, 2000 ppm IBA was found to be the best for rooting from stem cuttings. Among the auxins (IAA, IBA, and NAA) used, IBA was found to best for rooting from stem cuttings. Rooted cuttings were transferred to polybags consisted mixture of FYM: Sand: Soil in the ratio 1:1:1 (V/V), and kept in agroshadenet for one month. Among the rooting media studied (viz; Sand, Soil, Vermiculite) sand proved the best rooting medium.

Micro propagation:

Effects of different types of medium; MS, WPM, and B_5 were studied for *in vitro* shoot multiplication. Amongst the media, MS medium was found to be best for shoot multiplication. Among the different cytokinins (BAP, Kn, TDZ and Zeatin), used for *in vitro* shoot multiplication, MS medium with BAP was found to be best. Among the different auxins (IAA, IBA, and NAA alone) used, for *in vitro* shoot multiplication, IAA in the medium was found to be the best. For high rate of shoot multiplication, studies were conducted on auxins and cytokinins in MS medium. The results revealed that medium consisted of 5.0mg/l BAP and 0.1mg/l IAA favored 2.5 fold shoot multiplication in four weeks period. *In vitro* shoot multiplication cultures were maintained on MS medium supplemented with 0.5 mg/l BAP + 0.1 mg/l IAA + additives (ascorbic acid, citric acid, L- arginine, L- aspargine, adenine sulphate).

Fig 33. Macropropagated plant of *Salvadora persica.*

Fig 34. In vitro shoot multiplication of *Salvadora persica*.

Project-8: Development of technologies for multiplication of economically important desert plant - *Capparis decidua* (AFRI-105/FGTB/2010-2015).

Principal Investigator : Dr. Sartia Arya, Scientist F

Macropropagation

Three types of cutting of *Capparis deciduas* were used for rooting viz, softwood, semihard wood and hard wood. Semihard wood cutting gave better response. Effect of various concentration of IBA (500,1000,2000,5000 and 7500ppm), NAA (500,1000,2000 and 5000ppm) were studied, 1000 ppm IBA was found to be the best for rooting from stem cuttings. Experiments for rooting of stem cutting were conducted in April to March. Cutting harvested during the month of March-April and August-September-October were found to be best for rooting. Effect of various rooting medium was studied and Sand:Soil:FYM (2:1:1) was found to be the best for rooting of stem cutting.

Micropropagation

Nodal segments of *Capparis decidua* were surface sterilized with 0.1% $HgCl_2$ for 3-4 min. Surface sterilized nodal segments were inoculated on MS medium supplemented with different concentrations of cytokinins (BAP and Kn) alone and in combinations with auxin (NAA). Axillary bud break was achieved in 4-5 weeks. The bud break response (60-70%) was obtained on MS medium supplemented with BAP (4.0 mg/l) + NAA (0.1 mg/l) +additives (ascorbic acid 50mg/l, citric acid 25 mg/l, adenine sulphate 25 mg/l) with 2-3 shoot/explant. Experiments were conducted to find out the effect of different concentrations of cytokinin (BAP) and auxins (NAA and IAA) for *in vitro* shoot multiplication. MS medium supplemented with BAP (2.0 mg/l) + IAA (0.5 mg/l) and additives was found to be best for *in vitro* shoot multiplication. Effects of pH (4.0-8.0), liquid and semisolid media were tested for shoot multiplication and it was revealed that 5.5-6.5 pH was favorable for *in vitro* shoot multiplication on MS medium supplemented with 2.0 mg/l BAP + 0.5 mg/l IAA and additives. Effect of carbohydrate concentration was studied for *in vitro* shoot

multiplication. Sucrose at 3% concentration in the MS medium gave the best results with 3-4 folds of *in vitro* shoot multiplication. Two types of basal media viz, MS and WPM were tried to optimize multiplication rate of *in vitro* raised shoots and maximum shoot multiplication rate & 3-4 folds were obtained on MS medium supplemented with 2mg/l BAP + 0.5 mg/l IAA + additives.

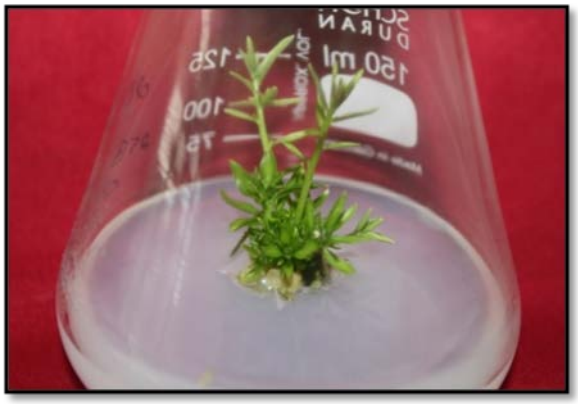


Fig 35. *In vitro* multiplication of *Capparis decidua*

Project-9: *In vitro* mass propagation of *Jatropha curcas* L. and optimization of low cost options for economizing the technology (AFRI- 83/FGTB/7/2007-2011).

Principal Investigor: Dr. Tarun Kant, Scientist E

Embryogenic cultures of *Jatropha curcus* were multiplied and mature somatic embryos were germinated. Somatic embryos derived plants were hardened in mist chamber. Experiments on rooting of microshoots were carried out, and rooting was 65% on MS medium supplemented with both IAA and IBA. Experiments were at final rooting stage using guar gum, sago and isabgol. Isabgol was found to be the best, followed by sago and guar gum as ideal low cost gelling agent. It has been concluded that best low cost gelling agent that may be used as a replacement of agar is isabgoal. Guargum and sago may also be used at all stages, except at rooting, where they cause problem due to their excessive stickiness. All TC raised plants (axillary bud and somatic embryo derived) were hardened. The plants have been established in large pots for the planting in the field condition on the onset of the monsoon season. The economics of the TC plants have been worked out. The cost of single *Jatropha* plant produced through somatic embryogenesis pathway comes out to be Rs. 17.00, while that produced through axillary based protocol is Rs. 22.00 and through organogenesis Rs. 23.25, respectively. All data has been compiled and analyzed.

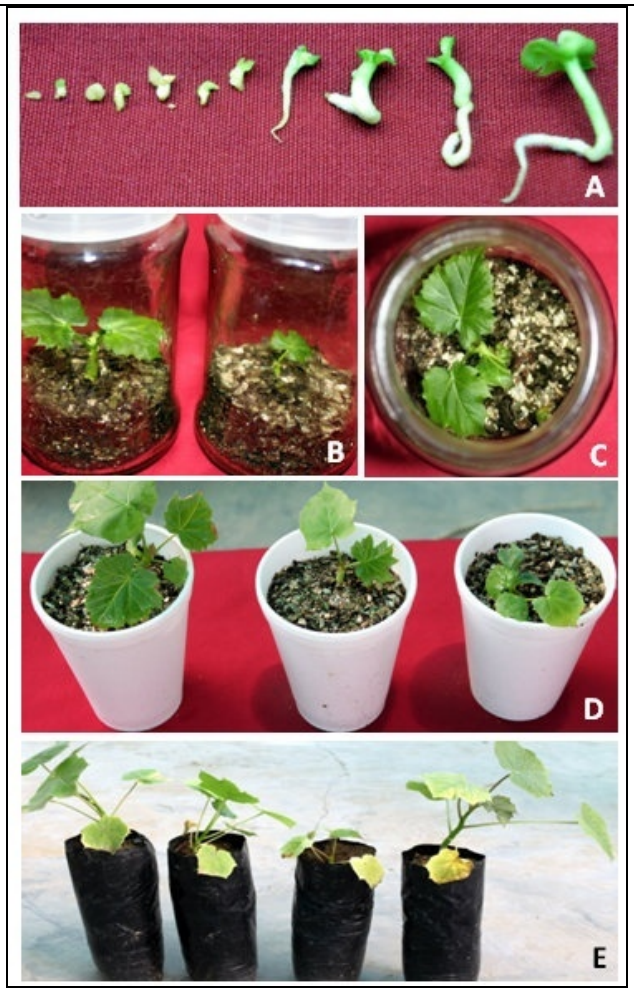


Fig. 36 (A-E): In *vitro* propagation of *Jatropha curcas* through somatic embryogenesis pathway: **A.** stages of somatic embryo development, maturation and germination; **B & C**. Germinated somatic embryos undergoing *in vitro* hardening in jam bottles; **D.** *Ex vitro* hardening of somatic embryo derived plants; **E.** Hardened plants growing in poly-bags in open nursery condition and ready for out planting.

Project-10: Study of salt tolerance through gene expression pattern analysis (AFRI- 102/FGTB/2010-2015).

Principal Investigator: Dr. Tarun Kant, Scientist E

An ultra-low-cost hydroponic system has been developed in house using black painted plastic containers of ~5 L volume with lids having appropriate holes for plant. The air pump along the silicon tubing and air stones were used to aerate the liquid Hoagland's solution (different strengths) or MS liquid medium, where roots grow. The system was tested and plant growth was recorded (Fig 37). Using Clustal multiple sequence alignment, the gene families were individually subjected to alignment to draw out unique non-homologous stretches of sequences for primer designing. Primers were designed for all sequences and validated through multiple factor evaluation of the specificity of these PCR primers using primer blast. RNA extraction and purification was done using an method involving FTA kits. *In silico* RT-PCR was carried. Moreover, FTA derived RNA was reverse transcribed through actual RT-PCR method using sensi-

script reverse transcriptase. RT-PCR products were checked electrophoratically. Analysis of gene products was carried out using Gene Expression Omnibus (GEO) in association of AtGeneExpress for 100 and 140 mM NaCl treatments, followed by PLEX database query. One putative gene was identified that may have role in abiotic stress physiology.

Fig. 37 (A-D) –Establishment and scaling-up of hydroponics system for raising *Lepidium sativum* and *Arabidopsis thaliana* plants under different salt regimes. **A.** Complete hydroponics setup in culture rack; **B.** Single unit of hydroponics system showing black painted box with holes for plant, air pump and silicon tubing; **C.** *L. sativum* plants growing hydroponically; **D.** Roots coming out from bottom of the box-lid fitted with 1.5 ml PCR tubes with bottom end cut-off.

Project: A Coordinated project on integrated management of Khejri mortality for socio-economic upliftment in Rajasthan (AFRI-1/FPD/2010-2014).

Component Principal Investigator: Dr. Tarun Kant, E

Biotechnology Component

Axillary bud break was achieved on MS medium +2.5 mg/l BA. Further 3-4 fold multiplication was observed on MS+5mg/l BAP+ additives. Micro-shoots multiplication was achieved from seedling derived material on MS+5.0 mg/l+ 1.0 mg/l IAA+addetives. Experiments to obtain micro-shoot multiplication are continuing from mature tree stem nodal segments. Experiment conducted for somatic embryogenesis from various explants sources. Embryogenic like callus was established. DNA extraction using modified CTAB method was carried out and standardized for the variability studies.

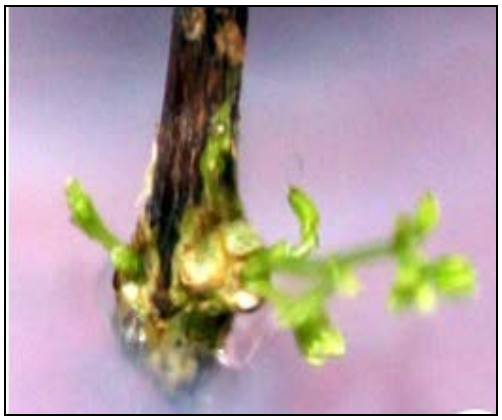


Fig 38. Multiple shoot induction in *Prosopis cineraria* from nodal shoot segment of mature tree

EXTERNALLY FUNDED ONGOING PROJECT

Project: Network research project on guggal *Commiphora wightii* Arn. Bhandari (AFRI-76/Silvi/ NMPB/2008-13).

Component III: Tissue Culture and DNA Fingerprinting

Component Principal Investigator: Dr. Tarun Kant, Scientist-E

More than four years old embryogenic callus cultures were maintained continuously on modified MS medium supplemented with hormones and without hormone free medium with alternate sub-culturing. Secondary and tertiary somatic embryos (SEs) were also obtained. Cyclic embryogenesis was established and stabilized. White long matured SEs were harvested for the germination on hormone-free MS medium. Germinated SEs were used for *in vitro* hardening. 40 plants in *in vitro* hardening stage and 70 plants in poly-bags, which are ready for out planting. Growth data (height, collar diameter, primary and secondary branches and number of leaves) were collected at regular intervals. Plants are growing well in the field condition for the last one year with 100% survival. The plants exhibited normal growth and no morphological abnormality noticed. Isubgol, sago powder and guar gum were used along with agar as a control for alternative low cost gelling agent experiments. DNA isolation and purification from fresh leaves of tissue culture raised *C. wightii* plants growing in field were carried out by using the protocol given by Sanghamitra *et al*, (2009). Six RAPD primers were tested to check the genetic fidelity of *C. wightii* tissue culture plants at preliminary level. It was observed that all bend were found monomorphic, as such no variation was observed.

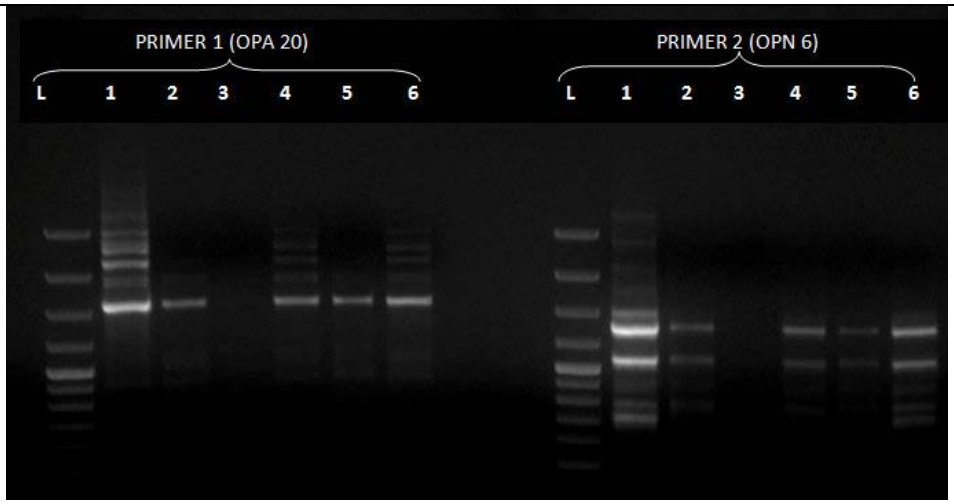


Fig 39. DNA Fingerprint generated using two RAPD primers (OPA 20 and OPN 6) of tissue cultured plants of *Commiphora wightii* growing under field condition

2.4 Forest Management

2.4.1 Overview

One of the most important forest policy goals is to improve forest management on sustained basis. For sustainable use of forest resources the strategy adopted is to harness the potential productivity of forests, simultaneously maximizing net yield from afforested lands. For conceptualizing a production function, forest management essentially needs accurate predictions of output of socio-economic benefits in terms of yields for all relevant combinations of measurable forest characteristics viz., age, site, density and growth. These estimates are crucial for intelligent management decisions on optimum rotation, planting density, thinning schedule, and treatment regime. Too much removal from forests may lead to liquidation of growing stock and too little would be inefficient use of resource because available growth potential is not fully harnessed and society is deprived of immediate benefits. Also such information is required for silvicultural and environmental management.

Unfortunately, information on the growth and yield of many species that are raised in semi-arid area of Rajasthan is meagre. The forest department is very much interested in proper management of its productive resources. Elaborate systematic and scientific studies on the growth and yield aspects of these species are still wanting. Estimation of stand volume with greater accuracy has always been a matter of interest for forest managers, as it is directly related with the production estimation. The wood volume equations assume importance in projecting the total volume at different stages (thinning and final harvest) as the plantations mature. Teak is well known of its high grade timber value. The volume equations developed will be useful to the SFD, Gujarat.

2.4.1.1 Summary of the achievements under the Theme

- For generating volume table, laid 14 sample plots in IGNP and Sojat (Plai) in case of *Prosopis cineraria* and *Ailanthus excelsa* and recorded data on DBH, merchatable height, DBH at mid of bole.

- In *Tectona grandis* Laid 6 sample plots and recorded observations on DBH, total height, height at first branch and total number of trees in plots in Gujarat for the development of volume table.

- The website of the institute developed in Hindi and English was updated regularly. The data for 80 plant species along with photographs were collected and organized on excel datasheet.

2.4.1.2 Projects under the Theme (in table as given at 2.1.1.2)

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	0	2	0
Externally Aided	0	2	0

2.4.2 Sustainable Forest Management (SFM)

Nil

2.4.3 Forest Economics

ICFRE FUNDED ONGOING PROJECTS

Project-1: Market survey on selected species in selected markets (AFRI-58/Silvi./1994-continue).

Principal Investigator: Dr. Sunil Kumar, Scientist E

Data regarding prices of timber such as *Tectona grandis, Dalbergia sissoo, Mangifera indica*, fuel-wood of mixed species, bamboo and poles were collected from the private markets of Jaipur and Ahemdabad at the end of months of each of four quarters. Data were compiled on prescribed formats and submitted to ADG (Stat.), ICFRE, Dehradun for publication of Timber and Bamboo Trade Bulletin.

2.4.4 Forest Biometrics

EXTERNALLY AIDED ONGOING PROJECTS

Project-2: Productivity and biometrics studies on some important species in semi arid regions of Rajasthan for their sustainable management (AFRI-95/Silvi/SFD/2009-2012 Request SFD Rajasthan for the extension).

Principal Investigator: Dr. Sunil Kumar, Scientist E

Laid out 14 sample plots in IGNP area (Mohangarh) and Dadia (Sojat) of *Prosopis cineraria* and *Ailanthus excelsa*. The 35 trees of *P. cineraria* were felled down at represented sites of IGNP. Measurements were taken of all eight sample plots at 3 RD, 08 RD, 1447 RD, 1340 RD, 1387 RD, 1355 RD, 740 RD & 704 RD of *P. cineraria.* Six sample plots of *A. excelsa* laid down at 19KJD, CSP-KJD 0-17 RD, 802 RD, 9 MD, 0-2 RD & Dadia (Sojat). The 23 trees of *Ailanthus excelsa* were felled.Observations of diameter, height were recorded for both of the species. The surrounding of sample area selected for permanent sample plots of *P. cineraria & A. excelsa* (both sides) were marked with rings of red colour paints. The trees lying within the selected area were numbered and plus marked with black paints at 1.37 m height, L-shaped trench were dug in corner of each permanent sample plots. Observations such as; D.B.H and height of trees, no. of trees and area of sample plots were recorded. Trees of *P. cineraria* (35) and *A. excelsa* were felled at each represented sites and standard observations such as D.B.H over and under bark at each of 3 meter logs, crown diameters and height at first branching, merchantable height were recorded.

Project-3: Productivity studies and modeling growth & yield in Teak plantations in Gujarat State (AFRI-/ Silvi/SFD/2010-2014).

Principal Investigator: Dr. Sunil Kumar, Scientist E

The survey of teak plantations was conducted at Varodara, Narmada, Panchmahal, Baria, Vyara, Dangs, Rajpiplla, Dahod and Godhara divisions and identified 16 sites out of 32 for studies. Request has been made to PCCF, Gujarat State Forest Department to seek permission for laying out of sixteen permanent sample plots and felling of total 80 trees of *Tectona grandis* of representative diameters classes, five each from the surrounding of each permanent sample plots in the plantation. The PCCF, Gujarat has asked to submit the exact DBH for felling of the trees before granting the permission of felling.Accordingly, observations were recorded at Comp. No. 301 (a), 301 (b), Comp. 213, Waghai Range, Dang Forest Division, Takalipada PF-164, PF-171, Valsad Range.

2.4.5 Participatory Forest Management

Nil

2.4.6 Policy and Legal Issues

Nil

2.4.7 Information and Communication Technology (ICT)

ICFRE FUNDED ONGOING PROJECTS

Project-4: Development of the web portal for forestry research extension (AFRI-82/IT-Cell/2007-2013).

Principal Investigator: Mr. A. K. Sinh, Scientist D

The website of the institute comprising of features related to the research publications of scientists, technologies developed, thematic information, bulletin board and image gallery etc. were developed in Hindi and English. All the technologies developed, the research publications of the scientists and the articles on the thematic information were uploaded on the site and was updated throughout the year. The main work carried out was for the development of the web application for the plants database and the collection of data for the plants species. An excel datasheet was prepared for the entry of the data and photographs of the species covering all the fields selected for the plants database. The collection of data was started again taking into consideration the data collected earlier. All the earlier leftover fields were also searched and the information was collected. The data has now been organized properly in the excel datasheets and the complete data of eighty important plant species have been collected. Four photographs of each species (i.e tee, leaf, flower and inflorescence) have been originally snapped and pasted in the excel datasheet of that plant and the photography of other species is under progress. The designing, optimization and testing work of the web application is being carried out. The refinement in the searches is also in progress and a refined datasheet for the plant species is also under construction in HTML and PDF format, which can be downloaded from the application. Once the web application is designed and optimized for the performance, the data collected will be imported into the application and will be hosted for on webserver for the users. It is targeted to collect the data for all the important tree and shrub species of the arid and semi arid region. Some of the original photographs taken in the flowering stage of some tree species are as follows

Fig 40 A. Flowering in *Albizia lebbeck (Siras)*

Fig 40 B. *Tecomella undulata* under flowering (Rohida)

Fig 40 C. Flowers of *Butea monosperma (Palash)*

Fig 40 D. A Flowering Tree of *Butea monosperma (Palash)*

Fig 40 E. Flowering in *Azadirachta indica (Neem)*

Fig 40 F. Flowers of *Kigelia pinnata (*Balam khira)

Fig 40 (A-F) Few representative tree speices used for web portal

2.5Wood Products – Nil

2.5.1 Overview
- 2.5.1.1 Summary of the achievements under the Theme
- 2.5.1.2 Projects under the Theme (in table as given at 2.1.1.2)

2.5.2 Wood and other Lignocellulosic Composites
2.5.3 Wood Processing
2.5.4 Value Addition and Utilization
2.5.5 Wood Chemistry
2.5.6 Pulp and paper

2.6 Non-wood and Forest Products (NWFPs)

2.6.1 Overview

Jatropha curcas, also known as physic nut, is unique among biofuels. Although oil can be extracted from over 80 known plant species, jatropha is currently the first choice for biodiesel. What makes Jatropha attractive to India is that it is a drought-tolerant and can grow in saline, marginal and degraded soil

requiring little water and maintenance. Considering vast semi-wild distribution of *J. curcus* in different parts of India, this plant is expected to have considerable genetic variation. Variability studies, which provide the basic information required for genetic improvement of species, are of paramount importance. Sufficient information on such aspect is lacking for this species in spite of its many uses.

In the present study, a total of 161 sources of *J. curcas* representing the promising Jatropha-growing belt of India, were screened and evaluated. The objective of the study was to understand the magnitude of genetic variation in growth, behaviour and adaptability in arid part of India to identify the best sources to be utilized for reforestation and future genetic improvement work.

Commiphora wightii (Arn.) Bhandari belongs to family Burseraceae is commonly known, as Guggal is one of the threatened species, which is becoming rare day by day due to human impact on forests including over exploitation, unscientific tapping for oleo-gum resin production and increasing biotic interference in he forests. Germplasm collection studies have been initiated earlier. However, earlier studies have not been scientifically explored and at present they do not have any known proven source accessions. However, other studies on germplasm collection and evaluation is lacking in India. Moreover, their collections were based on seed origin. For effective conservation of a species, it is essential to understand the extent and pattern of variability in natural populations caused genetically or by environmental factors. High variations in natural populations provide buffering potential as well as phenotypic stability (homeostatic) of the individual against unpredictable environments. The study of genetic variability and interrelationship of characters may lead to effective selection of plants most suited to arid environment. In our studies, attempts have been made to collect and test their performance on clonal basis so that they can represent true nature of mother plant. Clonal propagation techniques have been developed earlier, but it needs scientific statistical refinement. Present studies deal with the standardization of clonal propagation technique and performance of germplasm collected from all guggal growing areas of Rajasthan under arid environment. The work reported herein under All India Coordinated projects with different National Research Institutes and Universities. and funded by CSIR, New Delhi, DBT, New Delhi and NMPB, New Delhi.

2.6.1.1 Summary of the achievements under the Theme

- In rehabilitation of salt affected area fertilizer treatments significantly (p-0-00) influenced the fruit yield as there was no fruit setting in control in *S. persica* during the above average (532 mm) monsoon year and treatments with Potassium recorded maximum fruit yield. Whereas deficient monsoon (212 mm in 2009), $ZnSO_4$ promoted fruit yield.

- In *Acacia ampliceps* during good monsoon favoured a high pod yield with fertilizer application, 1.32 Kg (control) to 14.66 Kg (FYM + Urea) while there was no pod setting (in the year 2009) due to failed monsoon.

- In salt affected land, soil structures helped in the establishment of non salt tolerant grass and slopy soil structure was the best for leaching out the salt.

- To determine the nutritional content in lesser non NTFP, field survey was carried to locate and collect the plant material of *Cordia gharaf (*fruits) , *Cassia tora* (leaves), *Ceropegia bulbosa*

(tubers), *Haloxylon salicornicum* (seeds) and *Grewia tenax* (fruits) from Jodhpur, Pali, Udaipur, Phalodi, Dungarpur, Barmer and collected plant material.

- On the basis of multilocational clonal trials 14 accessions of *Jatropha curcas* and in progeny trials, 5 CPTs have been identified.

- Two seed yield equations have been developed in *Jatropha curcus.*

- Protocols for seed germination and vegetative propagation by micro-cuttings were standardized *in Commiphora wightii.*

- Developed technology of ethephone based non-destructive gum-resin harvesting in *Commiphora wightii*. Precise holes of measured size with increment borer and application of low doses of ethophan helped in checking the casualties.

- Information on 7 TBS (Tree Born oil Seed) species wre collected in prescribed format from biofuel authority of Rajasthan.

- In agritrial, interaction of irrigation and fertilizer does not showed any significant effect on growth performance of *Jatropha* after 61- month of planting.

2.6.1.2 Projects under the Theme (in table as given at 2.1.1.2)

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	2	0	1
Externally Aided	0	4	0

2.6.2 Resource Development of NWFPs

ICFRE PLAN CONCLUDED PROJECTS

Project-1: Effect of fertilizer application on growth and yield of 10 years old *Salvadora persica* and *Acacia ampliceps* plantations under silvipastoral system on arid salt affected soil (AFRI-89/NWFPD/2008-12).

Principal Invetigator : Dr. Ranjana Arya, Scientist E

Field trials were laid of *Salvadora persica and Acacia ampliceps* in 1997 and 1998 on saline alkali sandy soil in Jodhpur. For *S. persica,* 13 treatments viz; 1.Control, 2. FYM (10 Kg/plant), 3.FYM + Urea (500 g N), 4. FYM + $ZnSO_4$ (25 kg/ha), 5. FYM + K_2SO_4(50 g K_2O), 6. FYM + SSP (500 g P), 7. FYM + Urea

+ $ZnSO_4$, 8. FYM + Urea + K_2SO_4 , 9. FYM + Urea + SSP, 10. FYM + $ZnSO_4$ + K_2SO_4 , 11. FYM + $ZnSO_4$ + SSP, 12.FYM + K_2SO_4 + SSP and 13. FYM + K_2SO_4 + SSP + Urea + $ZnSO_4$ and in case of *Acacia ampliceps* ten treatments viz. 1.Control, 2. FYM (10 Kg/plant), 3. Urea (500 g N), 4. SSP (500 g P), 5. $ZnSO_4$ (25kg/ha), 6. K_2SO_4 (50 g K_2O), 7. FYM + Urea, 8. FYM + $ZnSO_4$, 9. FYM + K_2SO_4 , and 10. FYM + SSP were applied in Jan., 2009 to study the effect of fertilizer on growth and yield.

***Salvadora persica* trial**

In the above average monsoon (562 mm) year, the fruit yield ranges from 1.24 kg (T12- FYM + K2SO4 + SSP) to nil in contol treatment in ***Salvadora persica*** in 2010. Treatments significantly (p-0-00) influenced the fruit yield as there was no fruit setting in control. T_{12}) was the best treatment recording maximum overall fruit yield of 1.25 kg (207 g/tree), closely followed by T_{13}- 1.20 kg (240 g/tree) and T_8 - 1.10 kg (353g/tree), respectively indicating the positive influence of Potassium on fruit yield in a salty soil. Fruit yield in other treatments ranged from 64 g to 1.04 kg. During 2009 with deficient monsoon (212 mm) use of $ZnSO_4$ promoted fruit yield

On phenological observations in 2011-12, two times flowering and fruiting observed. The flowering was initiated in the month of Nov., 2011 and small seedless fruits were formed in 100% trees. However, they were aborted. Second fresh flowering was initiated in January, 2012. A total of 85.5% tree flowered and fruit setting took place in March, 2012 which was late as compared to 2011. While, multicoloured fruits were observed in most of the plants, whereas, only white fruits were observed in six plants. Annual growth data for the year 2011 showed that the incremental grwoth of height and crown ranges from 5.2 to 13.2 cm and 6.4 to 13.0 cm, respectively in different treatments.

Fig 41. Seedless fruits of *S. persica*

Fig 42. Fruits of different colour of *S. persica*

Fig 43. Normal fruits of *S. persica*

Fig 44. Fruits in different colour of *S. persica*

Acacia ampliceps trial

In year 2010, very good monsoon facilitated a high pod yield, 1.32 Kg (control) to 14.66 Kg (FYM + Urea) treatment in *A. ampliceps* trial, while there was no pod setting in the year 2009 due to failed monsoon. In this trial, maximum seed yield recorded was 2.13 kg in T4 (SSP) treatment and minimum 0.05kg in control. Treatments influenced pod/seed yield. Maximum 14.2kg pod yield was recorded in T_7 treatment where pod setting was observed in 90% trees, followed by T4 treatment (9.36kg pod yield in 88% trees) and T5 (6.0 kg pod yield in 50% trees). Zn influenced seed size and no of seed/g were 45 in T5 treatment as compared to 54 & 56 in T7 and T4 treatment, respectively while overall seed yield per tree was same 31-32 in all the three treatments.

Grass trial

Field trial was laid with two grass species *Cenchrus ciliaris* and *Sporobolus diander* on three soil structures, i) raised platform, ii) raised bund and iii) control in 2009.

In year 2011, soil structures influenced the dry grass yield; it was 313.1 and 285.9 g/m^2 for the platform and slope soil structures, respectively as compared to control 234g/m^2 for *S. diander*. Grass height ranged from 85- 107cm, no of clumps/m2 were 17-30, mean no of tillers /clumps were 48.5 – 71 in different treatments.

In case of *C ciliaris*, slope was the best structure which favoured 130.3 g/m^2 yield, followed by plateform 130.3 g/m^2 and minimum in control 61.7 g/m^2. Grass height ranged from 36- 110 cm, no of 5.7-13 clump/m^2, mean no of tillers /clumps 15.5 – 21 in different treatments. Thus, it is concluded that soil structures showed positive effect on leaching and its helped in establishment of non salt tolerant grass on saline soil.

Fig 45. *C. ciliaris* on raised Platform

Fig 46. *C. ciliaris* on raised Slope

Fig 47. *C. ciliaris*- Control

2.6.3 Sustainable Harvesting and Management

Nil

2.6.4 Chemistry of NWFPs, Value Addition and Utilization

ICFRE PLAN NEW PROJECTS INITIATED

Project-2: Tapping the potential of some selected indigenous lesser known wild edible plants for food

and nutrition in arid and semi arid regions (AFRI-113/NWFP/2011-2014).

Principal Investigator: Dr. Mala Rathore, Scientist D

To determine the nutritional content of some selected important wild food plants and to explore the possibility of developing value added products from lesser known species, field survey was carried out for availability of various samples in Jodhpur, Pali, Udaipur, Phalodi, Dungarpur, Barmer & Bikaner districts. BSI, JNV University, local people and forest officials were also contacted. *Cordia gharaf* fruits were collected from Jodhpur area and fruit pulp and seeds were separated. Moisture content, seed dimensions (seed index = 26.45) & seed: pulp ratios (1:4) were determined. Samples of *Cassia tora* were collected from Pali from three areas; Phalna, Bali and Kheda. Samples were shade dried and physical parameters of leaf & pods viz; length x width (4.08 x2.28cm – leaves and 19.54 x 2.76 cm-pods, Pali), weight, moisture content were recorded. Bhopalgarh area of Jodhpur was surveyed for *Ceropegia bulbosa*. Few samples of *C. bulbosa* were obtained from Kheda (Pali). The weight, length x width (2.82 x 2.32 cm - small; 4.6 x1.4 long) of leaves and tubers (2.8 x1.6 cm of Udaipur region) were recorded. Few tubers were sown in polybags for germination. *Haloxylon salicornicum* seeds were collected from Phalodi area. Samples were dried in shade and moisture content was determined. *Grewia tenax* fruits were collected from Kailana, Jodhpur. Nutrient analysis wrok has been initiated.

2.6.5 Biofuels and Bioenergy

EXTERNALLY AIDED ONGOING PROJECTS

Project-3: Establishment of multilocational clonal trial and seedling seed orchard of *Jatropha curcas* (AFRI-81/JU/SILV/DBT/2007-12).

Principle Investigator: Dr. D.K. Mishra, Scientist E

Two multilocational clonal field trials have been established at Haldughati, Udaipur. The first trial was established in the month of November, 2007 with 12 accessions and the second clonal trial was established with 8 accessions in the month of September, 2008 in RBD with four replications. Seedling seed orchards in Randomized Block Design (RBD) with 5 replications were established at Arid Forest Research Institute, Jodhpur and 15 replications at Haldughati, Udaipur. Percent survival in trial 1 varied from 08 to 42 percent. Highest value of mean plant height, number of branches and collar diameter was observed 124.24 cm in TERI/DBT/Jat/04-05, 4.33 and 5.30 cm in SDHQ4N4. While, lowest value of mean plant height, number of branches and collar diameter was observed in accession BTP-K (96.92 cm), 1.50 and 2.67 cm in TERI/DBT-Jat/06/16, respectively after 52 months of growth period. Data were non- significant for plant number of branches height and collar diameter.

In clonal trial 2, percent age survival varied from 0 to 13.89. Maximum value of mean plant height and collar diameter was 103.75cm and 4.32cm in NBRI-JA-9, whereas, maximum numbers of branches were 4.50 in J-2. However, minimum value of plant height was 41.67cm in HS-44, number of branches were 2.00 in both accessions i.e. HS-44 and NBRI-JA-139 and collar diameter 2.14cm in HS-44. Data were non-significant for all the three parameter.

At AFRI, Jodhpur site, percent survival varied from 0 to 100 percent in SSO. The accession TERI/DBT-JATROPHA/07/05-06/14 showed maximum plant height 340.00cm and collar diameter 11.39cm, whereas number of branches was 7.50 in accession J-110. Minimum plant height 142.50cm and collar diameter 3.45cm was observed in accession TERI/DBT-JATROPHA/05/85 whereas, minimum number of branches was 4.00 in five accessions (TERI/DBT-JATROPHA/04/03,TERI/DBT-JATROPHA/04/05-06/04,TERI/DBT-JATROPHA/04/19, TERI / DBT/ JATROPHA/01/05-06/02, and TERI/DBT-JATROPHA/05/26).

At Haldughati, Udaipur site, percent survival varied from 13 to 73 percent. Maximum plant height, number of branches and collar diameter were observed as 211.67cm, 5.20 and 6.61 cm in accession TERI/DBT-JATROPHA/04/16, TERI/DBT/JATROPHA/01/05-06/24, and TERI/ DBT-JATROPHA/ 07/05-06/38, respectively. Minimum plant height was showed by accession TERI/DBT-JATROPHA/05/26 (81.25cm). While, minimum number of branches were 1.50 in accession TERI/DBT-JATROPHA/07/05-06/30 and collar diameter 2.78cm in accession TERI/DBT-JATROPHA/04/31. Plantation at AFRI, Jodhpur site performed better than at Haldughati, Udaipur in term of growth parameter, however accessions planted at Udaipur site showed better survival than Jodhpur site. Data were non- significant. In half-sib trial, survival after 33 months of plantation varied from 0 to 46.67 percent. Maximum average plant height, number of branches and collar diameter observed were 226.25cm, 7.75and 4.55cm in accession MSSRF-62, respectively. Accession HAB-GARWAL showed lowest value of plant height (99.44cm), number of branches and collar diameter (1.94cm). The data was non-significant for all parameters.

Project-4: Genetic improvement of *Jatropha curcas* for adaptability and oil yield (AFRI-66/JU/Silvi/ CSIR/2005-12).

Principle Investigator: Dr. D.K. Mishra, Scientist E

Performance of 18 selected elite accessions under arid conditions after 72 months of growth period indicated that survival varied from 6.25 to 75.00 percent. Overall mean plant height, number of branches and collar diameter varied from 165.00 to 250.00cm, 3.00 to 5.50 and 4.68 to 9.48 cm, respectively. Seed yield ranged from no seed to 660.00g per plant. Percent survival in accessions of CRIDA varied from 31.25-75.00 percent. In accessions of CRIDA mean plant height, number of branches and collar diameter varied from 182.69-218.33cm, 4.00-4.75 and 6.38-7.30cm, respectively. Maximum plant height and collar diameter was observed in CRIDA-MP-Jhabua-02-03-JJ-06, while number of branches in CRIDA-AP-Adila-0904-JL-06. In CRIDA sources, only one accession CRIDA-MP-Jhabua-02-03-JJ-06 produced fruits and seed was 740.0g per plant. Performance of 63 native accessions after 65 months of growth period under arid conditions ranged from 33.33 to 100 percent, where as, average plant height, number of branches and collar diameter from 165.0 to 305.0cm, 2.00 to 5.00 and 3.77 to 12.68cm, respectively. Seed production varied from nil to 340.0g per plant.

On the basis of across site performance, 14 accessions have been selected. The percent survival varied from 12.50 to 50.00 percent in elite accessions and 33 to 66 percent in native accessions. Mean plant height, number of branches and collar diameter ranged from 150.0 cm to 230.0 cm, 32.0 to 86.00 and 5.25 cm to 7.60 cm, respectively in elite accessions. In native accessions, mean plant height, number of branches and collar diameter ranged from 177.50cm to 290.0cm, 37.50 to 165.0 and 6.96cm to 10.63cm, respectively. No fruiting was observed in elite and native accessions.

In spacing trial, after 56-months of planting, percent survival varied from 13.75percent in (2x2) to 38.75 percent in (3x3). Maximum mean plant height was observed 218.79cm in 2.5x2.5 spacing treatment, while number of branches and collar diameter was maximum 51.58 in 2.5x2.5 and 6.99cm in 3x3 spacing. Minimum plant height, number of branches and collar diameter was observed 192.00cm, 27.60 in 2x2 and 6.75cm in 2.5x2.5 spacing. Only one treatment seeded this year 86.4g per plant in 3x3 spacing.

From the result of main plot analysis (irrigation effect), average plant height was **230.00**cm in treatment I_0 and varied up to **245.52**cm in I_1. Maximum number of branches and collar diameter was observed **85.02** and **10.19**cm in I_3, respectively, while these were noticed minimum **50.54** and **8.09**cm in control. Three irrigation treatments were seeded this year except control and I_1, which was ranged from 40.10g per plant in I_2 to74.2g per plant in I_3 treatment. Plant growth performance was not significantly affected by irrigation.

From sub-plot analysis (effect of fertilizer) result revealed that mean plant height ranged from **227.01**cm in F_1 to **246.56**cm in F_2. The mean number of branches and collar diameter was observed maximum **80.83** & **10.12**cm in F_2 and minimum **57.47** & **8.25**cm in $F_1$and control, respectively. Three fertilizer treatments were seeded this year except control, which ranged from 3.2g in F_1 to 32.10g in F_2 treatment. Plant growth performance was not significantly affected by fertilizer. Interaction of irrigation and fertilizer does not showed any significant effect on growth performance of *Jatropha* after 61- month of planting.

In pollarding trial, performance of all the treatments was recorded after 49 months of imposing treatment. Percent survival varied from 24 percent (except control) to 32 percent in (T_0). The mean plant height and collar diameter ranged 171.75cm (T_2) to 216.13cm (T_3) and 6.71cm (T_0) to 7.97cm (T_2), respectively. Whereas, the mean number of branches ranged from 16.34 in control (T_3) to. 30.70 in (T_0). In pollarding trial, fruiting was observed in control and T_2 treatments during 2011-12. Analysis of variance suggested that effect of pruning is non -significant on all parameters of plant growth after 56 months months of planting.

Project-5: Network research project on guggal *Commiphora wightii* Arn. Bhandari (AFRI-76/Silvi/ NMPB/2008-13).

Principle Investigator: Dr. D.K. Mishra, Scientist E

Component I

The clonal performance trial was established in RBD design with 4 replications and each replication has 8 plants per accession in September, 2007. The trial is 53-months old and survival varied from 44% of Jalore to 100% of Jaipur, followed by 94% of (Barmer, Bikaner and Dausa). Mean Plant height varied from 120.14cm of Bharatpur to 205.22cm of Tonk, mean crown diameter from varied 114.64cm in Jalore to 203.9cm in Sikar source, nearly followed by 193.5cm of Tonk source and mean number of branches ranged from 4.1in Bhratpur to 7.6 in Jhunjhunu source. The data were significant for all the growth parameters at <0.01 probability level.

The main effects of various irrigation (I_1, I_2, I_3; 30, 45, 60 days) and fertilizer treatments (F_0 = No organic manure (FYM), F_1 = 2kg/pit, F_2 = 5kg/pit, F_3 = Urea 50g pit (46% Nitrogen), F_4 = SSP 50 g pit (20%

Phosphorus), F_5 = 5kg FYM+ Urea 50g/plant, F_6 = 5kgFYM+ SSP 50g/plant, and F_7 = Urea + SSP (50g each) applied. In agri-trial of *Commiphora,* after 52 months of planting in the field on mean plant height (cm), number of branches and crown diameter (cm) ranged from 192.69cm in I_3 to 208.69cm in I_1, 4.46 in I_1 to 5.05 in I_3 and 168.96cm in I_1 to 174.08cm in I_3, respectively. The analysis of variance showed that irrigation intervals had high significant effect on mean plant height and number of branche, whereas crown diameter was not affected by irrigation.

Fertilizer showed significant effect on *Commiphora wightii* plants. The mean height, number of branches and crown diameter varied from 192.2cm in F_7 to 215.8cm in F_2, 4.2 in F_1 to 6.6 in F_7 and 169.9cm in F_5, nearly followed by F_1 (167.6cm) to 188.2cm in F_2, respectively. Analysis of variance revealed that effect of fertilizer on plant growth with respect to number of branches was highly-significant, whereas plant height and crown diameter were significantly affected by fertilizer response.

Component II

To develop methodology for enhanced/non-destructive gum production

Component Principal Investigator: Dr. Ranjana Arya, Scientist-E

Tapping experiments were initiated in last week of March, 2011 in all the plants including those which were tapped twice earlier (in the year 2008 and 2009) with varying ethephon doses (C_0, C_1-175 and C_2-225 mg) and irrigation I (I_0 no irrigation, I_1-60 lit./plant; two days before tapping in both the ethephone doses). The first collection of gum was done after 7-15 days. Subsequent gum was collected after ten days to thirty days till May, 2011. Irrigation adversely influenced the gum yield in both the ethephone doses. Control recorded the least (25.13g) and C_2Io treatment yielded the highest (153.82 g) gum.

The total gum yield in different treatments was as C_0 - 25.13 g (range 4.62-12.59g), C_1Io (175mg) -59.54g (range 11.36-27.98g), C_1I_1 (175 mg)- 36.53g (range 5.96-16.35 g), C_2Io (225mg)- 153.82g (33.63-65.19g) and C_2I_1 (225 mg)- 50.73g (12.77-22.65g). Though the trees were tapped third time so far (12 months after third tapping) there was no casualty in any treatment.

All the three experimental trials were maintained in Kumatia enclosure, Kailana Forest Area, Jodhpur. Protection measures (application of termiticide and fungicide) were applied in August, September and December, 2011. Growth data (Height, crown and collar diameter) were recorded in Oct- Nov, 2011. While the control plants has minimum mean height 215.0 cm, crown diameter, 265.0 cm and collar diameter 13.5 cm **C_2I_0(225mg ethaphone)** treatment recorded maximum height 323.3 crown diameter 356.66 cm and collar diameter 18.06 cm, having 3-10 number of branches/plant . The incremental height, crown and collar diameter ranges from 8.91 to 21.11%, 6.31 to 11.17% and 3.72 to 8.96%, respectively, in different treatments.

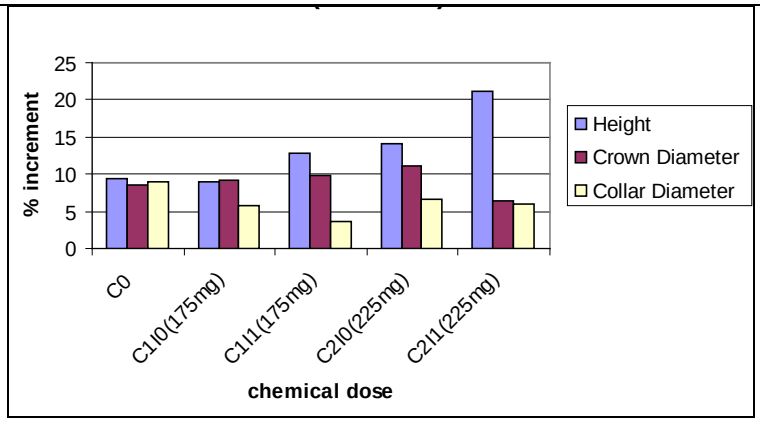


Fig 48. Percent increment of growth parameters (year 2011)

Data showed (Fig 48) that on the same dose of ethephon, irrigated plants has higher height increment as compared to un-irrigated plants. In case of collar diameter, the trend is reverse in which un-irrigated plants showed higher increment on the same dose. In crown increment, the effect of irrigation is not visible.

Soil analysis of plant pit samples collected in summer 2011 after cessation of gum exudation has been carried out. The ranges of per cent moisture were (0.25 to 1.22%), pH (7.31 to 8.32), EC (0.254 to 0.722 $dSm^{-1)}$), % SOC (0.119 to 0.973 %) and phosphorus (0.22 to 2.26 ppm).

Thin branches were collected to analyze secondary metabolites in the month of November, 2011. Percent moisture in thinner branches (post ethephone treated plants) was ranging from 62.55 in treated plants to 68.66 % in control. In experiment-2, Pre-ethephon solvent extractions with petroleum ether, ethyl acetate and acetone extracts were 1.52 to 1.86%, 1.02 to 1.38% and 0.71 to 0.94%, respectively. The thinner branches (post ethephon -2010) were collected after second consecutive gum extraction and pulverized. The powdered material was extracted with petroleum ether ($60\text{-}80^{o}$), ethyl acetate and acetone, successively. The mean values showed that maximum per cent extractives were obtained with petroleum ether. It was maximum in control (2.89 %), followed by 2.36 to 2.76 % for different doses of ethephon. In case of ethyl acetate, the pattern was reverse, minimum per cent extractives obtained in control (1.56%) while, maximum 1.62 to 2.12% in different doses of ethephon. Similarly, in acetone, 1.35 per cent in control, followed by 1.38 to 1.51% in different doses of ethephon. Indicating that extractives yield is increasing in treated plants as compared to control. It is also reported that Guggulsterone comes in ethyl acetate fraction.

Phenological observations were recorded on monthly basis for all the plants in experiment viz; 1, 2 and 3. Plants were lush green after rains in monsoon with occasional fruiting. Leaf started yellowing in early October and all the plants were completely leafless in late October, 2011 with flowering and sporadic fruiting. Fruits were collected in Dec, 2011 and it was found that untreated plants recorded 130 fruits/20 g as compared to 144 fruits/20 g in treated plants.

Project-6: Development of a database on tree-borne oilseeds (TBO) in India (Funded by NOVOD Board through ICFRE).

Principle Investigator: Dr. Sunil Kumar, Scientist E

In order to estimate of state wise acreage of cultivation of seven Tree Borne oilseed species from Gujarat and Rajasthan, government Institutions viz; State Forest Department, Horticulture, Agriculture Departments, NGO etc. were contacted and data were collected. Under this study, information regarding seven mandatory Tree Borne Oilseed Species viz; Jatropha (*Jatropha curcas*), Karanja (*Paongamia*

pinnata), Neem (*Azadirachta indica*), Mahua (*Madhuca indica*), Mango kernel as feed, Jojoba (*Simmondsia chinesis*), Piloo (*Salvadora spp*.) falling in the jurisdiction of AFRI viz. Gujarat and Rajsthan were collected and summeraized. Bio-fuel authority of Rajasthan plantation data; targets and achievement for *Jatropha curcas* raising seedling raising and district wise progress of nursery raising from 2006-07 to 2010-11 were collected.

ICFRE PLAN CONCLUDED PROJECTS

Project-7: Survey, selection performance trial and estimation of yield potential of *Jatropha curcas* in Rajasthan and Gujarat (AFRI-88/JU/SILV/2007-12).

Principle Investigator: Dr. D.K. Mishra, Scientist E

Two progeny trials one with 5 replications at AFRI, Jodhpur and another with 15 replications at Haldughati, Udaipur having single plant per replicate in RBD with 30 CPTs were established in July, 2008. At AFRI, Jodhpur site, the survival varied from 40 to 100 percent. Maximum mean height, number of branches and collar diameter were observed as 268.33cm (in BK-499), 6.80 (in 86 AFRI-3) and 10.95cm (in CSMCRI-1), while, these were minimum 126.00cm, 3.60 and 4.66cm, respectively in EL-19 AFRI-17. At Haldughati, Udaipur site, percent survival varied from 20 to 67 percent. Plant height, number of branches and collar diameter were maximum 151.67cm, 5.33 and 6.36cm, respectively in 76 AFRI-2. Minimum plant height and collar diameter were 46.67cm and 1.83cm in (86 AFRI-3), respectively and number of branches was 1.75 in CSMCRI-3. The CPTs at AFRI, Jodhpur site only yielded fruit and seeds, whereas, at Haldughati, Udaipur no flowering/fruiting was observed. Analysis of variance showed that the number of branches was significant at 0.01 probability level in AFRI, Jodhpur trial, whereas remaining growth parameter were non-significant at both sites.

Development of seed yield equations. Carried out measurement in the two sample plots of *J. curcas* laid out at Motiya Research Farm, Rajpipla (Gujarat) during 2011-12. Total mean height, mean collar diameter and mean crown width varied from 2.65m to 3.06m, 14.61-15.78cm and 2.23 to 2.33m, respectively. Observation on the seed yield was also taken, which varied from 300.0g to 360.95g/plant. Regression could produce relationship between seed yield and height, and SY vs. CD. Two different relationships: one LN (SY) vs. 1/HT or 1/CD, other SY vs. HT or CD. Calculated estimated seed yield based on these equations. The equation which gives more close value to observed data may be considered. It is clear that CSMCRI clones are better as compared to SRT and BCR. They are having more height and seed yield as compared to SRT & BCR, though their age is only 5 years, while ART and BCR are of 7 years of age. Based on data recorded from two plots (5-7 years) at Motiya research farm during 2011-12 the yield equation developed is as follows:

LN(SY(1)= 6.614686-2.24806*1/HT
LNSY(2)=4.33385+22.36682*1/CD
SY(1)= 94.50689+69.33952*HT
SY(2)=821.4786-32.1123*CD

2.7 Forest Protection

2.7.1 Overview

Forest Protection deals with the studies on the insect – pests, diseases and on biofertilizers in arid and semiarid areas of Rajasthan and Gujarat. During past 20years various research projects on different aspects, pertaining to forest protection research were undertaken. The projects were funded by various agencies either ICFRE under plan funds or by external funding agencies such as World bank (FREE), Gujarat Biotechnology mission Gujarat, SFD Rajasthan & Gujarat and AFRS, Australia.

2.7.1.1 Summary of the achievements under the Theme

- Seeds of *Acacia nilotica, Ailanthus excelsa, Prosopis cineraria, Salvadora persica, Salvadora oleoides, Tectona grandis* and *Azadirachta indica* have been collected and further studies related to the identification of emerged insect pest and their incidence of attack were carried out. *Carydon serattus* was found to attack on *Acacia nilotica* seeds.

- After first round of treatment using combination of different chemicals, recovery of 25-35% was recorded as compared to control where there was no recovery in case of *Prosopis cineraria.*

- Four isolates of *Ganoderma lucidum* were collected from four places of western Rajasthan for pathogenecity test and effective control measurement.

- Rearing of different larval instars of *Acanthophorus serraticornis* on artificial diet/wood was observed.

- Identified nematode Bursaphelenchus sp. collected from the soil of infested *P.cinerarea* trees.

- Through Koch's postulate it was established that *B. theobrome* and *Acremonium* sp. caused canker in *Tecomella undulata*.

- The total protein content in infected seedling increased as the days of inoculation of the pathogen (*B. theobrome*) increased, i.e. concentration of protein was more after 90 days of inoculation as compared to after 15 days of infection.

- In composting the major litter decomposing mycoflora reported were; *Aspergillus niger, Aspergillus flavus, Trichoderma* sp, and *Fusarium* sp were isolated and identified.

- Anaerobic composting in pits by using Farm Yard Manure + Dried leaves + Niprovat (containing *Trichoderma viride*) with mulching has taken 120 days in winter season; it is due to slow microbial activity in low temperature.

- In association with *Acacia nilotica* and *Ailanthus excelsa,* important genera viz. *Acaulospora, Gigaspora, Glomus* and *Sclerocystis* were identified. Among these four genera, *Glomus* occurred most frequently.

- The different species of *Glomus* were recorded as *G. aggregatum, G. fasciculatum, G. mosseae, G. macrocarpum G. microcarpum* and *G. constrictum.* Out of which, *G. fasciculatum* was dominant

species in all the sites of nurseries as well as in plantations of *A. nilotica* & *A. excelsa.*

- The spore population was varied from site to site and ranged between 163 to 480 propagules per 100 gm soil from the rhizosphere of *Acacia nilotica* and 195 to 670 propagules per 100 gm from the rhizosphere soil of *Ailanthus excelsa.*

- Antifungal properties of selected plant parts (flower bud of *Datura stramonium*, leaf & root of Tribulus terrestris, root, flower and fruit of *Argemone mexicana*) were evaluated against fungal pathogens *Rhizoctonia solani, R.bataticola, Fusarium moniliforme, F. solani, Alternaria alternata.*

2.7.1.2 Projects under the Theme (in table as given at 2.1.1.2)

Projects	Completed Projects	Ongoing Projects	New Projects Initiated During the Year
Plan	0	4	1
Externally Aided	0	0	1

2.7.2 Insects pests, diseases and control

EXTERNALLY AIDED NEW PROJECT INITIATED

Project-1: Studies on seed insect pests of indigenous and exotic forest tree species and to develop IPM packages for major insect damages in Gujarat (AFRI-107/GCR/SFD-Guj./2011-2014).

Principal Investigator : Dr. Meeta Sharma, Research Officer

The project has been initiated during April, 2011, funded by Gujarat Forest Department. Some base data such as the seed production area, distribution of the plantation sites, have been collected from State Forest Department. The seed samples have been collected from the eight selected tree species recommended by Gujarat Forest Department to study the insect pest incidence. The different experimental sites have been selected as per discussion with Add. PCCF (Research) and CCF (Research) Gujarat Forest Department for the study. The sites selected for the seed collection of respective tree species are; - Nadiad social forestry division (*Acacia nilotica*), Mehsana social forestry division (*Ailanthus excelsa*), Palanpur (Banas Kantha division) (*Boswellia serrata*), Bhuj (Kutch), Sorastra, Jamnagar (*Prosopis cineraria, Salvadora persica, Salvadora oleoides*), Gandhinagar division (*Azadirachta indica*), Rajpipla, Valsad and Dang (*Tectona grandis)* and Rajkot (grass species). Seeds of *Acacia nilotica, Ailanthus excelsa, Prosopis cineraria, Salvadora persica, Salvadora oleoides, Tectona grandis and Azadirachta indica* have been collected and kept in laboratory for further studies related to the identification of emerged insect pest and their incidence of attack. The rearing of insects is being conducted in laboratory under control conditions.

Fig 49. Infested pods of *Acacia nilotica*

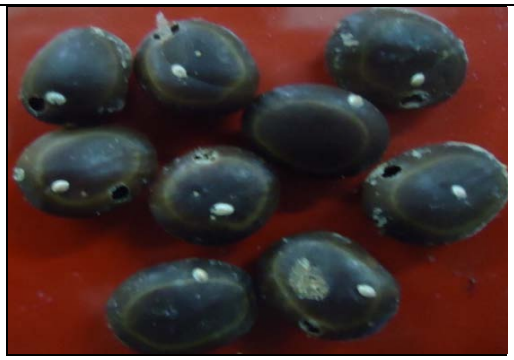


Fig 50. Infested seed of *Acacia nilotica*

ICFRE FUNDED ONGOING PROJECTS

Project-2: A Coordinated project on integrated management of Khejri mortality for socio-economic upliftment in Rajasthan (AFRI-1/FPD/2010-2014).

Principal Investigator: Dr. S.I. Ahmed, Scientist F

Component I : Forest Protection

Management of khejri mortality trials were laid out at six sites in five districts. These experimental sites include: 1) **Surani** (Balesar Road, Jodhpur), 2) **Raghunathpura** (Didwana in Nagaur), 3) **Jhareli** (Jayal in Nagaur), 4) **Goshala** (Fatehpur in Sikar), 5) **Churu** (Churu) and 6) **Sultana** (Jhunjhunu). The treatments comprised of; T-1=Bavistin (0.1%) + chloropyrophos (0.05%) + powermin @2ml/l and applied around two feet of trees trunk root treatment of 20 liter solution, T-2=20 g phorate granules at the base of the pit, covered with 8-10 inches layer of soil +50 g *Trichoderma* in talc mixed with 5 kg FYM, applied above the layer of phorate and another layer of soil over it, T-3= chlorpyriphos (20 EC) 15 ml + carbandazium (50 WP) 20 g + copper oxychloride (50 WP 40 g / tree. T-4= as control using soil work and drenching with 20 litres water /tree. First round of treatments were conducted during February-March, 2011 and data pertaining to infestation caused by pests/diseases was collected after six months of treatment to evaluate the effectiveness of different treatments in the various experimental sites. It was observed that the treated trees exhibited a significant effect on recovery ranging from 25 to 35% as compared to the control, wherein percentage of infected trees remained 100%. Observation was also recorded to study the impact of good rainfall during last two years on present scenario of Khejri mortality. A significant increase in foliage production in Khejri tree has been observed after good rains experienced since past two years, but the percentage of infestation caused by the root borer, *Acanthophorus serraticornis* and disease *Ganoderma lucidum*, in Khejri remained unchanged and found ranging between 90-100% of trees in the farmer's field. The second treatment was given during December, 2011 – January, 2012. The observations on the effect of second treatment will be recorded in June-July, 2012, six months after the treatment.

The biotic agents responsible for khejri mortality were identified as *Ganoderma lucidum* (a root rot fungus) and larvae of *Acanthophorus serraticornis* (a root boring insect). Annual, indiscriminate and frequent lopping practice and ploughing through tractors are also identified amongst some of the important contributing factors for acclerating severe stress to infected khejri trees. Freshly prepared cultures of *Ganoderma lucidum* and *Rhizoctonia bataticola* were inoculated in one and half years old seedlings of khejri for pathogenicity test. The pathogenicity tests of *Rhizoctonia bataticola* has been confirmed,

whereas, pathogenicity test of *Ganoderma lucidum* could not be established yet. *Trichoderma* as a bio-agent has been isolated and successfully multiplied in Sorghum seeds for further studies.

Bio-ecology of *Acanthophorus serraticornis* is being studied. Larvae of different instars were collected and brought to the laboratory for rearing purpose. The sizes of different age groups of larvae have been measured in order to establish the total number of larval instars. The life-cycle studies are being carried in the zinc cages, which have been provided by infested roots of the khejri trees. Experiment on modification of diet for rearing of *Acanthophorus serraticornis* by substitution of protein sources is in process. The artificial diet consists of different combinations of wheat flour, soy flour, jowar flour, Khejri saw dust, vitamins and other salts.

Soil from the infected tree and infected samples were sent to test for nematode infection to the Nematology Department at AMU, Aligarh and the presence of a pathogenic nematode *Bursaphalanchuss sp.* in the soil and infected bark which was collected near root zone have been confirmed.

Observations on the effect of mechanical ploughing on Khejri mortality

Observations were recorded from the orans, gochars, undulated terrains etc. and in mechanically ploughed farmers field in five districts (Nagaur, sikar, Jhunjunu, Jodhpur and Churu) in order to see the effect of mechanical ploughing on Khejri mortality. It has been recorded that no sign of natural regeneration was observed in the mechanically ploughed fields, whereas, new sprouts of Khejri were observed in almost all the blocks where in mechanical ploughing was not used. It indicates that regeneration is severely affected with the use of mechanical ploughing, though it does not have any direct impact on the tree mortality.

Impact of biotic stress on khejri mortality

Dead Khejri trees (20 trees/ locality) were examined randomly in each of the farmers field in all the five districts. Three dead trees at each location were randomly selected and uprooted to examine root borer/ disease infestation.Other dead trees were examined by removing the soil up to a depth of 0.5-1 m. Data obtained clearly indicates that all the infested Khejri trees were invariably infested with either root borer (*Acanthophorus serraticornis*) or root rot (*Ganoderma lucidum*).

Biochemical Studies

Survey for sample collection from disease resistant/identification of disease escape tree was undertaken in Jodhpur, Nagaur, Sikar, Churu, Jhunjhunu districts and Khejri pod samples were collected. The physical data of the fresh pods viz; moisture content, length, width, weight has been recorded. Fat analysis using soxhlet extractor was carried out for Rotu site. Variation in fat content was from 1.49% to 11.66% in shade dried samples. Methanol extractive yield was found to vary from 18.08% -39.76%. Fat and sugar content was less in infected trees and more in healthy trees whereas, phenol content was more in infected trees and less in healthy tree.

Ecological studies

Rainfall data was collected for the districts of Nagaur, Jhunjhunu and Sikar. Ground water table data (annual rainfall and water recharge) was collected of the districts of Barmer, Churu, Jhunjhunu, Jodhpur, Nagaur, Pali and Sikar, which demonstrate the annual status of amount of rainfall occurred and rainfall recharge in the ground for the years of 2007 to 2011.

Socio-Economic

There is a lack of information on socio-economic aspect of Khejri mortality, which is very essential to understand its impact and effect on crop productivity and livelihood of locals. The major impacts of Khejri mortality on the status of losses and reduction in the availability of fuel wood and fodder. The study area are; Nagour, Churu, Sikar, Jhunjhunu and Jodhpur of Rajasthan. Sample survey in Churu district was undertaken during the 2011. Eleven villages viz; Thailasar, Ramsara, Lakhau, Lohasanwada, Ratanpura, SingariBhadi, Jalkoi, Kasalasar, Dundnasar, Gogasar and Hariasar of Churu districts were surveyed and the 21 villages of Jodhpur and Nagour districts were surveyed to assess the economic losses due to khejri mortality. Thus, 45 villages were surveyed and interview of 250 head of households was carried out for assessing the economic loss from the widespread mortality of Khejri tree.

Extension Component

Pamphlet in Hindi & English on the "Problem of Khejri Mortality in North Western Rajasthan" and its management were published for raising awareness in public about Khejri mortality problem. In this pamphlet, problem of khejri mortality and recommendation for control and various factor affecting khejri tree were given in simple language. Total 5000 pamphlet were published for distribution among farmers and other stakeholders. These pamphlets were distributed to farmers/Forest staff/NGO during their institute visit. Besides this, some display boards related to Khejri mortality problem and its management were provided to the State Forest Department.

Project-3: Induction of systemic acquired resistance in rohida against stem canker (AFRI-100/FPD/2010-2013).

Principal Investigator: Dr. Sangeeta Singh, Scientist C

Six fungi had been isolated from the infected cankered stem of rohida. These were *Fusarium sp, Acremonium sp, Paecilomyces sp, Alternaria sp, Aspergillus sp, Botryodiploidia theobrome.* The pathogenecity studies were conducted on one and half year old rohida seedlings, singly and in combinations. Isolate no. 1 and isolate no 4 i.e. *Botryodiploidia theobrome* and *Acremonium* sps, respectively, produced same kind of symptom as produced on the infected stem from which they were isolated proving the pathogenecity. The symptoms were produced after 4 months of inoculation. Photosynthesis rate was calculated in healthy and disease seedlings using photosynthesis analyser in which change in the rate on carbon dioxide uptake was recorded. The result was compared with the healthy seedlings in which inoculation was done using sterilized water. Data were recorded at 15 days, 30days, 45 days 60 days and 90 days of inoculation. The results of photosynthesis are non-significant i.e. not much difference in healthy and inoculated seedlings. Biochemical studies of the inoculated and healthy seedlings to study change in concentration of protein, and other defense enzymes like; peroxidase, phenylalanine lyase and total phenolics are being analysed. Total protein has been studied and it was observed that there is increase in concentration of total protein as the number of days of inoculation increases, i.e. the concentration of protein after 90 days of inoculation (1.7 mg/litre) was approximately five times higher as compared to that of sample taken after 15 days of inoculation (0.35 mg/litre).

2.7.3 Mycorrhizae, rhizobia and other useful microbes

ICFRE PLAN NEW PROJECTS INITIATED

Project-4: Innovative approaches for augmentation of composting and biofertilizer production in hot arid regions (AFRI-111/FPD/2011-14).

Principal Investigator : Dr.K.K.Srivastava , Scientist-F

Litter decomposition mycoflora were isolated and cultured on potato dextrose medium (PDA) from different depth (5 cms, 10 cms, 20 cms, 30 cms and 45 cms) by dilution plate technique. The observations were taken regularly. The major mycoflora *i.e., Aspergillus niger, Aspergillus flavus, Trichoderma* sp, and *Fusarium* sp were isolated and identified. Unidentified bacterial colonies were also observed. The moisture content at different depth was recorded as 14.89%, 15.67%, 14.01%, 16.23% and 14.85%, respectively. Mass multiplication of indigenous consortium inoculum with dominancy of *Glomus fasciculatum* of AM fungi of *P. cineraia* (Khejri) , *Azadirachta indica* (Neem) and *Acacia nilotica* (babul) in pots have been prepared at AFRI Model Nursery, Jodhpur. Anaerobic composting in pits) by using Farm Yard Manure + Dried leaves + Niprovat (containing *Trichoderma viride*) with mulching was taken 120 days in winter season, it is due to slow microbial activity in low temperature. Identification and purification of litter decomposing fungi and bacteria are being done.

Fig 51. Anaerobic composting (FYM + Dried leaves + Niprovat (*T. viride)*)

Fig 52. Mulching with PVC sheet of anaerobic composting

Fig 53.VAM multiplication in beds

ICFRE PLAN ONGOING PROJECTS

Project-5: Evaluation and selection of efficient strains of AM fungi & *Rhizobium* for *Acacia nilotica* and *Ailanthus excelsa* in western Rajasthan (AFRI-103/FPD/2010-2013).

Principal Investigator: Dr. Neelam Verma, RO

Rhizosphere soil & root samples of *Acacia nilotica* and *Ailanthus excelsa* were collected from various forest nurseries *viz.*, Anupgarh shakha RD 237 Head (Ganganagar), Forest nursery at Madala ki Dhani,

Palsana (Sikar) & Gandhav Nursery (Barmer). In plantations, rhizosphere soil samples of *A. nilotica var. indica* were collected from various sites *viz;* Barmer (2), Ganganagar (5), Hanumangarh (5) and Sikar (5) district. For *A. nilotica var. cupressiformis* samples were collected from Ganganagar district (1) and samples of *Ailanthus excelsa* were collected from Barmer (2), Ganganagar (5), Hanumangarh (5) and Sikar (5) district. Soil samples were analyzed for pH, EC, (%) organic carbon (% OC) and phosphorous (P). The isolation of AM fungi was carried out by adopting wet sieving and decanting technique.

The important genera identified were; *Acaulospora, Gigaspora, Glomus and Sclerocystis.* Among these four genera, *Glomus* occurred most frequently. The different species of *Glomus* were recorded as *G. aggregatum, G. fasciculatum, G. mosseae, G. macrocarpum G. microcarpum* and *G. constrictum.* Out of which, *G. fasciculatum* was dominant species in all the sites of nurseries as well as in plantations. The spore population was varied from site to site and ranged between 163 to 480 propagules per 100 gm soil of *Acacia nilotica* and 195 to 670 propagules per 100 gm rhizosphere soil of *Ailanthus excelsa*.

Fig 54. ***Rhizobium nodules in roots of Acacia nilotica***

Fig 55. ***Glomus sp. collected from A. nilotica*** **from Barmer**

Fig 56. ***Acaulospora sp. collected from A. nilotic a*** **from Barmer**

Fig 57. ***Glomus sp.cCollected from A. nilotica*** **from Barmer**

Fig 58. ***Glomus sp. collected from A. nilotica*** **from Pali**

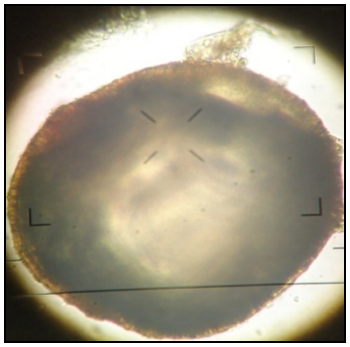


Fig 59. ***Gygaspora sp. collected from A. nilotica*** **from Barmer**

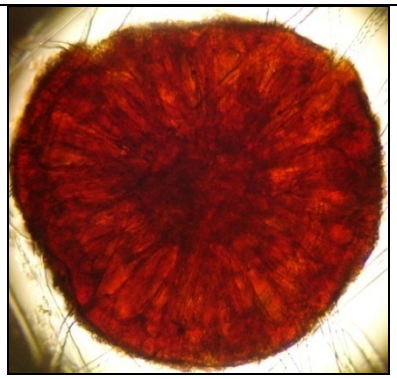


Fig 60. ***Sclerocystis sp. collected from A. nilotica*** **from Pali**

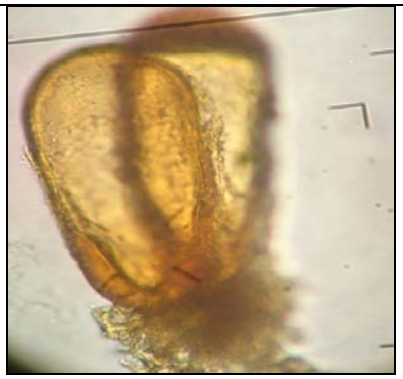


Fig 61. ***Sclerocystis sp. collected from A. nilotica*** **from Pali**

Fig 62. ***Sclerocystis sp. ollected from A. nilotica at Pali***

2.7.4 Weeds and Invasive species

ICFRE FUNDED ONGOING PROJECTS

Project-6: Evaluation of antifungal potential and identification of broad spectrum antifungal compound from selected tree/shrubs/weeds of Indian arid region (AFRI-93/AFED/2009-14).

Principal Investigator : Smt. Bhawana Sharma, Scientist C

Antifungal properties of selected plant parts were evaluated against fungal pathogen. Collection (flower bud of *Datura stramonium*, leaf & root of *Tribulus terrestris*, root, flower and fruit of *Argemone mexicana*) were carried out. The collected plant material were washed with distill water and dried in shade. A dried plant material was finely grinded. The powdered plant material of each plant was further extracted with respective solvents using soxhlet. Ethanolic extracts were dried with the help of rotary evaporator and water extracts were dried with the help of water bath. These two types of extracts were prepared aqueous and ethanolic from every plant, and evaluated against target fungi.

For Antifungal assay, pure culture of fungi have been collected from Plant Pathology Division of FRI Dehradun. These fungal pathogen were periodically sub-cultured and maintained on PDA medium and pure cultures are stored in refrigerator for further use. Antifungal activity of extract was determined by agar diffusion assay. PDA potato dextrose agar was used as the medium for anti fungal assay by well diffusion method. In petriplate, well of 6mm diameter was made and well were filled with a known concentration (50mg/ml) of extracts and kept in incubator at 28˚C temperature, the inhibition zones from the centre of the well was measured in millimeters and recorded.

After evaluating antifungal properties against five fungus, following results observed i) Alcoholic extract of *Argemone mexicana* root showed good antifungal activity against *Fusarium solani* ii) Aqueous and ethanolic extract of *Tribulus terrestris* leaves showed mild antifungal activity against selected fungi. iii) Alcoholic extract of *Datura stramonium* bud showed good antifungal activity against *Alternaria alternate*. iv) Alcoholic extract of *Datura stramonium* bud showed good antifungal activity against

Rhizoctonia solani.

Fig 63. Inhibition zone by alcoholic extract of *Argemone mexicana* root against *Fusarium solani*

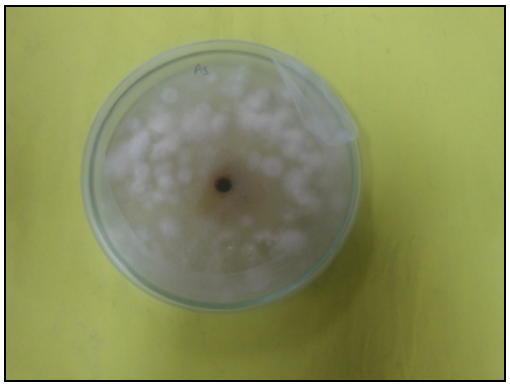


Fig 64. Inhibition zone by alcoholic extract of *Datura stramonium* flower bud against *Rhizoctonia solani*

2.7.5 Forest Fire and Grazing

Nil

3. Education Vistas/Activities

- A group of 25 students of Aravali Foundation, New Delhi visited laboratories, nursery and Interpretation Centre of AFRI on 25/4/11.
- A group of 29 women trainees from Jal Bhagirith foundation visited Nursery and AFRI Interpretation Centre on 20/5/11.
- Trainees Forest Guards (60) of State Forest Department, Jodhpur visited AFRI Laboratories, nursery, arboretum, interpretation centres and briefed them about research and trainings conducted by the AFRI by the Director and HODs on 27/5/11.
- A team of 23 trainees forest guard from FGTC, Udaipur visited AFRI nursery, on 27-7-2011.
- A group of 2o trainee of Jal Bhagirathi Foundation visited AFRI on 23-8-2011
- Eighteen students from Bachpan School, Jodhpur visited AFRI nursery on 18-8-11.
- Eighty students from class XII, Kendriya Vidhyalya no. 2, Army area, Jodhpur and five teachers visited institute, nursery, medicinal plant garden and Interpretation centre on 7 /9/11.
- A group of ten IFS officers, Haryanana Govt. visited Institute and the Director, AFRI briefed about AFRI activities. They also visited medicinal plant garden, nursery and Extension and Interpretation Centre, AFRI on October 18/9/11.
- Six members of Jal Bhagirathi Foundation, Jodhpur visited AFRI on 26-9-2011 and learned about developed technologies.

- Thirty participants of SLEM project training at AFRI Jodhpur visited Demo Village site, Salawas, medicinal plant garden, nursery, soil and water conservation and silvipastoral works at Demo village on 30th Sep, 2011.

- A group of 75 students and 19 teachers from Sainath Publick Scool, Milkman Colony, Jodhpur visited various labs, Hi-Tech nursery and extension and interpretation centre on Sep 30th, 2011 and medicinal plants garden.

- IFS probationers in two group (38 & 36 nos.) visited institute, and the Director, AFRI briefed about AFRI activities. They also visited extension and interpretation centre and Hi-Tech nursery, AFRI on 2nd and 3rd Oct, 2011.

- A group of 40 women farmers and 2 Agriculture Officers from Deputy Director (Extion), Zila Parishad, Jhalawar (Rajasthan) visited AFRI campus, medicinal plant garden, nursery and Extension and interpretation Centre on 23-11-11.

- A group of forty two forest guard trainees visited AFRI campus, Extension and interpretation Centre on 2nd Dec. 2011 during their visit lectures were also delivered.

- Forest officials (Two RFOs and Two Foresters) from Pinjore research circle Haryana State visited AFRI on two day Educational tour on 13-14 Dec,2011'. They were briefed about Salt affected land its afforestation work and visited the Gangani experimental area. Seed of *Accacia ampliceps* (1/2 kg) and *Colophospermum mopane* were given to them.

- B.Sc. Forestry students from Dr. Y. S. Parmar University of Horticulture & Forestry, Nauni Solan (Himachal Pradesh) visited institute, extension and interpretation centre, medicinal plant garden and nursery on 20/12/11.

- A group of 23 trainees foresters visited AFRI from Forest Training school, Pinjore, Haryana they also visited medicinal plant garden, nursery and Extension and interpretation Centre on 6/1/12 during their visit lectures were also delivered.

- A group of 51 B. Sc. (Forestry) students of University of Horticulture & Forestry, Solan (HP) visited institute and the Director, AFRI briefed about AFRI activities on 9/01/12. They also visited Extension and Interpretation Centre, medicinal plant garden and Hi-Tech nursery.

- A group 50 M. Sc. (Botany) students fromMahila Maha Vidhyalaya, Jodhpur visited institute on 13/01/12. They also visited Extension and Interpretation Centre and Hi-Tech nursery of AFRI.

- A group 16 M.Sc. Botany students & 4 Research Schloar from MLV Government College, Bilwara visited institute and the Director, AFRI briefed about AFRI activities on 19/01/12. They also visited Extension and Interpretation Centre and Hi-Tech nursery of AFRI.

- A group of 36 farmers from Jalore, Pali, Jodhpur and Naguar districts visited institute. The HOD, Agroforestry & Extension Division, AFRI briefed about AFRI activities on 20/01/12. They also visited Extension and Interpretation Centre, medicinal plant garden and Hi-Tech nursery, AFRI.

- A group of 49 trainees rangers from Forest Rangers College, Balaghat (MP) visited institute and the Director, AFRI briefed about AFRI activities on 20/01/12. They also visited Extension and Interpretation Centre, medicinal plant garden and Hi-Tech nursery.

- A group of 40 farmers from IWMP, Pindwara, Sirohi visited AFRI nursery and medicinal plant garden on 21/01/2012.

- A group of 38 forest guards of training institute Jodhpur visited AFRI nursery and medicinal plant garden on 21/01/2012.

- A group of 25 M. Sc. (Botany) students of Jai Narayan vyas University, Jodhpur along with two faculty member visited institute and the Director, AFRI briefed about AFRI activities on 30/01/12. They also visited Extension and Interpretation Centre, medicinal plant garden and Hi-Tech nursery, AFRI.

- A group of 24 B. Sc. (Forestry) students from Collage of Forestry, Sirsi, University of Agricultural Science, Dharwad (Karnataka) with faculty members visited institute on 01/02/12. They also visited Extension and Interpretation Centre, medicinal plant garden and Hi-Tech nursery.

- A group of 25 members of climate champion from the various regions of India visited AFRI. Director and Dr. G. Singh delivered lectures on climate change and AFRI research activities. They also visited medicinal plant garden and model nursery on 04/02/12.

- Sanjay Beniwal project scientist Jal Bagirathi foundation Jodhpur, along with 20 farmers visited nursery on28/02/12 .

- DFO training Jodhpur along with 35 forest guard of Maru training centre Jodhpur visited medicinal plant garden and nursery on 14/03/12.

- Director Press information Beuro (PIB) Ganktok (Sikkim), along with 4 members visited AFRI and nursery on 15/03/12.

- DFO training Jodhpur along with 35 trainees forest guard visited nursery on 21/03/12.

- A group of 31 Forest Range Officers (trainees) along with Shri N. V. Singh CCF, Director UFTA and Shri D. C. Mishra Course Director visited institute and the Director, AFRI briefed about AFRI activities 19/03/12. They also visited Extension and Interpretation Centre and Hi-Tech nursery, AFRI.

3.1 FRI University (Applicable for FRI, Dehradun only)

3.2 Trainings Organized

- Organized two weeks vocational training programme for the school students on Natural resource management in collaboration with Aravalli Foundation on May 15th-30th, 2011, at AFRI, Jodhpur.

- Organized summer training on the forest biotechnology for the M.Sc. biotechnology students from June 2nd to 15th, 2011.

- Organized one week compulsory training for the IFS officers on the Sustainable development of fragile desert ecosystem from Dec. 19th to 23rd, 2011.

- Organized training programme on conserving natural resources for sustainable development of dry area, organized under SLEM project by the AFRI, during September 27th & 28th, 2011.

- Organizing two days trainings on "Conserving natural resources for sustainable development is dry areas "under sustainable land & Ecosystem management (SLEM) on 22-23rd Feb. 2012, for NGOs, Forest officials, farmer & field functionaries.

- Organized one day training on *Jatropha* cultivation practices and its uses on March, 16th, 2012 at Village Gomati Chauraha, on March, 22nd, 2012 at village Dhilodia and on March, 23rd 2012 at village Sundercha in Rajsamand district. In each programme, 50 farmers were imparted training.

- Organized one week training programme on Geo-informatics application: Watershade, MGNREGA, in collaboration with National Institute of Rural Development, Jaipur from March 12-16th, 2012.

- **VVK training in Rajasthan:**

Three days VVK training was organized at Kishan Bhawan, Sriganganagar (Rajasthan) from 14th to 16th Nov, 2011. The total 67 participants (51 forest staffs and 16 farmers) participated in training. Training was imparted on Tree improvement programme, economic benefits of agroforestry, improved techniques for agri-horti system for higher production, water conservation and arid ecosystem, water management techniques, JFM and VAM/biofertilizer multiplication techniques and plant diseases and its management. Training were organized in both, lecture and field demonstration manner

Fig 65. VVK training inaugurated by Shri A,S. Guru, CCF, Bikaner at Kishan Bhawan, Sriganganagar on 14th Nov, 2011

Fig 66. Trainees of VVK visit at Kinnow (Mandarin species) cultivation at RAU, Sriganganagar on 15th Nov, 2011

- **VVK training in Gujarat:**

Three days VVK training was organized at Sinh Sadan, Sasan Gir, Junagadh (Gujarat) from 17th to 19th Oct, 2011. The total 65 person (30 forest staffs and 35 farmers) participated in training. Training was imparted on man-wildlife interface in Gir forest area, economic benefits of agroforestry, important grasses and its management in silvipastural for fodder production, nursery techniques, people sensitization techniques, JFM and advances in forestry sector and composting techniques. Training was organized in both, lecture and field demonstration way.

Fig 67. VVK training inaugurated by Shri R.L. Meena, CCF (WL), at Sinh Sadan, Sasan Gir on 17th Oct 2011

Fig 68. VVK trainees visit to shelter belt plantation at Adari Village, Beraval, Junagadh on 18th Oct 2011

- **VVK training in DNH:**

Van Vighyan Kendra was inaugurated by Shri S. K. Agarwal, CCF, Forest Department, Dadra & Nagar Haveli, and Daman, UT. Two days VVK training was organized at Khanvel, Silvasa, UT, DNH from 24th to 25th Jan, 2012. The total 30 persons (15 forest staffs and 15farmers) were attended training programme. They imparted training about nursery techniques, economic benefits of agroforestry and soil & water conservation techniques. Training was organized in both, lecture and demonstration manner.

Fig 69. Shri S. K. Agarwal, CCF, Forest Department, Dadra & Nagar Haveli, and Daman, UT inaugurated VVK training at Khanvela, Siulvasa on 24th Jan, 2012.

Fig 70. VVK trainees to Rudhana nursery, Khanvel, Silvasa on 25th Jan, 2012.

- **Training under Demo Village:**

Two days Demo village training was organized at AFRI, Jodhpur from 26th to 27th Dec, 2011. The total 43 persons (23 forest staffs and 20 farmers) attended training. Imparted training about planting stock improvement, economic benefits of agroforestry, soil & water conservation techniques, silvi-pastoral management and nursery techniques. Training was organized in both lecture and field demonstration manner.

Fig 71. Demo training inaugurated by Shri I. A. Mughal, CF, Jodhpur at AFRI, Jodhpur on 26th Dec, 2011

Fig 72. Visit of trainee at Demo site Salawas on 27th Dec, 2011 as a part of field visit

3.3 Visits Abroad

Dr. T.S. Rathore, Director along with Dr. R.K. Mittal, ADG (Educ.), ICAR, New Delhi at Dr. Madan Mohan, ADG (Marine & Fisheries), ICAR, New Delhi, attended and participated in 2nd meeting of ASEAN- India working group on Agriculture and Forestry held at Palembang, South Sumatra, Indonesia from March 6-8th 2012,

3.4 Participation in Seminars/Symposia/ Workshops/Trainings

- Dr. G. Singh participated in a workshop on "Identification of the landscapes/eco-systems for interventions under the Green India Mission" during 28-29 April 2011 at New Delhi.
- Dr. G. Singh participated in a consultative meeting cum workshop on Base line study, communication strategy and Monitoring & Evaluation of SLEM Programme at ICFRE, Dehradun on 10-11 May 2011, organized by Technical Facilitation Office, SLEM Project, Directorate of Extension, ICFRE.
- Dr. G. Singh participated in a one day workshop on Defining the methodology for Vulnerability and Risk Assessment for Rajasthan on 13th May 2011 at Meeting hall, Rajasthan State Pollution Control Board (RSPCB), Jaipur.
- Dr. T. S. Rathore, Director, and Sh. N. Bala, Scientist E attended the 'Stakeholders Consultation and Launch of the UN Decade on Biodiversity (UNDB) for Asia and Pacific' in New Delhi on 23rd May 2011 at hotel Ashok, New Delhi.
- Dr. T. S. Rathore, Director, Dr. G. Singh, Scientist F and Shri N. Bala, Scientist E attended a workshop on 'Revival of forests in dryland areas: challenges and strategies' at ICFRE, Dehradun on 17th June 2011, organized by Technical Facilitation Office, SLEM Project, Directorate of Extension, ICFRE.
- Dr. Tarun Kant, Scientist E and Dr. Sangeeta Singh, Scientist C, imparted specialized training on DNA fingerprinting from 11-20 July, 2011 at NBPGR, New Delhi.
- Dr. G. Singh participated in brainstorming workshop on Desertification mapping and reporting on impact indicators held at CGO Complex, MoEF, New Delhi on 27 July 2011.
- Dr. Ranjana Arya, Scientist-E Dr. D.K. Mishra, Scientist-E and Dr. U.K. Tomar, Scientist-E attended and participated in National Workshop on, Conservation and Sustainable Utilization of Commiphora wightii (Guggul), organized by Gujarat Forest Department at Gandhinagar on 15-16 September, 2011.
- Dr. T.S. Rathore, Director, Dr. S.I. Ahemd, Scientist F, Dr. K.K. Srivastava, Scientist F and Dr. Meeta Sharma, RO attended National Seminar on Biodiversity and Intangible Natural Heritage" held on 28th September, 2011 at ZSI, DRC, Jodhpur.
- Dr. Sangeeta Singh, Scientist C and Dr. Shiwani Bhatnagar, Scientist B, attended two days training on Conserving natural resources for sustainable development in dry areas, under Sustainable land and ecosystem management programme, organized by Arid Forest Research Institute, Jodhpur 29th -30th September, 2011.
- Dr. T.S. Rathore, Director and Dr. G. Singh, Scientist F participated in one day regional workshop under Green India Mission, organized by State Forest Department Rajasthan on 11th October, 2011 held at Jaipur.
- Dr. T. S. Rathore, Director, AFRI, attended International conference on Rediscovering wood: The key to a sustainable future, organized by the IWST, Bangalore on 19-22 October, 2011.

- Dr. T.S. Rathore, Director, Dr. G. Singh, Scientist F, Dr. I.D. Arya, Scientist F, Dr. D. K. Mishra, Scientist E, Mr. N. Bala, Scientist E, Dr. Mala Rathore, Dr. Tarun Kant, Scientist E, Dr, Dr. Abha Rani, Scientist D, Mr. Manish Singh, Scientist B and Smt. Sangeeta Tripathi, RO attended First Indian Forestry Congress from 21-25 November 2012 at IARI, New Delhi, organized by the FRI, Dehradun.
- Smt. Seema Kumar, Scientist D, attended and participated in five days training on Effect of invasive species/weeds on productivity of forest plantations and natural forests and different cost effective methods for their control, organized by Kerala Forest Research Institute at Peechi, Thrissur, Kerala from 13th -17th December, 2011.
- Dr. D.K. Mishra, Scientist E, Shri Manish Kumar Singh, Scientist B and Dr. N.K. Bohra, RO attended in National conference on Current status and opportunities in medicinal plant of that desert, held during December 17-18th, 2011, and organized by Mahila P.G. Mahavidyalya, Jodhpur.
- Smt. Sangeeta Tripathi, RO, attended International conference on NWFP for sustained livelihood from 17-19 December, 2011 at Bhopal.
- Dr. Ranjana Arya, Scientist-E attended and delievered lead talk in National Symposium on Resource utilization through integrated farming system and biodiversity conservation in drylands, organized at RRS, CAZRI, Kukma, Bhuj from 20-22 December, 2011.
- Dr. Tarun Kant, Scientist D, attended the National Symposium on Assessment & conservation of forest genetic resources through biotechnological interventions on 19-20 December, 2011 organized by the Institute of Forest Productivity, Ranchi.
- Dr. Sangeeta Singh, Scientist C, and Dr. Shiwani Bhatnagar, Scientist B, attended National workshop on Stress agriculture and climate change: Exploring synergy with natural resource management in agriculture (NaRMA-III), organized by ARS, Mandore, Jodhpur, 21st-22nd December 2011.
- Dr. Sangeeta Singh, Scientist C, Dr. Shiwani Bhatnagar, Scientist B, Shri Manish Kumar Singh, Scientist B and Km. Desha Meena, RO, attended seminar on Intellectual property & innovation management in knowledge era (IPIM-2011), organized by National Research Development Corporation, New Delhi, Vyas Engineering College for Girls, Jodhpur, 27th December, 2011.
- Dr. I.D. Arya, Scientist F, and Dr. Sarita Arya, Scientist F attended National symposium on Impact of Plant tissue culture on advance in plant biology, organized by Loyalla College Ahemdabad, 19th-21st January, 2012.

- Ten Scientists of AFRI attended and participated in a five days training programme especially on use of R- software, scientific writing, lecture deliberation and observations of forestry at experiments, etc training was given by Prof. K. N. Gadow, Germany and organized at AFRI, Jodhpur from 9th - 13th January, 2012.

- Dr. Tarun Kant, Scientist D, attended National Conference on Omics for Biotechnology (NCOB-2012) on 22-23 February, 2012, organized by the Central University of Rajasthan, Kishangarh.
- Shri Manish Kumar Singh, Scientist B, attended training on conserving natural resources for sustainable development in dry areas, held during February. 22-23rd, 2012, organized by AFRI, Jodhpur.
- Dr. G. Singh participated and presented a lead paper in XXIII national symposium on Chronology' and Seminar on 'Diversity and physiology of Desert fauna, organized by Department of Zoology, JNV University, Jodhpur on 1-3rd March 2012 .
- Dr. I.D. Arya, Scientist F, attended National Seminar on Agroforestry: An evergreen Agriculture for food security and environmental resilience, organized by Navasari Agriculture University, Navsari, Gujarat, February 2-4 March, 2012.
- Dr. G. Singh, Shri N. Bala and Dr. Abha Rani participated in a workshop on The dying river: A struggle for survival' held at Water Resource Centre, Jal Bhagirathi Foundation, Jodhpur on 5th March, 2012.
- Dr. S.I. Ahmed, Scientist F, Dr. G. Singh, Scientist F, Smt. Seema Kumar, Scientist D, Dr. Sangeeta Singh, Scientist C and Dr. Shiwani Bhatnagar, Scientist B and Dr. Meeta Sharma, attended XIII National symposium on chronobiology and seminar on diversity and physiology of desert fauna, organized by Department of Zoology, J.N.V. University, Jodhpur and Indian Society for Chronobiology, March, 1-3,2012.
- Dr. G. Singh, Scientist F, Dr. Ranjana Arya, Scientist E and Smt. Seema Kumar Scientist D and Dr. Meeta Sharma, RO, attended and participated in the NAIP All India Workshop on Utilization of Prosopis juliflora: Challenges and opportunities, organized by Central Arid Zone Research Institute and held at CAZRI, Jodhpur from 12th -13th March, 2012.
- Shri Manish Kumar Singh, Scientist B, attended training on Environment Impact Assessment held during March 12-16, 2012, organized by FRI, Dehradun.
- Dr. S.I. Ahmed, Scientist F, Dr. Sangeeta Singh, Scientist C and Dr. Shiwani Bhatnagar, Scientist B, attended National Seminar on Forest Health Management (FHM-2012) held at Institute of Forest Genetics and Tree Breeding, Coimbatore on 21-22 March, 2012 .
- Shri Manish Kumar Singh, Scientist B attended National Seminar on Indian Agriculture: Preparedness for Climate Change, held during March 24-25th, 2012, organized by Division of Agronomy, I.A.R.I., New Delhi.

- डॉ. यू. के. तोमर वैज्ञानिक ई., ने भारतीय भाषाओ में तकनीकी शब्दावली का विकास विषयक संगोष्ठी में प्रतिभागिता की। दिनांक 28-29 अप्रैल 2011, नई दिल्ली।

- डॉ. यू. के. तोमर, वैज्ञानिक ई., ने वैज्ञानिक तकनीकी शब्दावली आयोग की स्थापना के पचास

वर्ष पूर्ण होने के उपलक्ष में स्वर्णजयंती समारोह में सहभागीता की, 27 अप्रैल, 2011

- डॉ. नीलम वर्मा, अनुसंधान अधिकारी, एवं डॉ. के. के. श्रीवास्तव, वैज्ञानिक एफ, ने सब्जियों में लगने वाले रोग एवं उनका उपचार के बारे में रक्षाप्रयोगशाला, जोधपुर, 23-24 जनवरी 2012 को पत्रवाचन एवं सहभागिता दी।

- श्रीमति संगीता त्रिपाठी, अनुसंधान अधिकारी, ने राजभाषा वैज्ञानिक संगोष्ठी, रक्षाप्रयोगशाला, जोधपुर, में 23-24 जनवरी 2012 में प्रतिभागिता दी।

4. Extension Panorama/Activities

- **National Forest Library and Information Centre** (NFLIC) (Applicable for FRI, Dehradun only)
- Environmental Information System (ENVIS) (Applicable for FRI, Dehradun only)

4.1 Report on Van Vigyan Kendras (VVKs) and Demo Village (DV)

Progress/Status Report of Van Vigyan Kendras, under AFRI, Jodhpur

State wise locations of established VVKs

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

(a) VVK at Bichhawal Nursery, Bikaner (Rajasthan)

Various meetings were conducted with Rajasthan Forest officials regarding VVK works. Under Rajasthan VVK, one hi-tech nursery at Bichhwal, Bikaner (along with a satellite nursery Mohangarh) of SFD Rajasthan were upgraded/renovated in 2009-10.

Maintenance of Hi-Tech Nursery Bichhwal, Bikaner: Maintenance of Hi –Tech nursery Bichhwal, Bikaner have been executed and rice husk insecticide, seed and PVC pipe were procured for the Hi-Tech nursery.

(i) **Raising of Seedlings:** 3000 quality seedlings of *Prosopis cineraria* and *Dalbergia sissoo* have been raised in Hi-Tech nursery Bichhwal, Bikaner under VVK.

(ii) **Extension activities:** VVK and Demo activities were published in AFRI Darpan (Special issue on VVK/DV), Year 9 Volume 4, Oct–Dec, 2011 and provided to the various stakeholders for wide publicity. Twelve display boards were handed over to ACF, WFP, Jaiselmer to display at the

satellite nursery Mohangarh, Jaiselmer for farmers/stakeholders under VVK, Bikaner.

(iii) **VVK Training:** Three days VVK training was organized at Kishan Bhawan, Srianganagar (Rajasthan) from 14th to 16th Nov, 2011. The total 67 participants (51 forest staffs and 16 farmers) attended training. They imparted training on planting stock improvement programme, economic benefits of agroforestry, improved techniques for agri-horti system for higher production, water conservation and arid ecosystem, water management techniques, JFM and VAM biofertilizer production techniques and plant diseases and its management Training was organized in both, lecture and field demonstration manner.

(b) VVK at Chhipardi Beedi, Rajkot (Gujarat)

Meetings organized between AFRI official and additional PCCF (Research), CF (Research) and DCF (Research) & Nodal Officer (VVK) at GFRI, Gandhinagar regarding research demonstration, renovation of Hi-Tech nursery, high quality raising seedlings and training works for financial year 2011-12. DCF (Res) was briefed about the works under VVK, which need to be taken up at VVK Display Centre & VVK's model nursery at R&D Centre, Rajkot

(i) **Maintenance of Hi-Tech Nursery:** Maintenance works of Hi –Tech nursery, Chhipardi Beedi, Rajkot have been executed. Garden pipe, fogger and accessories, fertilizer & insecticide were procured for the Hi-Tech nursery.

(ii) ***VVK Training:*** Three days VVK training was organized at Sinh Sadan, Sasan Gir, Junagadh (Gujarat) from 17th to 19th Oct, 2011. The total 65 person (30 forest staffs and 35 farmers) attended the training. Training was imparted by the trainees on man-wildlife interface in Gir forest area, economic benefits of agroforestry, important grasses and its management in silvipastural for fodder production, nursery techniques, people sensitization techniques, JFM and advances in forestry sector and composting and vermi composting techniques. Training was organized both in lecture and field demonstration manner.

(iii) ***Raising of High Quality Seedling:*** 2500 high quality seedlings of grafted viz; *Zizyphus mauritiana, Embelica officinalis* and *Cordia mixa* and *Casuarina equisetifolia* from seeds/cutting and of each species minimum 500 seedlings were raised in the Hi-Tech nursery at Research and Development Centre, Rajkot for farmers/stakeholders under VVK. The maintained Hi-Tech nursery facilities are utilized by GFD for mass multiplication of important tree species through vegetative propagation and also using seeds.

(iv) **Extension material**: VVK and Demo activities were published in AFRI Darpan (Special issue on VVK/DV), Year 9 Volume 4, Oct – Dec, 2011 and displayed at VVK Rajkot for wide publicity.

(c) Khanwel (Dadra & Nagar Haveli and Daman)

(i) **Establishment of VVK:** Shri Ashok Kumar, IFS, GCR and Dr. G. Singh, Scientist – F & HOD/FED Div met to Dr. Mohan Jeet Singh, Development Commissioner and Secretary (Forest), Dadra & Nagar Haveli, Daman & Diu, UT, Silvasa along with Shri S.K. Agarwal, CCF, DNH. A discussion was made with them about VVK aim, concept, training for human resource

development, nursery maintenance and dissemination of developed technologies of ICFRE and SFDs under VVK. MOU was signed between AFRI and Forest Department, Dadra & Nagar Haveli and Daman, UT on 24th Jan, 2012.

(ii) **VVK Training:** Van Vighyan Kendra was inaugurated by Shri S. K. Agarwal, CCF, Forest Department, Dadra & Nagar Haveli, and Daman, UT. Two days VVK training was organized at Khanvel, Silvasa, UT, DNH from 24th to 25th Jan, 2012. The total 30 participants (15 forest staffs and 15 farmers) attended the training programme. They imparted training on nursery techniques, economic benefits of agroforestry and soil & water conservation techniques. Training was organized both in lecture and field demonstration manner.

(iii) **Extension activities:** Already prepared display boards (Hindi and Gujarati languages) of research findings and technologies developed were displayed at the Rudhana nursery, Khanwel, Silvasa, (DNH) for farmers/stakeholders. Various literature viz; leaflet, pamphlets, brochures and AFRI Darpan were displayed at Rudhana nursery.

Demo Village, Salavas, (Jodhpur)

1. **Establishment and strengthening:** MOU was signed between Director, AFRI and Sarpanch, Salawas village, Jodhpur for additional land adjoining of the forest nursery (FD), Salawas, Jodhpur on 30th May, 2011. Pacchyat land of 1.5 ha was allowed by Salawas Gram Panchayat (GP) for Demo Village (DV) activities. Thus, total 8.68 ha GP & FD land is available for Salawas DV activities.
2. **Extension activities:** Van Mahotsav 2011 was celebrated at the site of Demo Village, Salavas, Jodhpur on 28th July, 2011 with involvement of Salawas Gram Panchyat and SFD Jodhpur. Sh. Malakhan Singh Bisnoi, MLA Luni was chief guest of function. Sh. I. A. Mugal CF, Jodhpur and Mrs. Akanksha Choudhry, DFO (WL), Jodhpur were invited as special guests. The programme was organized at demo-village site, Salavas for sensitizing to people about demo village activities carried out by AFRI at Salawas Gram Panchyat. Hundred quality seedlings of *Prosopis cineraria* and *Azadirachta indica* were distributed among the farmer to promote agroforestry and enhance land productivity.

Fig 73. Addressing by Dr. T. S. Rathore, Director, AFRI, Jodhpur to the people

Fig 74. Celebrating Van Mahatsava at Demo Village site, Salavas

Fig 75. Shri Malkhan Singh Bishnoi, MLA, Luni planting Khajri (*Prosopis cineraria*) seedings at the site of Demo Village, Salawas, Jodhpur

Fig 76. Shri Malkhan Singh Bishnoi, MLA, Luni distributing seedings to the farmers at Demo Village, Salawas, Jodhpur

3. **Demonstration of developed technologies/models at Demo site:** The model nursery was constructed. The agroshed, varmi compost, Ditch cum mound as Cattle Proof Trench and live hedge fencing were constructed near SFD nursery, Salawas, Jodhpur for demonstration purposes as well as high quality seedling production for farmer/stakeholders.

   The soil and water conservation measures viz.; rubble stone check dam and V-ditches were constructed for demonstrated *In-situ* water conservation and its impact on recharge of ground water and biodiversity. Silvipastoral model of *Cenchrus ciliaris* grass along with *Codia gharafa* and *Zizyphus nummularia* planted with intervention of *in-situ* water conservation were developed for demonstration purposes.

4. **Demo training:** Two days Demo village training was organized at Arid Forest Research Institute, Jodhpur during 26th – 27th Dec, 2011. The total 43 participants (22 forest staffs and 20 farmers) attended the training. They imparted training on nursery techniques, VAM, organic and compost manure forming techniques, soil and water conservation, agroforestry and silvipastoral model. Training was mainly organized in demonstration way.

Mass communication material and media

- Information booklets of AFRI published and provided for wider publicity to farmers/stakeholders.
- AFRI Darpan – Quarterly Hindi magazine was published. One combined issue (600 copies Jan2011-June, 2011) and two separate issues (600 copies) were published and provided to various stake holders.
- Training programmes organized under VVK and Demo Village were published in many daily local news papers (Hindi and Gujarati) for wide publicity among the public.
- On the occasion of VAN Mahotsav, 500 pamphlets were printed and distributed to the stakeholders.
- Brochure (5000) on Khejari mortality problem and its management were also printed for publicity under dissemination of information.

- AFRI pamphlet/folder (9000) consisted details of the mandate, thrust area of Institute and technologies/package developed by the AFRI were published under VVK/DV scheme for wider extension activities.

Participation in Kisan Mela/Exhibition/Trade fair etc:

Participated in melas held at Jodhpur and other places in Rajasthan for dissemination of research results and developed technologies of various research activities of the Institute using display material like; posters, panels, books, brochures/leaflets/information booklet etc. to the people at large especially the farmers and other end users:

(a) Participated in the Western Rajasthan Hastshilp Utsav, held at Rawan Ka Chabootra, Jodhpur from 5^{nd}-15^{th} January, 2012.
(b) Participated in Science Technology Day celebration at Jhunjhunu on May, 13^{th}, 2011, organized by the State DST, Rajathan. (Fig.82)
(c) Participation in 19^{th} National Children Congress held at Jaipur from 26-31 December, 2011.(Fig.83)

4.2 Technologies transferred

- Developed regression to estimate above ($\sqrt{W} = a+bD$) and below ground ($W = a+bD^2$) biomass of *Prosopis juliflora.* Here D is collar diameter of *P. juliflora* tree and a & b are regression constants.
- Package of the practices developed in rain water harvesting in Aravalli has been extended under demo village activities at Salawas for wider publicity and replication by the stake holders.

4.3 Research Publications

Research Publications in Scientific Journals

1. Abha Rani, Pravin H. Chawhaan and Mala Rathore (2011) Seeds of *Hyptis suaveolens*- A source of mucilage. *Indian Forester* **137**(6): 744-750.
2. Ashok Kumar, Beena Tripathi and G. Singh (2012). Tree and shrub diversity in degraded hills of Bar-conglomerate formation of Pali districts of Rajasthan. *Indian Forester* **138**: 107-112.
3. Bilas Singh and G. Singh (2011). Phosphorus enhanced establishment, growth, nutrient uptake, and productivity of *Dalbergia sissoo* seedlings maintained at varying soil water levels in an Indian arid zone. *Journal of Sustainable Forestry* **30** (6): 480-495.
4. D. K. Mishra and N. K. Bohra (2011). Biofuel: As environment friendly fuel and an opportunity for socioeconomic development with reference to *Jatropha. Green Farming* **2**(6): 744-747.
5. D. K. Mishra and N. K. Bohra (2011). Establishment of seed production area of *Acacia nilotica* (L.) delile var. *indica* in Rajasthan. *Green Farming* **2**(2): 162-165.
6. G. Singh (2011). Effects of irrigation on growth and on biomass and nutrient partitioning in

Eucalyptus camaldulensis seedlings. *J. Sustainable Forestry* **30**: 564-583.

7. G. Singh, N. Bala and C.S. Purohit (2011). *Eragrostis tremula* (Lam.) Hochst. ex Steud. Gajanandii, a new variety from Indian desert. *Indian Forester* **137**(6): 796-799.

8. G. Singh and T.R. Rathod (2012). Water use and biomass production in tree seedlings irrigated near filed capacity in arid environment. *Indian Forester* **138**: 5-9

9. G. Singh, T.R. Rathod, N.K. Limba, G.R. Choudhary and A.U. Khan (2012). Growing *Jatropha curcus* with rainwater harvesting in hilly tract of south western Rajasthan, India. *Indian Forester* **138**(3): 214-220.

10. G. Singh, G.R. Choudhary, B. Ram and N.K. Limba (2011). Effects of rainwater harvesting on herbage diversity and productivity in degraded Aravalli hills in western India. *J. Forestry Research* **22**(3): 329-340.

11. G. Singh and Smita Shukla (2011). Effects of *Azadirachta indica* canopy manipulation and nitrogen fertilization on diversity and productivity of herbaceous vegetation in an arid environment of India. *Arid Land Research and Management* **25**: 129-150.

12. K. Parmar, Sushma Prajapati, U. K. Tomar and Tarun Kant (2011). Efficient *In vitro* mass propagation through optimized somatic embryogenesis in *Commiphora wightii* – A source of guggulsterones, *J. Plant Pathol. Microbio*. Special issue *Biotechnology-2011*, 014 , p. 526.

13. P. Chaudhry, K. Bagra and Bilas Singh (2011). Urban greenery status of some Indian cities: A short communication. International *Journal of Environmental science and Development* **2**(2): 98-101.

14. N. K. Bohra, J. K. Shukla, A. Tripathi and D. K. Mishra (2011). Neem - A wonder Tree. *MFP News* XXI (1): 13-15.

15. N. K.Bohra and D. K.Mishra (2011). *Boswellia serrata*-Indian Frankincense tree. *MFP News July-Sept.* XXI (3): 24-25.

16. N. K. Bohra, D. K. Mishra, R. L. Suara and J. K. Shukla (2011). Role of bamboo in socio-cultural aspects in Rajasthan and Gujarat stated of India. *MFP News* XXII (1): 7-11.

17. N. K. Bohra, J. K. Shukla, A. Tripathi and D. K. Mishra (2011). *Tribulus terrestris*-An important medicinal plant of arid zone. *Journal of Non-Timber Forest Products* **18**(1): 63-66.

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21. Vinod S. Gour and Tarun Kant (2011). Efficacy of low cost gelling agents and carbon source alternatives during in vitro rooting of *Balanites aegyptiaca* and *Phyllanthus emblica* microshoots. *Tree and Forestry Science and Biotechnology* **5**(1): 58-60

Chapters in Books

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2. Ranjana Arya (2012). Significant trees and shrubs for development of perennial fodder resources and livelihood support of desert dwellers. **In**: Fodder for Sustainable Livestock Production and Environmental Security; ARS, Keshwana, Jalore, pp.76-84.

3. R.N. Pandey, S. Arya, A. Kant and I.D. Arya (2011). Commercial micropropagation of bamboo: a case study. **In:** Advances in bamboo plantation, management and utilization. I.D. Arya, T.S. Rathore, Sarita Arya, and T. Kant (Eds.). Vinay printer, Jodhpur, pp.31-50.

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6. U.K. Tomar (2012). Assessment, management, conservation and improvement of forest genetic resources of North Western India. In: K. Palanisamy, N. Krishnakumar & R. Anandalakshmi (eds.), Forest Genetic Resources Managemnent in India, pp. 159-165. Published by I.F.G.T.B. Coimbatore, TN, INDIA.

Abstracts in Seminar/Symposium

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2. Atul Tripathi, J. K. Shukla, R. L. Suara and D. K. Mishra (2011). Standardization of clonal propogation in *Commiphora wightii* (arn.) Bhandari. **In**: Abstract of the National Workshop on conservation and sustainable utilization of *Commiphora wightii* (Guggal), organised by SFD, Gandhinagar, 15-16 September, p13.

3. Atul Tripathi and D. K. Mishra (2011). Growth performance and correlation analysis of 16 *Jatropha curcas* Linn. Clonal accession collected from Western Himalayan Region of India under arid environment. **In**: Abstract of the First Indian Forest congress, organised by FRI, Dehradun, 22-25 Nov., p58.

4. A. Gehlot and I.D. Arya (2011). In vitro axillary shoot proliferation for development of micropropagation techniques of *Alianthus excelsa* roxb. **In**: Abstract of the Indian Forest Congress, New Delhi, pp.186-187.

5. A. Gehlot, S. Arya and I.D. Arya (2011). Development of autovegetative propagation (cuttings)

techniques of *Azadirachta indica* A. Juss for rapid production of plants. **In**: Abstract of the National workshop on stress agriculture and climate change: exploring synergy with natural resource management in agriculture. Mandore. Jodhpur, p.

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7. A. Kumar and S. Bhatnagar, (2012). Biodiversity study of predators and parasites associated with lac insect. **In**: Abstract of the National seminar on forest health management, organized by IFGTB, Coimbatore, p.79.

8. Anchal Sharma, S.I. Ahmed, and Meeta Sharma (2012). Influence of temperature and relative humidity on the survival of *Daphnis nerii* (Lepidoptera: sphingidae) and its food efficacy on host plant in arid and semi arid region. **In**: Abstract of the International conference on Entomology, organized by Department of Zoology and Environmental sciences, Punjabi University, Patiala, Punjab, p. 65.

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13. Bhawana Sharma, K.K. Srivastava, Sangeeta Singh, Neelam Verma and Ram Niwas (2011). Antifungal properties of *Citrullus colocynthis* against economic important pathogens. **In**: Abstract of the National Seminar on Biodiversity and Intangible Natural Heritage at ZSI, DRC, Jodhpur, pp. 9-10.

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Congress, at New Delhi, p. 141.

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16. Bohra, N.K., T.S. Rathore, M.R. Baloch, P.H. Chawhaan, D.K. Mishra and S.R. Deora (2011). *Ex situ* conservation of medicinal plants of arid and semi arid regions for education, research and utilization. **In**: The National conference on Current status and opportunities in Medicinal Plants of Thar Desert, organised by Mahila P.G. Mahavidyalaya, Jodhpur, 17-18, Dec.2011, p.

17. Deepali Chauhan (2011). *In vitro* clonal propagation of *Tecomella undulata* Sm. A threatened high value timber species of arid region. **In**: Abstract of the Ist Indian forest congress, held at New Delhi, p.194.

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20. A. Gour (2011). Morphological, biochemical and genetic variability in *Commiphora wightii*. **In**: Abstract volume of 1st Indian Forest Congress, held at New Delhi, 22-25, Nov.2011, pp. 326-327.

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22. I. D. Arya, A. Kant, R. Sharma and S. Arya (2011). *In vitro* strategies to produce planting stock to conserve the degrading forests of hill bamboo (*Drepenostachyum falcatum*) and Muli Bamboo (*Melocanna baccifera*). **In**: Abstract of the National symposium on assessment and conservation of forest genetic resources through biotechnological interventions, organized by the Institute of forest productivity, Ranchi, p.90.

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28. K.K. Srivastava, Neelam Verma, Sangeeta Singh, Bhawana Sharma and Anamika Sharma (2011). Selection of an efficient strain of arbuscular mycorrhizal fungi for mehndi (*Lawsonia inermis*) and ashwagandha (*Widhania somnifera*). **In**: Abstract of the Indian Forestry Congress, at New Delhi, pp. 200-201.

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31. J. K. Shukla D. K. Mishra R. L. Suara and N. K. Bohra (2011). Market scenario, demand status and conservation concern of medicinal plants in north-western Rajasthan, India. **In**: Abstract of the National conference on Current status and opportunities in medicinal Plants of Thar desert organised by Mahila P.G. Mahavidyalaya, Jodhpur, 17-18 December, p. 86.

32. J. K. Shukla, Atul Tripathi D. K. Mishra and R. L. Suara (2011). Vegetative multiplication of *Commiphora wightii* (Arnott) Bhandari through air layering technique and its comparative growth performance in Indian desert conditions. **In**: Abstract of the National Workshop on conservation and sustainable utilization of *Commiphora wightii* (Guggal), organised by SFD, Gandhinagar, 15-16 September, p.11.

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35. Mala Rathore (2011). *Withania coagulens* - An important endangered medicinal plant of Thar desert. **In**: Abstract of National Symposium on Assessment & conservation of forest genetic resources through biotechnological interventions, 19-20 December, held in Ranchi, p. 76.

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43. N. Bala, G. Singh, Gangaram, N. K. Limba and K. R. Choudhary (2011). Comparing growth, biomass and water use of *Eucalyptus camaldulensis* with native tree species under different levels of waterlogging and salinity in indian arid zone. **In**: Abstract of the 1st Indian Forest Congress, held at NASC Complex, New Delhi during 22-25 th November 2011, p. 215.

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46. N.K.Bohra and D. K. Mishra (2011).Changing rainfall pattern in western Rajasthan and its affect on agriculture and socio-economy**. In**: Abstract of the First Indian Forestry congress, organised by FRI, Dehradun, 22-25 Nov., p377.

47. Neelam Verma, K.K. Srivastava and Rama Parmar (2011). Arbuscular mycorrhizal (AM) diversity in *Acacia nilotica* willd. Ex Del. under arid agro-ecosystems. **In**: Abstract of the National Seminar on Biodiversity and Intangible Natural Heritage at ZSI, DRC, Jodhpur, p. 25.

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६२ण रंजना आर्या, संगीता त्रिपाठी**,** माला राठौड़, हेमंत कुमार रतना राम लोहरा एवं आर.के.मीणा ;२०१२द्ध रू राजस्थान के तैलीयबीज ळोत एवं जनहित में उनकी उपयोगिता, प्रोसिडिंग्स, राजभाषा वैज्ञानिक संगोष्ठी, रक्षा प्रयोगशाला, जोधपुर २३-२४ जनवरी २०१२ , पृष्ठ सं.८-१६

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4.3 Seminars/Symposia/Workshops Organized

- Organized one day workshop on IPR in collaboration with Rajasthan State DST, Jaipur and AFRI, Jodhpur on May 25th, 2011.

- Organized pre forestry congress workshop on 'Forests in an Expanding Economy' on 19th July 2011 at AFRI, Jodhpur

- Organized Brainstorming workshop for the formulation of All India Coordinated Programme on Arid and Semi Arid Regions (CP-ASAR) was held on 4-5 August, 2011, at AFRI, Jodhpur, sponsored by the

DST, New Delhi.

- Organized technical session of theme 'Forests in an Expanding Economy' in Indian Forestry Congress' during 22-25th November 2011 at NAASC Complex, New Delhi.

- Organized two days workshop on 'Sustainable Land Ecosystem Management-Country Partnership Program in India & 3rd National Steering Committee (NSC) Meeting 2012 on 27th -28th February 2012 at AFRI, Jodhpur.

4.5 Consultancies

- Consultancy project on Survey and characterization of soils and vegetation in the proposed land of IIT Rajasthan was carried out of amounting ` 2.93 lakhs (sponsored by the IIT, Rajasthan, Jodhpur).

- Consultancy for the preparation of project on developing mega shelterbelt in Western Rajasthan amounting ` 4.8 lakhs was carried out (sponsored by Rajasthan Pollution Control Board, period May 2011-July 2011).

- Technical consultancy to grow *Jatropha curcus* genotypes in Rajasthan of amounting ` 8.1 lakhs (sponsored Rajasthan State Boifuel Authority, 2010-2015).

4.6 Technical Services

- Demonstration of promising genotypes of Jatropha in Rajasthan state & training to farmers and stake holders, State Biofuel Authority, Rajasthan

- Prepared display materials and demonstrated research findings on forest soils, Biodrainage, rain water harvesting for increasing productivity of degraded Aravalli hills at Van Vigyan Kendra and Kisan mela.

- Disseminated research findings to farmers through lectures organized at different institutions

- As and when required provided technical services to SFD, Rajasthan , Gujrat, Ministry of Environment and Forest, New Delhi, Farmers and NGO's in the forestry and allied aspect with particular emphasis on combating desertification, rehabilitation of degraded land, silviculture, modern nursery, forest protection and tree improvement.

4.7 Activities of Rajbhasha

वर्ष 2011–12 के दौरान संस्थान का हिंदी पत्राचार 75.22 फीसदी रहा। तथा फाईलों पर औसतन 84.09 फीसदी टिप्पणियां हिंदी में लिखी गई। कुल 04 हिंदी कार्यशालाएं संस्थान में आयोजित हुई। वर्षपर्यन्त चार तिमाही बैठकें आयोजित हुई। संस्थान प्रमुख ने नराकास की नियमित बैठकों में भाग लिया। संस्थान की वेबसाईट को आंशिक तौर पर हिंदी में किया गया। संस्थान की हिंदी पत्रिका ''आफरी दर्पण'' को सरल हिंदी भाषा में प्रकाशित किया गया तथा उसकी साज सज्जा तथा पठनीय सामग्री को स्तरीय बनाने के प्रयास हुए। दिनांक 14 से 28 सितम्बर, 2011 को हिंदी पखवाड़ा आयोजित किया गया जिसमें सरकारी कामकाज में हिंदी के प्रयोग को बढावा दिए जाने से संबंधित विभिन्न प्रतियोगिताओं का आयोजन हुआ। हिंदी पखवाड़ा के दौरान वर्ष 2010–11 के हिंदी कार्यो के लिए संस्थान कर्मियों को राजभाषा पुरस्कार प्रदान किए गए। संस्थान के कार्मिकों को सारांश हिंदी सॉफ्टवेयर पर हिंदी कार्य का प्रशिक्षण दिलवाया गया। संस्थान को वर्ष 2010–11 के हिंदी कार्यो के लिए नराकास, जोधपुर की ओर से नगर राजभाषा चल वैजयंती एवं प्रशस्ति पत्र प्रदान कर सम्मानित किया गया। प्रशिक्षण सामग्री तथा उपयोगी पत्रक/ प्रचार प्रसार सामग्री हिंदी में प्रकाशित कर वितरित की गई। वर्ष 2011–12 के दौरान पुस्तकालय हेतु `8774/– मूल्य की हिंदी पुस्तकें खरीदी गई। प्रशासनिक तथा जनता से जुडे पत्राचार को हिंदी में ही करने पर जोर दिया गया। संस्थान कर्मियों ने विभिन्न कार्यशालाओं/ राजभाषा संगोष्ठियों में भी भाग लिया। हिंदी की स्तरीय पत्रिकाओं हेतु प्रकाशनार्थ जनोपयोगी सामग्री तथा वैज्ञानिक लेख भेजे गए। आकाशवाणी में हिंदी भेंटवार्ताएं भी दी गई।

4.8 Awards and Honours

- Dr. Tarun Kant received the **Young Scientist Award, 2012** from the Foundation for Scientific Forestry (FSF), Ranchi, during National Symposium on Assessment & Conservation of Forest Genetic Resources through Biotechnological Interventions on 19-20 December, 2011 at Institute of Forest Productivity, Ranchi.

4.9 Special Activities (Such as Van Mehotsava, Forestry Day and Other occasions)

International Biodiversity Day 22nd May, 2011

Every year International Biodiversity Day is celebrated on 22nd May. This year also, this programme was organized at AFRI Arboratum. All staff scientist & officers of AFRI attended the celebration. Sh. P. J. Parmar, Retired Joint Director, BSI, Jodhpur was graced the occasion. Following activities were carried out viz;

- Ceremonial Plantation – On this occasion 50 plants of various arid and semiarid tree species *Capparis decidua, Mangifera indica, Saraca indica, Pithecellobium dulce, Annona squamosa, Prunus dulcis, Annona retculata* were planted in the arboretum of AFRI.


Fig 77. Ceremonial plantation by Sh. P. J. Parmar & Dr. T. S. Rathore at arboretum AFRI

- In house Session – The lectures were delivered.

- Chief guest Sh. P. J. Parmar told that biodiversity is indispensible for survival of life on earth. Each and every species has some unique role in ecosystem. Due to destruction of forests many plant and animal species are facing risk of extinction and environmental problems like climate change, Global warming are also emerging.

- AFRI's quarterly Hindi magazine "AFRI DARPAN" (having special issue on Forest Genetic & Tree Breeding Division) was released jointly by the chief guest Sh. P. J. Parmar & Dr. T. S. Rathore the Director AFRI on this occasion.

Celebration of World Day to Combat Desertification : 17 June, 2011

- Every year world day to combat desertification is celebrated on 17 June. This year theme declared was 'Forests keep dry lands working'. A brief programme was organized by AFRI Jodhpur on this occasion. Ceremonial plantation was done at UBI Bank, Basni branch, Saraswati nagar, Jodhpur. Sh. S. R. V. Murthy, DFO Jodhpur was graced the occasion. All staff scientist & officers of AFRI attended the celebration. Following activities were carried out;
- Ceremonial Plantation – On this occasion around more than 50 plants of various arid and semiarid tree species were planted in the premises of UBI Bank, Basni branch, Saraswati nagar, Jodhpur.

Fig 78. Ceremonial Plantation by chief guest sh. S. R.

Fig 79. Ceremonial Plantation by staff UBI Bank,

V. Murthy DFO Jodhpur on occasion of "world day to combat desertification"

Basni branch, Saraswati nagar, Jodhpur Jodhpur on occasion of "world day to combat desertification"

- Special guest Sh. S. R. V. Murthy DFO Jodhpur delivered lecturer on Sand dune stabilization through power point presentation.
- Dr. Ranjana Arya, Scientist E AFRI delivered talk on afforestration on stress sites through and also discussed impact of salinity on vegetation and soil.
- A pamphlet on "World day to combat desertification" was also published and distributed to the stakeholders.

Celebration of World Environment Day : On 5th June, 2011

Theme: Forests-Nature at Your Service

Every year World Environment Day is celebrated on 5th June. This year also a programme was organized at AFRI Arboratum. All staff, scientists & officers of AFRI attended the celebration. Sh. D. K. Gupta, Branch Manager, UBI Bank, Sarasvati Nagar was graced the occasion. Following activities were carried out;

- Ceremonial plantation – On this occasion, 50 plants of various arid and semiarid tree species were planted in the arboretum of AFRI.

Fig 80. Ceremonial plantation by Dr. T. S. Rathore at AFRI arboretum

Fig 81. Ceremonial plantation by AFRI staff at AFRI arboretum

- Lectures were delivered on the importance of World Environment Day.
- A pamphlet on problem of Khejri mortality and its management was released jointly by Dr. T. S. Rathore, Director AFRI, Sh. M. R. Baloch HoD/AFED, Dr. I. D. Aarya, Dr. Ranjana Aarya, Dr. D. K. Mishra on this occasion.

Celebration of Van Mahotsav

Van Mahotsav was celebrated on 28th July, 2011 with involvement of Salawas gram panchyat and SFD Jodhpur. **Sh. Malakhan Singh Bisnoi MLA Luni** was invited as the chief guest of function. Sh. I. A.

Mugal CF, Jodhpur and Akanksha Choudhry DFO wildlife Jodhpur were invited as special guests. The whole programme was celebrated at **demo-village site, Salavas** for sensitizing people about demo village and activities carried out or by AFRI at Salawas panchyat. Following activities were carried out;

- Total **300 persons** (AFRI employees, farmers, panchayat members, students etc) participated in Van Mahotsav.
- Two banner depicting the theme were designed, prepared and displayed. Four big flax banners and six laminated display boards depicting various activities of AFRI were also displayed at celebration site.
- Ceremonial planting of various tree species seedlings at demo-village was carried out by chief guest **Sh. Malakhan Singh Bisnoi,** MLA Luni, **Sh. Omaram Patel Sarpanch Salawas, Sh. Hazari Singh, a social worker,** and AFRI officials.
- **Dr. T. S. Rathore Director** AFRI, **Sh. Ashok Kumar GCR** & **Dr. S.I.Ahmed** HOD/FP detailed out about the purpose of Demo village/VVK and various activities carried out by AFRI.
- **Pamphlet in Hindi** about Van Mahotsav and **Information Booklet of AFRI** (Hindi) were also released on the occasion by the chief guest Sh. Malakhan Singh Bisnoi, MLA Luni and Director, AFRI.
- One hundred fifty quality seedlings of Khejri, Rohida, Sissoo & ,Karange were distributed to the farmers of Demo Village for the planting.
- The news was covered in local daily Hindi newspapers like; Rajasthan Patrika and Dainik Bhaskar.

Distinguished Visitors

- Director General , ICFRE, Dehradun, Dr. V.K.Bahuguna, IFS, visited AFRI from 20th to 21st june 2011. He visited labs, interpretation centre , library and community hall of the institute. The Director General also inaugurated mist chamber and renovated nursery facilities on 21st June 2011. He also addressed and took meeting with all the officers, Scientists and other officials of the institute.

- Shri K.L.Meena, I.G.,BSF Jodhpur visited medicinal plant garden, nursery and Extension and Interpretation Centre, AFRI with 2 members on 24/9/11.

- A group of nine African countries accompanied by Central Academy for state Forest Service Dehradun (CASFOS), total 18 participants under India-Africa Forum under a training programme on "Combating Desertification and Climate Change" visited Institute, and the Director, AFRI briefed about AFRI activities as themselves developed. They also visited Extension and Interpretation Centre and Hi-Tech nursery, AFRI on 8/10/11.

- D.D.G, ICFRE, Mr. Dasgupta visited AFRI nursery on 27/02/12.

- A group of Scientists from 11 African countries visited AFRI on 18-3-12. Director, AFRI briefed about AFRI activities They also visited Extension and Interpretation Centre and Hi-Tech nursery, AFRI.

5. Administration and Information Technology

Introduction

5.1 Information Technology

1. **Commissioning of the Knowledge Network Leased Line**

   The leased line of the knowledge network has been commissioned in the institute providing as additional bandwidth of 100 mbps to the institute in addition to the MPLS-VPN of the ICFRE. The leased line is running successfully in the institute since its commissioning.

2. **Fabrication of the GIS Laboratory**

   A GIS Laboratory has been fabricated in the institute under the one time grant with an objective to provide GIS related facilities to all the divisions of the Institute. The state of art laboratory has been fabricated with wooden paneling and tiling, air conditioning and power backup. The equipments for the laboratory will be procured after the receipt of the funds from ICFRE.

3. **Maintenance of the IT Infrastructure**

   The IT infrastructure including the hardware, software, LAN, MPLS-VPN and EPABX wireless network of the institute has been maintained properly during the year. A total numbers of twenty nine video conferencing sessions for 49 hours were conducted with the onetime equipment grant officials during the year.

4. **Successful execution of IFRIS Modules**

   All the IFRIS modules of the IFRIS like; FAS, PIMS, RIMS, Payroll and EDMS have been run successfully in the institute throughout the year. Leave of all the employees were applied and approved through PIMS during the year. Entries of all the vouchers were completed in FAS. Pay slip were made available to the employees in their respective PIMS account through the payroll module.

5. **Updation in the Website**

The website has been updated and new articles and few new features were added to enrich and enhanced its functionality and appearance. New articles on the thematic information were added to the portal. The Research publications of the scientists were updated. Similarly, details of completed projects were also updated. Events happening at the institute were uploaded in the bulletin board and photographs of the research and the events of the Institute were uploaded. Information of new tenders and vacancies were made available to user by updating website on regular interval.

5.2 Sevottam: Activities relating to the Citizens/Clients Charter as detailed below has to be included in the Annual Report 2011-2012.

5.2.1 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. As ICFRE has already mandated its 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". Under the auspices, AFRI is enduring its forestry research for conservation of biodiversity and enhancement of bio-productivity in Rajasthan, Gujarat and Dadra & Nagar Haveli 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 populace represented by different stake holders. Under these thrust areas, Institute is implementing its research endeavors after duly recognizing the users need. Main research focus of the institute **includes :**

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

Procedures have been formulated for identifying the research problems of the arid region; developing the projects based on the problems and dissemination of the research results and technologies to the users.

In order to identify the research problem, stakeholders meeting are organized in the two states viz. Rajasthan and Gujarat falling under the jurisdiction area of the institute. Officials from SFD's, Progressive farmers, Scientists and NGO's participate in the stakeholders meeting and express the problems on which the research is required.

Based on the research problems given by the stakeholders, in house discussions are made amongst the scientists of the institute and the research projects are formulated by the scientists after the thorough review

of scientific literature.

The projects are sent to the external experts for their suggestions. After incorporating the suggestions/modifications, the projects are presented before the Research Advisory Group (RAG) Meeting and subsequently to the Research Policy Committee (RPC) meeting for approval. After the approval of projects, the funds are allotted for the projects and the projects are executed by the scientists.

The technologies developed through the projects are demonstrated to the users with the help of demonstration trails, extension trainings, Van Vigyan Kendras, printed material and the website of the institute.

5.2.2 Action taken to implement the Charter;

To fulfill the charter, research projects have been prepared in consultation with the stakeholders in Rajasthan and Gujarat, vetted by outside experts, and RAG members and finally by RPC for internal funding and implementation. Projects have also been submitted for various donor agencies for implementing the Charter. Stakeholders meet of AFRI, Jodhpur was organized at Jaipur on 6th July, 2011 and at Forest Training Research Center, Gandhinagar on 29th July 2011. RAG Meeting of AFRI was held on 3rd-4th November, 2011. New project proposals of various divisions were presented by the PIs. RAG Meeting was chaired by Shri Abhijit Ghose, Ex. PCCF, Rajasthan Projects approved by RAG were presented in RPC meeting held in February, 2011 at ICFRE, Dehradun by the Director, AFRI. RPC directed to formulate the projects in the form of All India coordinated projects, which will again be presented to RPC for approval.

Several extension trainings were held during the year for dissemination of research results produced by various projects executed in the institute. Three issues of the AFRI darpan, the quarterly magazine of AFRI were published in order to apprise the public about the research activities going in the institute. Trainings were also organized in the Van Vigyan Kendra's of Rajasthan and Gujarat and Demo Village at Salavas, Jodhpur for dissemination of research results. 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. The information booklet and a pamphlet on problem of Khejri mortality and its management were also released by the institute.

In addition to these environmental awareness programs were organized by the institute in the form of World Environment Day, Biodiversity Day, Combating Desertification Day and Van Mohotsava, the details of which have been mentioned above.

5.2.3 Details of Training Programmes, Workshops, etc. held for proper implementation of Charter

Mentioned above under point No. 3 Education Visits/Activities.

5.2.4 Details of publicity efforts made and awareness campaigns organized on Charter for the

Citizen/Clients

Mentioned above under point No. 3 Education Visits/Activities.

5.2.5 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 of the ongoing research projects were presented to the internal and external experts of the Research Advisory Group who gave their comments on the quality of the new projects and the progress of the ongoing projects. The experts prioritized the new projects and expressed their satisfaction on the progress of the ongoing projects.

5.3 Welfare measures for the SC / ST/ backward / minority communities

A SC/ST/backward/minority communities welfare committee has been constituted at the Institute. Shri P.H.Chawhaan, Scientist-E has been designated as the Chief Liason Officer of the committee with four other members. The committee looks after the welfare aspect and the grievances of the employees of the SC/ST/backward/minority communities, if any. It is pertinent to mention that only one grievance was reported in the year 2011-2012 from the employees of AFRI, Jodhpur which was solved amicably by the SC/ST/backward/minority communities welfare committee.

6. Annexure

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 Officers	Subject matter(s) allocated
Arid Forest Research Institute	Dr. T.S. Rathore Director, AFRI 0291-2722764 Email: dir_afri@icfre.org Phone : 0291-2742549 FAX : 0291-2722764	Shri M.R.Baloch, IFS, Head Agroforestry & Extension and Silviculture Division,AFRI Email: mrbaloch@icfre.org Phone : 0291-2727271 0291-2729198 FAX : 0291-2722764	All matters related to AFRI, Jodhpur

Details enclosed in Annexure I

2. Email and Postal addresses

Arid Forest Research Institute,

	P.O. Krishi Upaz Mandi, New Pali Road, Jodhpur, 342005 Email : dir_afri@icfre.org Phone : 0291-2742549 FAX : 0291-2722764 3. Intellectual Property 3.1 Patents Granted 3.2 Others

Annexure I

RTI Annual Return Information System

Quarterly Return Form

Public Authority: Ministry of Environment & Forests

Quarter: 1st

Year: 2011-2012

Quarter – April to June, 2011

Mode: Insert Status : New Return

		Progress during the month				
	Opening Balance as on beginning of Ist Quarter	No. Of applications received as transfer from other PAs u/s 6(3)	Received during the Quarter (including cases transferred to other PAs)	No. Of cases transferred to other PAs u/s 6(3)	Decision where requests/ appeals rejected	Decision where requests/appeals accepted
Requests	03	Nil	05	01	Nil	05
First Appeals	Nil	Nil	Nil	N.A.	N.A.	N.A.

Total no. of CAPIOs designated	Total no. of CPIOs designated	Total no. of AA's designated
01	01	01

Block II (Details about fees collected, penalty imposed and disciplinary action taken)			
Registration Fee Collected (in Rs.) u/s 7(1)	Additional fee collected (in Rs.) u/s 7(3)	Penalities Amount Recovered (in Rs.) as directed by CIC u/s 20(1)	No. Of cases where disciplinary action taken against any officer u/s 20(2)
Rs.50/-	Rs.1346/-	Nil	Nil

Block III (Details of various provisions of section 8 while rejecting the requested information) - NA													
No. of times various provisions were invoked while rejecting requests													
Relevant Section of RTI Act 2005													
Section 8(1)										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	other

Block IV (Details regarding compliance of direction/recommendation of the Commission) - NA			
S.No.	Reference No. Of cases wherein Commission made specific recommendation as per section 25(5) (max. 20 chars.)	Whether action is initiated to comply with recommendation of Commission.	Details, thereof (max. 250 chars.)
1-		-Select-	
2-		-Select-	
3-		-Select-	
4-		-Select-	
If the Public Authority made any changes in regard to its rules/regulations/procedures as a result of requested information by the citizens, please provide the summarized details of the changes (max. 500 chars.)			

Block V (Details regarding compliance of direction/recommendation of the Commission) - NA		
Last Date of Uploading the Pro-active Disclosures on the webside of PA	Name of the person who is entering/updating data	Designation of the person who is entering/updating data
General Information uploaded	Smt. Kusum Parihar	Research Assistant – II C/o Incharge, IT-Cell of the Institute.

(M.R. Baloch, IFS)
Public Information Officer,
AFRI, Jodhpur.

RTI Annual Return Information System

Quarterly Return Form

Public Authority: Ministry of Environment & Forests

Quarter: II

Year: 2011-2012

Quarter – July to Sept., 2011

Mode: Insert Status : New Return

		Progress during the month				
	Opening Balance as on beginning of II Quarter	No. Of applications received as transfer from other PAs u/s 6(3)	Received during the Quarter (including cases transferred to other PAs)	No. Of cases transferred to other PAs u/s 6(3)	Decision where requests/ appeals rejected	Decision where requests/appeals accepted
Requests	02	02	09	Nil	Nil	09
First Appeals	Nil	Nil	01	Nil	Nil	01

Total no. of CAPIOs designated	Total no. of CPIOs designated	Total no. of AA's designated
01	01	01

Block II (Details about fees collected, penalty imposed and disciplinary action taken)			
Registration Fee Collected (in Rs.) u/s 7(1)	Additional fee collected (in Rs.) u/s 7(3)	Penalities Amount Recovered (in Rs.) as directed by CIC u/s 20(1)	No. Of cases where disciplinary action taken against any officer u/s 20(2)
Rs.90/-	Rs.246/-	Nil	Nil

Block III (Details of various provisions of section 8 while rejecting the requested information) - NA													
No. of times various provisions were invoked while rejecting requests													
Relevant Section of RTI Act 2005													
Section 8(1)										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	other

Block IV (Details regarding compliance of direction/recommendation of the Commission) - NA			
S.No.	Reference No. Of cases wherein Commission made specific recommendation as per section 25(5) (max. 20 chars.)	Whether action is initiated to comply with recommendation of Commission.	Details, thereof (max. 250 chars.)
1-		-Select-	
2-		-Select-	
3-		-Select-	
4-		-Select-	
If the Public Authority made any changes in regard to its rules/regulations/procedures as a result of requested information by the citizens, please provide the summarized details of the changes (max. 500 chars.)			

Block V (Details regarding compliance of direction/recommendation of the Commission) - NA		
Last Date of Uploading the Pro-active Disclosures on the webside of PA	Name of the person who is entering/updating data	Designation of the person who is entering/updating data
General Information uploaded	Smt. Kusum Parihar	Research Assistant – II C/o Incharge, IT-Cell of the Institute.

(M.R. Baloch, IFS)
Public Information Officer,
AFRI, Jodhpur.

RTI Annual Return Information System

Quarterly Return Form

Public Authority : Ministry of Environment & Forests

Quarter: III

Year: 2011-2012

Quarter – Oct. to Dec., 2011

Mode: Insert Status : New Return

		Progress during the month				
	Opening Balance as on beginning of lll Quarter	No. Of applications received as transfer from other PAs u/s 6(3)	Received during the Quarter (including cases transferred to other PAs)	No. Of cases transferred to other PAs u/s 6(3)	Decision where requests/ appeals rejected	Decision where requests/appeals accepted
Requests	01	05	08	03	Nil	09
First Appeals	Nil	Nil	01	Nil	Nil	01

Total no. of CAPIOs designated	Total no. of CPIOs designated	Total no. of AA's designated
01	01	01

Block II (Details about fees collected, penalty imposed and disciplinary action taken)			
Registration Fee Collected (in Rs.) u/s 7(1)	Additional fee collected (in Rs.) u/s 7(3)	Penalities Amount Recovered (in Rs.) as directed by CIC u/s 20(1)	No. Of cases where disciplinary action taken against any officer u/s 20(2)
Rs.80/-	Rs.249/-	Nil	Nil

Block III (Details of various provisions of section 8 while rejecting the requested information) - NA													
No. of times various provisions were invoked while rejecting requests													
Relevant Section of RTI Act 2005													
Section 8(1)										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	other

Block IV (Details regarding compliance of direction/recommendation of the Commission) - NA			
S.No.	Reference No. Of cases wherein Commission made specific recommendation as per section 25(5) (max. 20 chars.)	Whether action is initiated to comply with recommendation of Commission.	Details, thereof (max. 250 chars.)
1-		-Select-	
2-		-Select-	
3-		-Select-	
4-		-Select-	
If the Public Authority made any changes in regard to its rules/regulations/procedures as a result of requested information by the citizens, please provide the summarized details of the changes (max. 500 chars.)			

Block V (Details regarding compliance of direction/recommendation of the Commission) - NA		
Last Date of Uploading the Pro-active Disclosures on the webside of PA	Name of the person who is entering/updating data	Designation of the person who is entering/updating data
General Information uploaded	Smt. Kusum Parihar	Research Assistant – II C/o Incharge, IT-Cell of the Institute.

(M.R. Baloch, IFS)
Public Information Officer,
AFRI, Jodhpur.

RTI Annual Return Information System

Quarterly Return Form

Public Authority : Ministry of Environment & Forests

Quarter: IV

Year: 2011-2012

Quarter – January to March, 2012

Mode: Insert Status : New Return

		Progress during the month				
	Opening Balance as on beginning of IV Quarter	No. Of applications received as transfer from other PAs u/s 6(3)	Received during the Quarter (including cases transferred to other PAs)	No. Of cases transferred to other PAs u/s 6(3)	Decision where requests/ appeals rejected	Decision where requests/appeals accepted
Requests	03	Nil	10	Nil	Nil	10
First Appeals	Nil	Nil	Nil	N.A.	N.A.	N.A.

Total no. of CAPIOs designated	Total no. of CPIOs designated	Total no. of AA's designated
01	01	01

Block II (Details about fees collected, penalty imposed and disciplinary action taken)			
Registration Fee Collected (in Rs.) u/s 7(1)	Additional fee collected (in Rs.) u/s 7(3)	Penalities Amount Recovered (in Rs.) as directed by CIC u/s 20(1)	No. Of cases where disciplinary action taken against any officer u/s 20(2)
Rs.100/-	Rs.364/-	Nil	Nil

Block III (Details of various provisions of section 8 while rejecting the requested information) - NA													
No. of times various provisions were invoked while rejecting requests													
Relevant Section of RTI Act 2005													
Section 8(1)										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	other

Block IV (Details regarding compliance of direction/recommendation of the Commission) - NA			
S.No.	Reference No. Of cases wherein Commission made specific recommendation as per section 25(5) (max. 20 chars.)	Whether action is initiated to comply with recommendation of Commission.	Details, thereof (max. 250 chars.)
1-		-Select-	
2-		-Select-	
3-		-Select-	
4-		-Select-	
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General Information uploaded	Smt. Kusum Parihar	Research Assistant – II C/o Incharge, IT-Cell of the Institute.

(M.R. Baloch, IFS)
Public Information Officer,
AFRI, Jodhpur.

LIST OF PROJECTS, AFRI, JODHPUR

Thrust Area/ Theme	Title of the projects	Status of project New/ Ongoing /Concluded	Externally Aided (E) Plan (P)	Raj.	Guj.
2.1 ECOSYSTEM CONSERVATION AND MANAGEMENT					
2.1.2 Climate Change	Project-1: Studies on carbon sequestration in different forest types of Rajasthan (AFRI-88/EED/ 2008-12). (Request for one year extension i.e. 2012-2013).	Ongoing	Plan	√	
2.1.3 Ecology & Environment	Project-2: Phytoremediation of soil for productivity enhancement during land disposal of effluent (AFRI/FED/13(2)/Phyto/2011-2015, Externally funded by the SFD, Rajasthan).	New	Externally Aided	√	
2.1.4 Biodiversity	Project-3: Impact of *Prosopis juliflora* on biodiversity, rehabilitation of degraded community lands and as a source of livelihood for people in Rajasthan State (104/AFRI- 2010-2013).	Ongoing	Plan	√	
	Project-4: Screening, identification and preparation of a comprehensive check- list of the Lepidopteron fauna of Sasan Gir National Park of Gujarat state (AFRI-108/GCR/2011-14).	New	Plan		√
2.1.5 Forest Botany	Nil				
2.1.6 Tribal and Traditional knowledge system	Nil				
2.2 FOREST PRODUCTIVITY					
2.2.2 Silviculture	Project-1: Studies on seed traits of seeds collected from seed stands / SPAs / SSOs / CSOs of important species of Gujarat state (AFRI/JU/SILV/2007-2012).	Concluded	Plan		√
	Project-2: Refinement of modern nursery practices for raising quality seedlings of selected important forest tree species of arid and semi arid areas (AFRI-109/Silvi/2011-16).	New	Plan	√	√
2.2.3 Social Forestry, Agor-Forestry/Farm Forestry	Project-3: Development of economically viable and integrated Agroforestry models for arid region	Concluded	Plan	√	

Thrust Area/ Theme	Title of the projects	Status of project New/ Ongoing /Concluded	Externally Aided (E) Plan (P)	Raj.	Guj.
	(AFRI-55/Silvi/2006-12).				
	Projec-4: Identification of extent of forest lands in forest fringe villages (AFRI/FED/2011-2013 Funded by the NRAA)	New	Externally Aided	√	√
2.2.4 Forest Soils & Land Reclamation	Project-5: Enhancing productivity of saline wastelands in Kachchh- through improved tree planting techniques and silvipastoral study (AFRI-77/NWFP/SFD/AFRI-2006-12, Gujarat SFD sponsored project)	Concluded	Externally Aided		√
	Project-6: Identification of soil-vegetation relations and indicator species for assessment and rehabilitation in lower Aravalli of Rajasthan (AFRI-101/EED/ 2010-14).	Ongoing	Externally Aided	√	
	Project-7: Characterization and classification of forest soils of Rajasthan (AFRI-85/FED/ 2007-2012).	Ongoing	Externally Aided	√	
	Project-8: Carbon stock and soil classification mapping for Rajasthan forests (AFRI/FE/2011-14).	New	Externally Aided	√	
2.2.5 Watershed Management	Nil				

2.3 GENETIC IMPROVEMENT					
2.3.2 Conservation of Forest Genetic Resources	Project-1: Assessment of Guggul germplasm for studying population density, diversity, female-male plant's ratio for *in situ* and *ex situ* conservation in Rajasthan (AFRI- 106/FGTB /SFD-RAJ/ 2010-13, Funded by SFD, Rajastha).	Ongoing	Externally Aided	√	
2.3.3 Tree Improvement	Project-2: Investigations on genetic variation and inheritance of Western Indian Teak (*Tectona grandis* L.f) (AFRI-94 /Silvi/2010-2015).	Ongoing	Plan	√	√
	Project-3: Genetic improvement of *Tecomella undulata* (AFRI-33/FGTB/ 2002-2013)	Ongoing	Plan	√	
	Project-4: Multilocational trial of *Eucalyptus camaldulensis* and *D. sissoo* clones in Gujarat (AFRI-41/FGTB/2002-2012).	Ongoing	Plan		√
	Project-5: Screening of high oil and Azadirachtin in Neem (AFRI-45/FGTB-8/2002-2013).	Ongoing	Plan	√	
2.3.4 Vegetative Propagation	Project-6: Demonstration trial of male and female *Ailanthus excelsa* plants raised through grafting (AFRI-79/FGTB/2006-2013).	Ongoing	Plan	√	
2.3.5 Biotechnology	Project-7: Development of tissue culture technology for multiplication of economically important desert plant *Salvadora persica* (AFRI-92/FGTB/2009-2014).	Ongoing	Plan	√	
	Project-8: Development of technologies for multiplication of economically important desert plant - *Capparis decidua* (AFRI-105/FGTB/2010-2015).	Ongoing	Plan	√	

	Project-9: *In vitro* mass propagation of *Jatropha curcas* L. and optimization of low cost options for economizing the technology (AFRI-83/FGTB/7/2007-2011).	Ongoing	Plan	√	
	Project-10: Study of salt tolerance through gene expression pattern analysis (AFRI-102/FGTB/2010-2015).	Ongoing	Plan	√	
2.4 FOREST MANAGEMENT					
2.4.2 Sustainable Forest Management	Nil				
2.4.3 Forest Economics	Project-1: Market survey on selected species in selected markets (AFRI-58/Silvi./1994-continue).	Ongoing	Plan	√	√
2.4.4 Forest Biometrics	Project-2: Productivity and biometrics studies on some important species in semi arid regions of Rajasthan for their sustainable management (AFRI-95/Silvi/SFD/2009-2012 Request SFD Rajasthan for the extension).	Ongoing	Externally Aided	√	
	Project-3: Productivity studies and modeling growth & yield in Teak plantations in Gujarat State (AFRI-/ Silvi/SFD/2010-2014).	Ongoing	Externally Aided		√
2.4.5 Participatory Forest Management	Nil				
2.4.6 Policy and Legal Issues	Nil				
2.4.7 Information and Communication Technology (ICT)	Project-4: Development of the web portal for forestry research extension (AFRI-82/IT-Cell/2007-2013).	Ongoing	Plan	√	√
2.5 WOOD PRODUCTS					
2.5.2 Wood and other Lignocelluloses 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)					

2.6.2 Resource Development of NWFPs	Project-1: Effect of fertilizer application on growth and yield of 10 years old *Salvadora persica* and *Acacia ampliceps* plantations under silvipastoral system on arid salt affected soil (AFRI-89/NWFPD/2008-12).	Concluded	Plan	√	
2.6.3 Sustainable Harvesting and Management	Nil				
2.6.4 Chemistry of NWFPs, Value Addition and Utilization	Project-2: Tapping the potential of some selected indigenous lesser known wild edible plants for food and nutrition in arid and semi arid regions (AFRI-113/NWFP/2011-2014).	New	Plan	√	
2.6.5 Biofuels and Bioenergy	Project-3: Establishment of multilocational clonal trial and seedling seed orchard of *Jatropha curcas (*AFRI-81/JU/SILV/DBT/2007-12).	Ongoing	Externally Aided	√	
	Project-4: Genetic improvement of *Jatropha curcas* for adaptability and oil yield (AFRI-66/JU/Silvi/ CSIR/2005-12).	Ongoing	Externally Aided	√	
	Project-5: Network research project on guggal *Commiphora wightii* Arn. Bhandari (AFRI-76/Silvi/ NMPB/2008-13).	Ongoing	Externally Aided	√	
	Project-6: Development of a database on tree-borne oilseeds (TBO) in India (Funded by NOVOD Board through ICFRE).	Ongoing	Externally Aided	√	√
	Project-7: Survey, selection performance trial and estimation of yield potential of *Jatropha curcas* in Rajasthan and Gujarat (AFRI-88/JU/SILV/2007-12).	Concluded	Plan	√	√
2.7 FOREST PROTECTION					
2.7.2 Insects pests, diseases and control	Project-1: Studies on seed insect pests of indigenous and exotic forest tree species and to develop IPM packages for major insect damages in Gujarat (AFRI-107/GCR/SFD-Guj./2011-2014).	New	Externally Aided		√

	Project-2: A Coordinated project on integrated management of Khejri mortality for socio-economic upliftment in Rajasthan (AFRI-1/FPD/2010-2014).	Ongoing	Plan	√	
	Project-3: Induction of systemic acquired resistance in rohida against stem canker (AFRI-100/FPD/2010-2013).	Ongoing	Plan	√	
2.7.3 Mycorrhizae, rhizobia and other useful microbes	Project-4: Innovative approaches for augmentation of composting and biofertilizer production in hot arid regions (AFRI-111/FPD/2011-14).	New	Plan	√	√
	Project-5: Evaluation and selection of efficient strains of AM fungi & *Rhizobium* for *Acacia nilotica* and *Ailanthus excelsa* in western Rajasthan (AFRI-103/FPD/2010-2013).	Ongoing	Plan	√	
2.7.4 Weeds and Invasive species	Project-6: Evaluation of antifungal potential and identification of broad spectrum antifungal compound from selected tree/shrubs/weeds of Indian arid region (AFRI-93/AFED/2009-14).	Ongoing	Plan	√	√
2.7.5 Forest Fire and Grazing	Nil				