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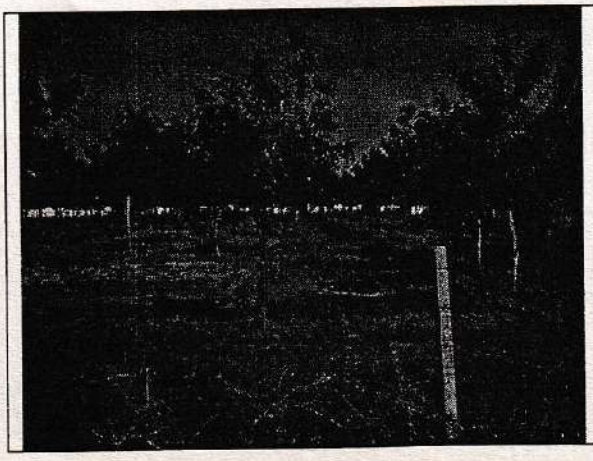
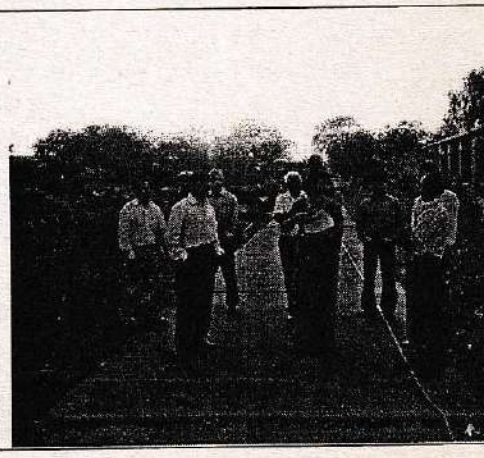
ANNUAL REPORT

2006-2007





ARID FOREST RESEARCH INSTITUTE

P.O. Krishi Mandi, New Pali Road,

Jodhpur- 342 005 (Rajasthan)

2006-07

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Annual Report 2006-07

AFRI at Glance

Arid Forest Research Institute, Jodhpur (Rajasthan), is one of the eight institutes under the Indian Council of Forestry Research & Education (ICFRE), an autonomous body 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, especially in the hot arid and semi-arid region of Rajasthan, Gujarat and Dadra & Nagar Havelli.

The main thrust areas of the institute are soil, water & nutrient management, technologies for afforestation of stress sites, management of plantations, growth and yield modeling, planting stock improvement, bio-fertilizers and bio-pesticides, Agroforestry, JFM & extension, phytochemistry & non-timber forest products, integrated pest & disease management and forestry education. During 2006-07, thirty three projects were executed including twelve externally funded projects from Rajasthan Forest Department, Gujarat Forest Department, Deptt. of Bio-technology, Govt. of India, New Delhi; National Medicinal Plant Board, N. Delhi and CSIR N.Delhi.

The year 2006-07 was declared as **International year of Desert & Desertification (IYDD)** by the United Nations Organization. In this connection following activities were undertaken at AFRI, Jodhpur during the year:-

1. **World day to Combat Desertification** was celebrated on 17th June 2006. Prof. L.K. Shekhawat, Vice Chancellor, Jai Naraian Vyas University, Jodhpur was the Chief Guest in the function in which Director, CAZRI presided over. Logo, Sticker and slogans were released on the occasion. A bilingual brochure (A-3 size) containing information on deserts, their distribution, effects, significance of the day etc. was also released on this day. The pamphlets and brochures were sent to all government. departments., universities, research institutions, NGOs, progressive farmers and public representatives up to village Panchayat level in Rajasthan state to generate public awareness and mobilize the masses to get associated and for their active cooperation in Combating desertification .
2. A National workshop was organized on the topic **"Forestry for food security in dry zone"** for two days i.e. 6th and 7th October 2006. More than one hundred delegates from different Scientific Institutions, including DDG (Education) and Director, Research, ICFRE, Dehradun; participated in the said workshop.

One week IFS officers' refresher training course was organized at AFRI, Jodhpur during 21st -25th August, 2006 on **"Integrated approach for sustainable development of fragile desert ecosystem"**. The training was sponsored by Ministry of Environment and Forests, Government of India, New Delhi. Eighteen (18) IFS officers from different states participated in the refresher course. Besides class room interaction, participants were taken to Indira Gandhi Nahar Pariyojna (IGNP) area and Desert National park in Jaisalmer District. They were also taken to a Zizyphus based agri-horti field of a progressive farmer in Jodhpur district to make them aware about the utility of such agroforestry systems in improving productivity and income generation in arid region. Eminent resource persons from AFRI and other reputed organizations delivered talks/lectures and interacted with the participants.

SIGNIFICANT RESEARCH ACHIEVEMENTS

Generalised height-diameter equations were developed for *Tecomella undulata* plantations in IGNP area of Rajasthan State.

Potential density and Basal area projection models were developed for *Acacia nilotica* and *Eucalyptus* hybrid plantations in Gujarat State.

The hollowness problem in *Tecomella undulate(* Rohida) trees initiates with the formation of cankers in the main trunks of the trees. The percentage of canker formation was found in trees having girth range from 80 cm onwards irrespective of age and girth class. The maximum percentage(18.65%) of cankers has been noticed in the trees with girth range above 121 cm.

Heavy termite infestation in Rohida trees at 1438 RD, Mohangarh and 1252 RD and 1265 RD at Nachna (both in Jaisalmer district)was also observed. Species responsible for the damage of bark and canker were identified as *Microcerotermes* sp. *Botryodiplodia theobromae* and *Phoma* sp. causing 40% damage. Foliar spray of 0.02% of Monocrotophos in combination with Bavistin 0.1% was recommended as remedial measure.

Ashwagandha (*Withania somnifera*) were found attacked by aphids, leaf blotcher and two species of predatory bugs (Cocinelidae) were recorded to feed on these sap sucking insects from adjoining areas of Jodhpur. Isabgol (*Plantago ovata*) crop was found severely attacked by an unidentified of aphid species from Sojat (Pali).

Two pathogens namely, *Rhizoctonia bataticola* causing charcoal root rot and *Rhizoctonia solani* were isolated and identified from Guggal collected from Vasan Nursery, Gandhinagar. Die back of branches after gum exudation was also observed in Guggal plantation at Herbal Guggal Farm, Mangaliavas near Ajmer.

Method for identification of the right stage immature embryo containing unripened seeds for initiation of the embryogenic callus cultures has been developed in case of Guggal (*Commiphora wightii*). This method enables establishment of callus with higher somatic embryogenesis rate.Medium for somatic embryo multiplication and maturation has been optimized.Complete regeneration protocol utilizing the two pathways involving callus phase (viz somatic embryogenesis) and by passing the callus phase (micropropagation through cotyledonary nodal segments) has been established.A systematic two phase hardening protocol has been developed and used successfully to get hardened plants.

Projects completed during 2006-2007

Project 1: **Stand dynamics of some important tree species of Gujarat.**
[AFRI-57/Silvi/2001-2006].
Principal Investigator – Dr. V.P. Tewari

Findings:

1. Total wood & variable bole-length volume equations have been constructed and validated for both the species that assume importance in projecting the total and commercial volume at different stages (thinnings and final harvest) as the plantations mature. Volume equations proposed may be applied on any population/sample of these species available in the study area as these equations have been validated for independent data set.

Total wood volume equations:

(i) *E. hybrid*

$Vob = 0.000076*D^{2.761477}$

$Vub = 0.000036*D^{2.919192}$

$Vob = 0.000014*D^{2.141947}H^{1.168588}$

$Vub = 0.000004*D^{2.143407}H^{1.509019}$

(ii) *A. nilotica*

$Vob = 0.000071*D^{2.735778}$

$Vub = 0.000044*D^{2.810563}$

$Vob = 0.000018*D^{2.363677}H^{0.938962}$

$Vub = 0.000010*D^{2.421580}H^{0.989619}$

Variable bole-length volume equations:

(i) *E. hybrid*

$Vmob = \pi*D^2*(0.000103*h - 0.000077*(h^2/H) + 0.000016*(h^3/H^2))$

$Vmub = \pi*D^2*(0.000090*h - 0.000098*(h^2/H) + 0.000050*(h^3/H^2))$

(ii) *A. nilotica*

$Vmob = \pi*D^2*(0.000040*h - 0.000103*(h^2/H) + 0.000068*(h^3/H^2))$

$Vmub = \pi*D^2*(0.000032*h - 0.000084*(h^2/H) + 0.000050*(h^3/H^2))$

where, Vob and Vub are the total wood volumes (in m^3) over-bark and under-bark, respectively. Vm is merchantable stem volume (m^3) to a top height h, D is the dbh in cm and H is the total tree height in m.

2. The site index equations developed may be used for assessing productive capacity of site and to select sites suitable for a particular species. These are also useful in estimating site index at base age given height at some other age as well as estimating height at some desired age given site index.

E. hybrid $H_2 = 130.2464(H_1/130.2464)^{\exp(Z)}$ with

$Z = 0.1098/(0.5129-1)A_2^{(b_3-1)} - 0.1098/(0.5129-1)A_1^{(0.5129-1)}$

A. nilotica $H_2 = 58.4434(H_1/58.4434)^{\exp(Z)}$ with

$Z = 0.0635/(0.3073-1)A_2^{(b_3-1)} - 0.0635/(0.3073-1)A_1^{(0.3073-1)}$

3. The relationship between the average tree size and the number of surviving trees per unit area has been described by means of a limiting line. This relationship is helpful in generating information about the maximum number of trees ha^{-1} to be kept in the stands given the mean diameter of the trees in the stands.

E. hybrid $N_{G\max} = 29443.7 D_{G\max}^{-1.16145}$

A. nilotica $N_{G\max} = 23972.26 D_{G\max}^{-1.31384}$

4. Path invariant algebraic difference form basal area prediction models have been developed and these can be used to analyse the relationship between stand density and tree growth. In combination with the stand density model, the proposed basal area projection models may also be used to define the type and weight of thinnings in the stands. Thus the models presented are crucial in evaluating silvicultural treatment options.

E. hybrid:

$$\ln(BA_2) = \ln(BA_1) - 0.9861*\left(\frac{1}{A_2} - \frac{1}{A_1}\right) + 0.4344*(\ln N_2 - \ln N_1) + 1.062*(\ln H_2 - \ln H_1) + 0.2639*\left(\frac{\ln H_2}{A_2} - \frac{\ln H_1}{A_1}\right)$$

A. nilotica:

$$\ln(BA_2) = \ln(BA_1) - 1.6416 * \left(\frac{1}{A_2} - \frac{1}{A_1}\right) + 0.5636 * (\ln N_2 - \ln N_1) + 0.8758 * (\ln H_2 - \ln H_1)$$

where,

BA_1 and BA_2 = basal area (m^2) at age A_1 and A_2

H_1 and H_2 = top height at age A_1 and A_2

N_1 and N_2 = Number of stems at age A_1 and A_2

α, β, γ and δ = model parameters

Project 2: Studies on seed quality improvement in respect of various tree species of arid and semi-arid areas. (AFRI-59/Silvi/2002-06)

Principal Investigator: Dr. D.K. Mishra

Findings

Project was started in 2002 and concluded in 2007. Final report of the project has been submitted. The significant conclusions drawn from the studies are given below.

- Seed must be collected directly from branches.
- Any colour of physiological mature fruits can be collected for immediate sowing. However, if sowing is delayed, green-yellow seeds may be preferred. Green-yellow showed the best indices of maturity (on colour basis) and had more potential than green and yellow fruits. It can also be stored for longer period.
- Washed thoroughly seed (T_4) gave better seed and seedling traits.
- Seeds must be dried in shade, if conditions allow. Otherwise seed may be dried in dryer at 45±1°C.

- Neem seeds can be collected either from morphologically superior or inferior stands for immediate sowing. However, superiors gave better results during storage.
- The optimum temperature for seed testing was at 30±1°C and between paper (BP) media gave best results.
- Fresh neem seeds may be sown either in horizontal or in downward orientation and upto 3 cm depth whereas, stored seeds must be sown only in horizontal orientation.
- Seed grading affected seed germination. However, large and medium neem seeds performed better than smaller seeds in storage.
- Age of the tree delays flowering and fruiting in neem.
- Age class IV showed lower germination percentage (70%) higher MGT and lower GV in neem.
- The best period for seed collection in neem is 11 WAA (weeks after anthesis).
- Fresh neem seeds of all mother tree age showed higher oil content than stored seeds. However, age classes I and II exhibited higher oil content as compared to age classes III and IV. Reduction in oil content was minimum in age class IV during storage and it was best for oil production.
- The neem seed stored under airtight containers at low moisture content showed P_{50} for 85 days. However, seeds can be stored best at low moisture (M_4, 5.5%) and low temperature (T_3, 5±1°C) for longer period (P_{50}, 326 days) in airtight container. Open container seeds showed P_{50} for 233 days at ambient room temperature.
- Hydration pretreatment enhanced viability upto 3-6 times of stored neem seeds.
- Fresh neem seeds do not require any type of pretreatment. However, stored seeds may be pre-treated with Urea (1%) for better germination and seedlings attributes.
- Only black colour seeds of *C. wightii* should be collected for nursery raising. Fruits must be kept in poly bag for 24h before maceration and depulping.
- Fully mature golden brown pods of *Ailanthus excelsa* and *D. sissoo* should be collected.

Project 3 : Micropropagation of an important medicinal plant of the arids and semi arids –*Commiphora wightii* (Arn,) Bhandari. [AFRI-42/FGTB/2002-2007].

Principal Investigator: Dr. Tarun Kant, Scientist D

Findings:

1. Method for identification of the right stage immature embryo containing unripened seeds for initiation of the embryogenic callus cultures has been developed. This methods enables establishment of callus with higher somatic embryogenesis rate.
2. Medium for somatic embryo multiplication and maturation has been optimized.
3. Complete regeneration protocol utilizing the two pathways involving callus phase (viz somatic embryogenesis) and by-passing the callus phase (micropropagation through cotyledonary nodal segments) has been established.
4. A systematic two phase hardening protocol has been developed and used

successfully to get hardened plants. The two phases include:

Hardening phase I: in vitro hardening (done in tissue culture lab itself)

Hardening phase II: Ex-vitro hardening. The successfully *in vitro* hardened plantlets (after passing through phase I) are subjected to ex vitro hardening in mist chamber.

5. A total of 15 hardened plants have been planted in the field and their performance evaluation will be carried out in the years to come. The plants have shown 100% survival percentage since plantation (2 months).

Project 4. Litter dynamics and soil changes during stand development in plantation forest. (AFRI-35/FED/2002-2006)

Principal Investigator- N Bala, Scientist D

Findings:

The experiment was initiated in the year 2002 to study litter dynamics and soil changes at various stages of plantation in Indira Gandhi Nahar Pariyojna (IGNP). Four age groups and six species were selected for the study. 76 litter plots of 10 x 10 m^2 area were laid in plantations of *Eucalyptus camaldulensis, Acacia nilotica, Acacia tortilis, Tecomella undulata, Prosopis cineraria* and *Dalbergia sissoo* at Nachna, Sada and Ramgarh area along IGNP.

Litter plot in *E. camaldulensis* plantation in IGNP area

Litter production varied greatly among species and age classes as well. *E. camaldulensis* was found to produce highest quantity of litter. Though leaf litter production was high in *D. sissoo* compared to *A. tortilis* and *A. nilotica*, total litter production was low. Bimodal pattern of litter-fall was observed in the species i.e., summer and winter, being highest in summer. Decomposition rate (weight loss) was rapid in case of *A. nilotica* litter with half decay in 0.66 years. Litter in *E. camaldulensis* plantation showed a slow rate of decomposition. There was an increase in soil organic carbon (SOC), NH_4-N, NO_3-N and PO_4-P in the plantation area with increase in age. Lowest availability of all these nutrients

was observed in *T. undulata* and *E. camaldulensis* plantations. Litter nutrients were high in old stands.

Carbon stock in top 25 cm soil layer has been worked out to be high in *P. cineraria* and *A. nilotica* (7.87 Mg ha^{-1}), followed by *A. tortilis* (7.75 Mg ha^{-1}), *E. camaldulensis* (6.75 Mg ha^{-1}), *D. sissoo* (6.37 Mg ha^{-1}) and *T undulata* (5.25 Mg ha^{-1}).The study reveals that the plantations of different species and stand age modify the nutrient compositions in varied degree and in general improve soil condition and increase carbon stock in biomass, litter and soil.

Project-5: Development of Suitable Models for Urban Aesthetic Forestry suitable for Arid & Semi Arid Region of Rajasthan (AFRI-63 / Silvi / UIT / 2001-06).

Principal Investigator- Arvind Apte

Findings:

About six thousand numbers of plants were planted at seven important locations (6.3 Km length) within the Jodhpur city during 2002 to 2005. Growth and survival data in respect of the plants raised under the experimental plantations on various road sites have been recorded. District Administration, Jodhpur has been requested to issue suitable orders for further maintenance of plants as AFRI does not have maintenance funds.

Average height and diameter growth of various ornamental tree species raised under the experimental plantations have been observed in the order of *Dalbergia sissoo* > *Azadirachta indica* > *Cassia siamia* > *Tecomela undulata* >*Pongamia pinnata* > *Alistonia scholaris* > *Casia fistula* > *Delonix regia.*

Projects continued during 2006-2007

Project 1: Market survey on Timber, Bamboo and fuelwood.

[AFRI-58/Silvi/Continue].

Principal Investigator – Dr. V.P. Tewari

Status:

The data regarding prices of various forest produces viz., timber, fuel-wood, bamboo were collected from the markets of Jaipur and Ahmedabad on quarterly basis. Data collected were compiled and submitted to the ADG (Stat.), ICFRE, Dehradun on prescribed format for publication of Timber and Bamboo Trade Bulletin.

Project 2 : Screening of exotic and indigenous plant species for their performance on salt affected soil with different management project.

[AFRI-49/NWFP/1997-2008].

Principal Investigator: Dr. Ranjana Arya

Status:

A total of seven experimental trials exist at the salt affected area of Gangani in Jodhpur district laid out in different years (from 1997 to 2003) out of which Experiment-1 & 4 were concluded in 2003; 2,3 and 6 in the year 2004-05 and 5 and 7 in 2005-06. At present Experiment 8 is going on.

Experiment 8:

An experimental trial was laid in August 2003 with two fodder species namely *Zizyphus mauritiana* (ber) and *Colophospermum mopane*. The trial was laid with two levels of gypsum (0 and 100% soil G.R.) and three doses of nitrogen (0, 9 and 18 g of N in the form of urea) on two modes of planting (control and circular dished mound). *C.mopane* registered 95 % survival on CDM and 89 % in control after three years of planting, while it was 53 and 64% for *Z. mauritiana*. Mopane recorded better mean height (77.8 cm) and crown diameter (114.4 cm) on CDM as compared to control(71.5 & 106.4) while for Ber crown was more on control 60.2 to 57 cm. Over all mopane recorded 100 % and 76.9 % more crown on CDM and control than Ber. Positive influence of nitrogen application was observed for height and Crown dia for mopane only. In third year of growth ber showed better growth under control conditions compared to CDM.

Site Improvement: There is no appreciable difference in soil pH values in pre and post monsoon seasons for Ber and mopane.

Soil pH is ranging from 8.1 to 9.0 and 8.2 to 9.1 in 0-25 and 25-50 cm soil layer from plant pit in summer (May 05).Trench (0-25 cm soil layer) recorded pH from 8.1 to 8.6. Soil pH of post monsoon season in Nov 05 maintained nearly similar results.

% SOC values from 0.13 to 0.25 in post monsoon season and registered 50 % increase over initial values in plant pit and inter- row spaces.

Additional informations

Sueada nudiflora After 72 months it recorded 79.2 and 66.7 percent survival on CDM and DRM as compared to 55 % under control conditions. The average growth (height and crown diameter) on structures was also higher. The total dry biomass was also 98 and 106 % more on DRM (2.16 tha^{-1}) and CDM (2.25 tha^{-1}) than on control (1.09 tha^{-1}). High percent ash content in leaves is balanced by high percent protein content (27.5 & 16.4 in CDM; 34 & 13.9 in DRM and 28.5 &14.0 in control). The total soluble sugar content was higher in control (6.01%) as compared to CDM (4.55 %) and DRM (3.30 %). Thus *S. nudiflora* has the potential to be introduced as fodder species on arid sandy soils.

Rodent control measures: Experimental area suffered with serious rodent problem.Periodic rodent control measures were applied.

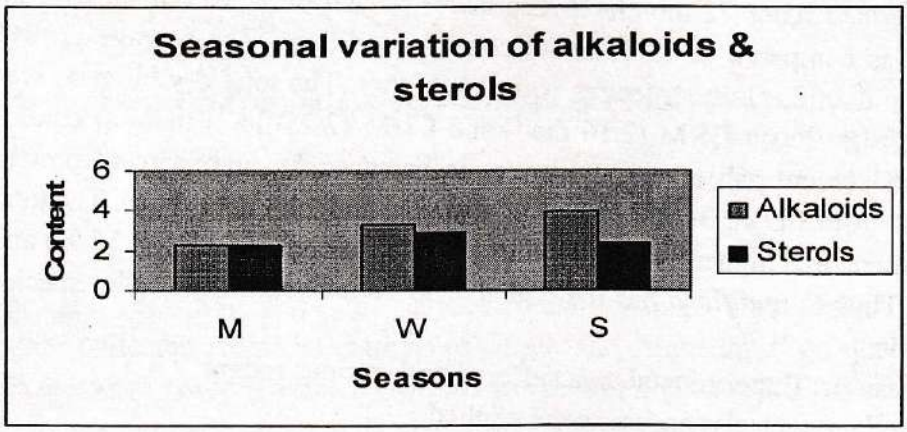
Project 3: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time.

(AFRI-50/NWFP/2002-2007)

Principal Investigator: Dr. Mala Rathore

Status:

The project aims at determining the optimum harvesting time for flowers of *Calotropis procera* so that the medicinally active principles can be exploited to the maximum. *Calotropis procera* flowers collected for different seasons for two years and have been extracted over soxhlet with various solvents. Total extractives determined show maximum extraction during monsoon. Investigations on sterol and alkaloid content of these flowers showed that the total alkaloid content was maximum in summer season and minimum in monsoon season. Yield of total sterols was maximum during winters and lowest in monsoon. The mean alkaloid content was found to be 2.27 %, 3.33 % & 3.89 % and sterol content was 2.30%, 2.86% & 2.35 % in monsoon, winter and summer seasons respectively. Further alkaloid and sterol contents for third consecutive year in monsoon and summer seasons have been determined and that of winter season is under progress. Also collection of flowers from all the nine agroclimatic zones of Rajasthan has been done for studying the variation in these secondary metabolites.

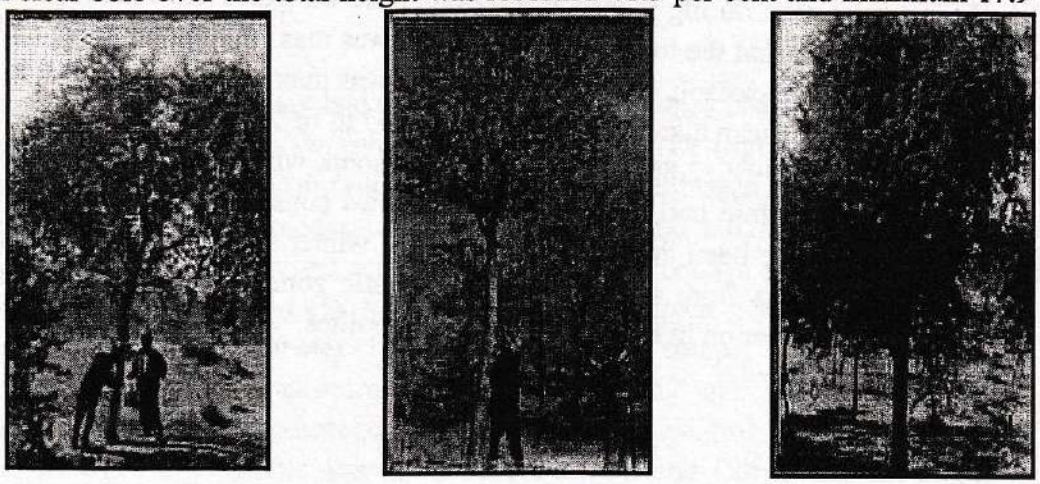


Project 4: Genetic Improvement of T*ecomella undulata*. (AFRI- 44/FGTB/2002-06)

Principal Investigator: .C.J.S.K. Emmanuel

Status:

Rohida (*Tecomella undulata*) has multifarious uses and is well grown in arid regions. It is well distributed in Rajasthan and Gujarat. The species has been overexploited from its natural habitat for obtaining good quality of timber. To bring improvement in the productivity of this tree candidate plus trees (CPTs) in different areas have been selected; 30 CPTs in the irrigated tract of IGNP canal area from the plantation raised in 1987 and 35 CPTs in the unirrigated areas in the Farmers Field. The data has been recorded for the total height, clear bole d.b.h., and the colour of the flower. The clear bole percentage was calculated over the total height of the CPTs selected, the maximum clear bole over the total height was recorded 46.5 per cent and minimum 17.9 per cent.



Photographs of the CPTs selected

Project 5: **Screening of high oil and azadirachtin in Neem.**

(AFRI-45/FGTB/2002-06)

Principal Investigator: .C.J.S.K. Emmanuel

Status:

Twelve hectares of progeny trials of summer and winter flowering CPTs at AFRI, Jodhpur and high azadirachtin and high oil CPTs at Govindpura Jaipur are being maintained periodically phenological observations are recorded on the trial. This year the trial has not started flowering.

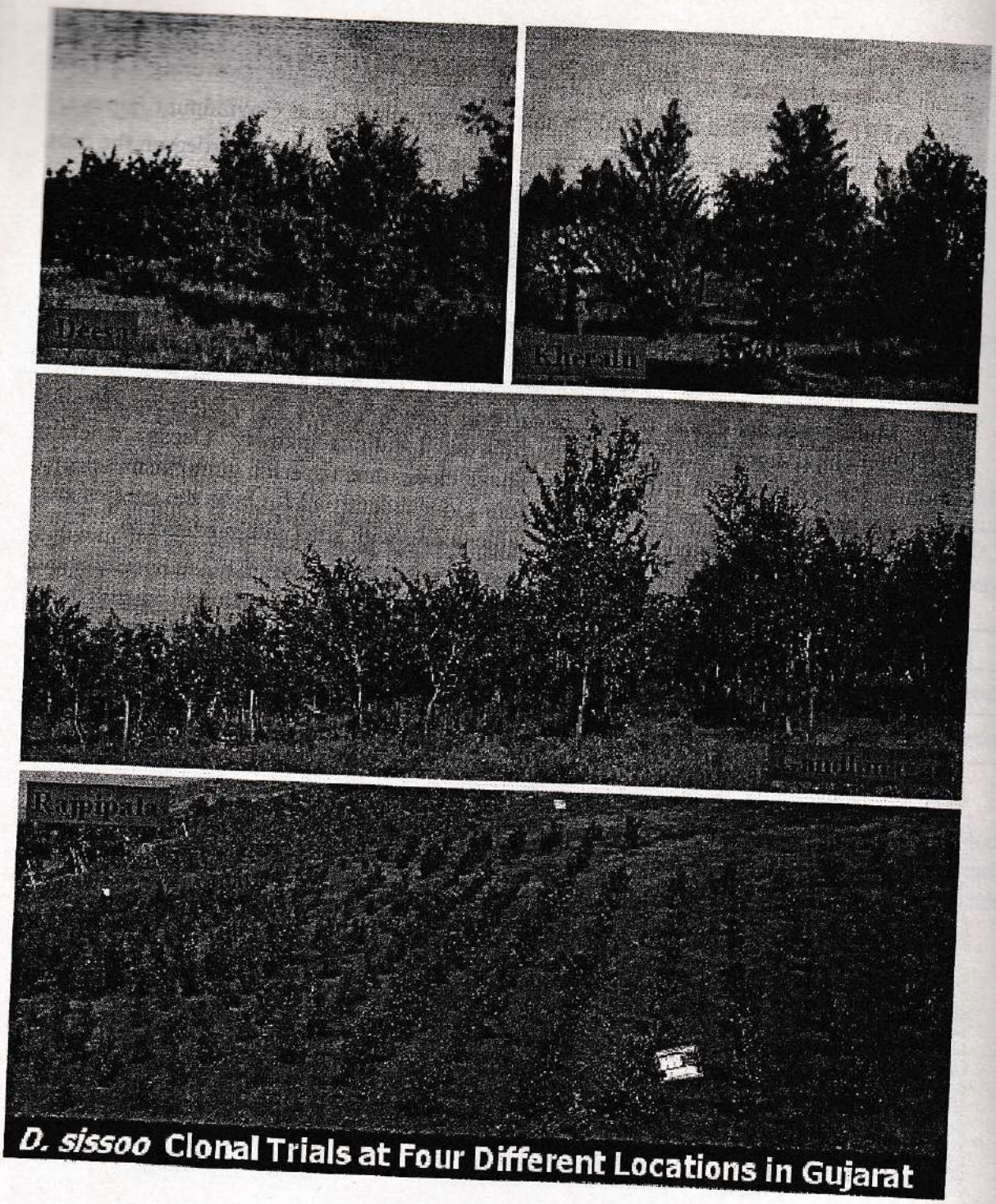
Project 6 : **Multilocational trial of *Eucalyptus camaldulensis* and *D. sissoo* clones**
(AFRI-41/FGTB/2002-2006)

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

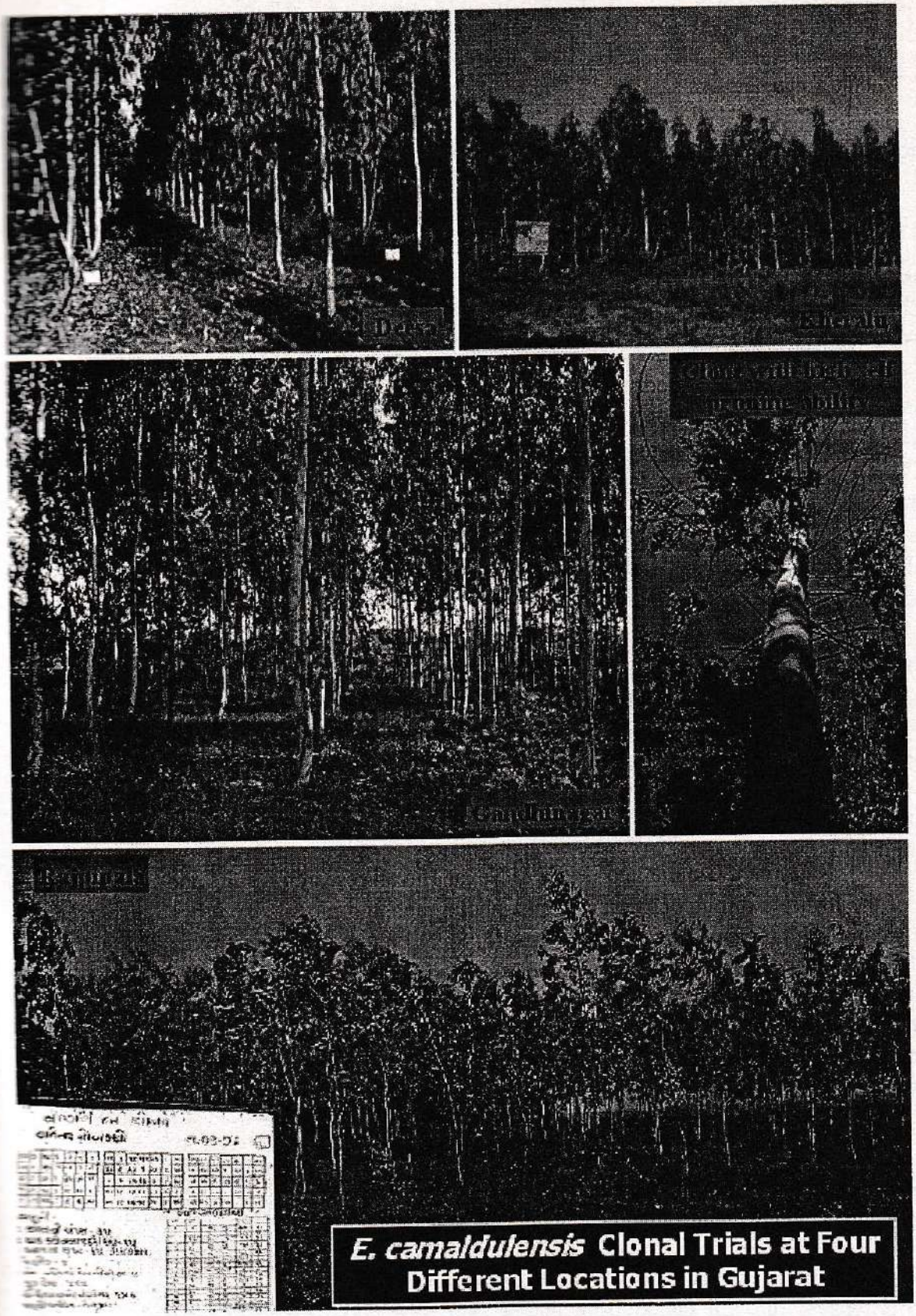
Multilocational clonal trial of *Eucalyptus camaldulensis* and *Dalbergia sissoo* is established in August 2003 at four different locations namely Deesa, Kheralu, Gandhinagar, Rajpipala in Gujarat state. These clones are superior germplasm selected under WB project and other sources. Best four clones identified for both the species after 3½ years of growth are listed in following table along with site (within brackets).

Species	Clone Number & Locations			
E. camaldulensis	99(D,K,G,R) 4	128(D,K,G) 3	115(D,G,R) 3	105(D,K,R) 3
D. sissoo	G5 (D,G,R) 3	89 (D,K,R) 3	6 (D,K,G) 3	3 (D,R) 2

This year some more data have been collected on physiological parameters such as Photosynthesis, Transpiration, PAR at leaf surface, Leaf & air temperature, Stomatal conductance and soil 40 samples have also been collected from four corners and middle of each plot. Soil analysis for of pH, EC, NPK and carbon stock in samples is completed.



D. sissoo Clonal Trials at Four Different Locations in Gujarat



E. camaldulensis Clonal Trials at Four Different Locations in Gujarat

Project 7: Identification and screening of some suitable nitrogen fixing species of dry region for their utilization in improvement of soil fertility and biomass. (AFRI -36 / FED /2002-2006)

Principal Investigator- Dr. S.P.Chaukiyal, Scientist B

Status:

Thirty beds of the size 5 x 5 m were prepared. Seeds of *Rhynchosia minima, Clitoria ternatea, Mucuna pruriense, Crotalaria burhia and Mimosa hamata* have been sown in the prepared beds. Soil samples were collected from the beds and analyzed for soil nutrients and soil enzymes. Acid phosphatase activity increased from August to November and lowest activity was in December and was high than in control. Nearly same trend was also observed for alkaline phosphatase activity. Acid and alkaline phosphates activity was 2.23 and 2.18 fold, respectively, greater than control. An increasing trend was observed in dehydrogenase activity also from August to October. Dehydrogenase activity was always higher (2 to 3 fold) in the soil collected from the rhizosphere of the plants as compared to the control plot

Project 8: Transfer of forestry technology through demonstration and training for increasing productivity and sustainable management of natural resources (Establishment of Interpretation centre)

[AFRI-54/AFE/2002-2006].

Principal Investigator- Sh. C.S. Dange, IFS

Status:

- Rajasthan, Gujarat and Dadra & Nagar Haveli research results and other activities of the Institute through charts, exhibits, photograph and models have been displayed. To accomplish the same ,materials used were :Steel Letters, Wooden Boxes, Curtain Cloth, Circular Platforms, Electric Switchboards, Door with fitting, Distempering & Painting, Maps, Poster Album. Display Boards, Fixing of Letters, Foot step works, Back light printing board, Fixing of curtains, Focus lights-25 Nos., Enlarged photographs, Laminated photographs, Name plates, Fitting of fancy lights, Tube light fitting(CFL), Fixing of focus lights and Brickwall.

Project 9: Develop strategies and methodologies for extension of forestry research technologies in semi- arid and arid areas. [AFRI-71/AFE/2005-2009].

Principal Investigator- Shri C.S. Dange

Status:

Extension through handouts/ paper articles insertions, multimedia applications and mobile exhibits display periodically. Organised Quiz and Painting Competition, publicised 5000 leaflets and 3 banner slogans, "World Environment Day 2006" was celebrated; and distributed10,000 leaflets, 10 banner slogans, sticker, article and poems. Organised trainings for 42 Watershed Development Team members sponsored by Zila

Parishad Jodhpur (12th to16th Sept.,'06) and for 60 Watershed Development Team members sponsored by Zila Parishad Jalore (17th to22nd Dec.,'06), and our resource persons lectured on various topics related to forestry and horticulture. Organised a stall in Paschimi Rajasthan Udyog Hastshilp Utsav-2007 (05th to14th Jan., 2007).

Project 10: Relative resistance of neem provenances to insect pests and mites and their bio management in arid areas. [AFRI-73/FP/2006-09]

Principal Investigator – Dr. S. I. Ahmed

Status:

Three species of termites, ***Odontotermes obesus*** (Rambur), ***O. redemanni*** (Wasmann) and ***O. gurdaspurensis*** Holmgren (Termitidae) are among the common insect pests in neem provenance at AFRI. Termite workers feed on the roots and stem portions irrespective of age and ecological parameters of neem plants. The damage occurs by hollowing out or by partly removing the bark of the roots and stem. The oriental yellow scale, *Aonidiella orientalis* Newstead (Diaspididae), neem scale, *Pulvinaria maxima*, *P. azadirachtae* Green, Indian wax scale, *Ceroplastes ceriferus* Anderson, Wax scale, *Ceroplastes pseudoceriferus* Green, The shield scale, *Lecanium* sp. (Coccidae) *and Pseudococcus* sp. (Psedococcidae) are amongst the insect pest collected and identified during the last three months. Four species of sap sucking insects have been identified to cause minor damage to the robust trees of neem in the provenance trials.

Project 11: Management of potential insect pests and diseases of important medicinal plants grown in arid and semi-arid regions.

[AFRI- 72/FP/2006-2009]

Principal Investigator – Dr. S. I. Ahmed

Status:

Severe infestation of a noctuid caterpillar species has been noticed on all mehndi, (*Lawsonia inermis*), growing areas at Sojat road (Pali). The caterpillars are the semiloopers brown to black in colour depending on the number of instars. The larvae are voracious feeders of foliage. Heavy termite infestation was recorded in the Guggal (Commiphora wightii) plantation at Kailana (Jodhpur) wherein about 1.50 cm thick stem of Guggal were found infected by stem rot as well as termite infestation resulting drying of the stem and shoots. Guggal plants at AFRI model Nursery were noticed infested severely by a lepidopteron pest and white fly. Foliar spray of 0.02% of Monocrotophos in combination with Bavistin 0.1% is recommended as remedial measure. Severe infestation of termites has also been noticed in the root system of mature Guggal plants at Herbal Guggal Farm, Mangaliavas near Ajmer. Ashwagandha (Withania somnifera) were found attacked by aphids, leaf blotcher and two species of predatory bugs (Cocinelidae) were recorded to feed on these sap sucking insects from adjoining areas of Jodhpur. Isabgol (Plantago ovata) crop was found severely attacked by an unidentified of aphid species from Sojat (Pali).Sporadic incidence of black leaf spot, brown leaf spot & blight disease was commonly found all mehndi (Lawsonia inermis) growing areas at Sojat road (Pali). The pathogen was identified as Alternaria sp. causing black leaf spot disease. Some mehndi fruits were found attacked by fruit- rot disease. Stem dry rot in Guggal (Commiphora wightii) was noticed in young

plantations of Guggal from AFRI nursery, adjoining Guggal growing areas at Jodhpur and Vasan nursery, Gandhinagar. Leaf blight disease was also noticed in Guggal nursery at Gandhinagar. Two pathogens namely, Rhizoctonia bataticola causing charcoal root rot and Rhizoctonia solani were isolated and identified from Guggal collected from Basan Nursery, Gandhinagar and Gujarat. Die back of branches after gum exudation was also observed in Guggal plantation at Herbal Guggal Farm, Mangaliavas near Ajmer. Leaf blight disease was recorded from Ashwagandha (Withania somnifera) at AFRI model nursery. The fungus was isolated and identified as Alternaria sp. Isabgol (Plantago ovata) crop was found severely attacked by downy mildew disease at Sojat (Pali).The incidence of the disease was noticed about 35-40% The fungus was identified as Peranospora sp. Farmers were advised to foliar spray (0.02%) of Monocrotophos in combination with Dithane M-45 @ 0.2% after fifteen days interval as remedial measures.

Projects continued during 2006-2007 (Externally aided)

Project 1. Genetic improvement of *Jatropha curcas* for adaptability and oil yield. [AFRI-66/Silvi/CSIR/2005-2010].

Principal Investigators : Dr. R.L. Srivastava & Dr. D.K. Mishra

Status:

We have collected 23 elite and 180 native accessions of Jatropha and planted them in our experimental field. Elite accessions planted in September 2005 and 2006 showed variation in percent survival, total mean height, collar diameter, crown diameter, number of branches, and female to male ratio. The survival percentage ranged from 18.75 to 100 percent. Accession number SKNJ-1 (Sardar Krushi Nagar) has died and was unable to survive here. The major threat in arid region is termite infestation and cost pf termite treatment is very high in arid areas. The maximum (100%) survival was obtained in accession numbers 12 and 13 from CRIDA, 20 from FRI, Dehradun and 21 from PAPL Bangalore. Other accessions showed 18.75 to 93.75 percent survival.

After 18-months of planting in the field, accession numbers CSMCRI-GJ-PCM-C_3, CRIDA, Raipur and JPH009, PAPL, Bangalore performed better. Production of fruits per plant varied from 175g in CSMCRI-GJ-PCM-C_3 to 3.67g in SKNJ-$_9$, Urli Kanchan after 18-months of planting.

Out of 180 accessions planted, 30 accessions have died and remaining accessions showed 33 to 100 percent survival. Maximum mortality was observed in accessions supplied by CRIDA (12 accessions), followed by NBPGR (8) and FRI (6). Accessions received from CSMCRI, Bhav Nagar and AFRI showed no mortality and 2 accessions each from NBRI and PAPL died after transplantation in the field.

For developing agro- technology, seeds from a single tree having more than 40% oil have been collected and seedlings have been raised. Plantations have been done in July 2006 in split plot design. Initial observations have been recorded on above ground height, number of branches and Crown diameter after 6-months of planting. The treatments were imposed in November 2006. Average height was 95.28cm in control and varied upto 106.71cm in plants irrigated at 15-days interval. Irrigation has significantly affected crown diameter in I_1-treatments (mean 68.31cm).

Project 2 : Locational trials on Bamboos (NMBA) [AFRI-43/GTB/2005-2008].

Principal Investigator: Dr. U.K. Tomar

All the three trials are established in July 2006. Initial and after one month growth data has been recorded as per guide lines of NMBA. Soil samples have been collected from all the three experimental plots and soil analysis for of pH, EC, NPK and carbon stock in samples is completed

Trial	Survival %	Height (cm) & No. of Shoots
Species	95%	DA-57(4), BT-48(4),BN-56(2), BB-45(5), BV-81(3), DS-76(4)
Water Management	98%	BB-60 (5)
Spacing	96%	BB-45 (3)

Species (*BB=B. bambos, BN=B. nutans, BV=B. vulgaris, BT=B. tulda, DA=D. asper and DS=D. strictus*)

Project 3: Multiplication and field trial of Bamboos through tissue culture in Rajasthan & Gujarat. [AFRI-68/GTB/2005-2008].

Principal Investigator: Dr. U.K. Tomar

- Superior Planting stocks of *Bambusa bambos* TC plants (8000) were procured from TERI New Delhi and *Dendrocalamus strictus* (4000 plants) were procured from I.H.B.T. Palampur. Remaining planting material of *D. strictus* were raised at TC lab of A.F.R.I. Jodhpur from seed source TFRI Jabalpur.
- As per guidelines provided by DBT, demo plantations and experimental plantations of *Bambusa bambos* and *Dendrocalamus strictus* plants raised through tissue culture and with conventional techniques in both the states were raised in July 2006 (25 ha Dahod Gujarat, 20 ha Kuaslagarh, 5 ha Saira Rajasthandetails are as follows:

Location	District	State	Annual Rain Fall	Soil Type	pH range	Area
Chakhalia Village, Jhalod	Dahod	Gujarat	400-900 mm	Loamy sand	6.1-7.9	25 ha
Khajurawala chuna, Kaushal Garh	Banswara	Rajasthan	700-900 mm	Sandy loam	6.1-7.0	20 ha
Bokada village, Saira	Udaipur	Rajasthan	500-800 mm	Sandy loam	7.1-8.4	5 ha

- Survival percentage of both species after four months is above 95% at Kushalgarh (Rajasthan) and Dahod (Gujarat) locations. However, success rate in terms of survival (%) is about 70% at Saira, Udaipur.
- Data and soil samples (75 No.) were collected from all three sites. Soil analysis for of pH, EC, NPK and carbon stock in samples is completed.

Project 4: Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges. [AFRI-39/FED/2002-2006].

Principal Investigator: Dr. G. Singh

Status:

75 plots of about 700 m^2 area were laid in 0-10, 10-20% and >20% with five treatments (control, contour trench, gradonie, Box trench and V. ditch rainwater

harvesting structure) in five replicates. Growth and seedling survival were recorded in June 2006 and January 2007. Causality replaced in July 2006. Runoff measured from July to October 2006 (12 times) and water samples collected (two times) for nutrient analysis. Vegetation diversity monitored and community biomass determined (Fig 1).

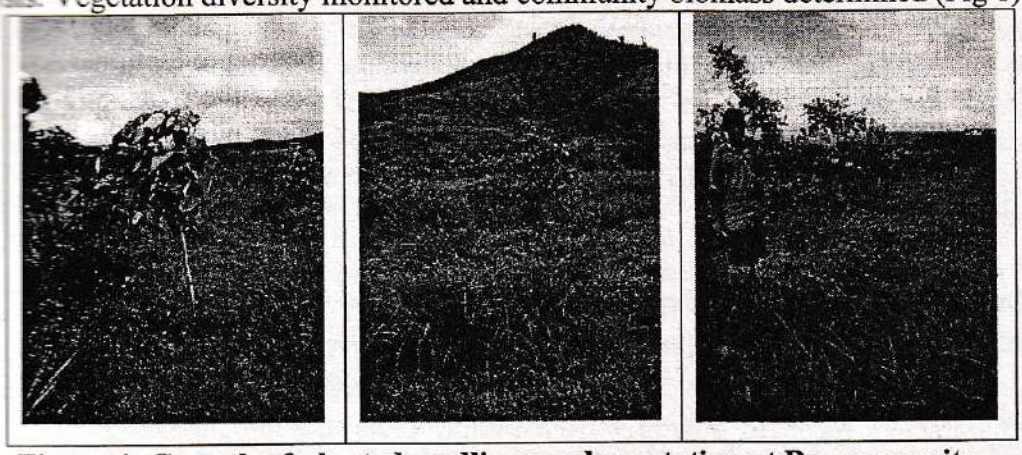


Figure 1. Growth of planted seedlings and vegetation at Banswara site.

Highest run-off losses were recorded from 10-20% slope plots. Water loss was highest in control plots, whereas the lowest run-off loss was from Contour trench plots on June 1, 2006. In most of the other observations lowest run-off from the V-ditch plots except on 7 August when it was lowest in Box trench plots.

Nutrient loss (NH_4-N and NO_3-N) along with run-off water was highest in control plots. Loss of dissolved solids and PO_4-P was lowest from Contour trench plots. Soil water content (SWC) determined in May, August, September, November 2006 and January 2007 indicated highest SWC in >30% slope plots except in September and January (highest in 0-10% slope). Lowest SWC was in 10-20% slope in all the observations (Table 2). Order of SWC in May 2006 was Contour trench > Box trench > Gradonie > V-ditch > Control. Highest SWC were in V-ditch plots in 0-20 cm soil layer and Gradonie plots in 20-40 cm soil layer in August 2006. In January 2007, SWC was lowest in the control plots, whereas the highest SWC was in Box trench plots in both the soil layers.

Seedling survival was highest in *Emblica officinalis* (91.1%) and lowest survival in *Dendrocalamus strictus* (79.5%) in May 2006. The survival was highest in 0-10% slope area (86.1%) and lowest in >20% slope area (70.7%) with an average survival of 79.1%. Considering the rainwater harvesting structures, the survival was lowest (76.0%) in the control plot and highest in Contour trench plot (83.4%). Seedlings of *Dendrocalamus strictus* were tallest whereas the seedlings of *Holoptelia integrifolia* were smallest. Heights of the seedlings were greater in the 0-10% slope area than in the other slopes for all the species except for *H. integrefolia*. *H. integrifolia* perform well in 10-20% slope area. *E. officinalis, A. catechu, S. cumini, H. integrefolia* and *G. arborea* performed best in Contour Trench plots, *D. strictus* perform well in Box Trench plots and *A. indica* perform well in V-ditch plots.

Seventy five herbs and grass species were recorded in October 2006. Two species are yet to be identified after fresh collection in next season. Highest numbers of herbs/grass species and their population were in 0-10% slope area. Vegetation production was highest in 10-20% slope. Both fresh and dry masses of the grasses were

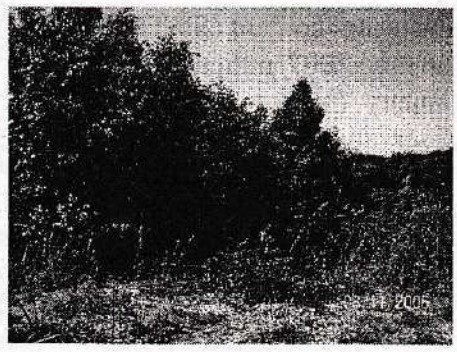
lowest in the plots of >20% slope area. V-ditch plots in 0-10% slope and Gradonie plots in 10-20 and >20% slope indicated highest herbage production. Average vegetation production was 273.9 g m^{-2} (84.8 g m^{-2} in upside of the plots, 393.6 g m^{-2} within the treated plots and 342.3 g m^{-2} down side of the treated plots) in the protected (experimental) area as compared to 105.4 g m^{-2} in the unprotected area (i.e., outside of the experimental area).

Project 5: Study of Characteristic Features Pertaining to Bio-drainage Potential of Some Selected Tree Species. [AFRI-38/FED/2004-2008].

Principal Investigator- N. Bala

Growth parameters recorded quarterly from sample plots at Anupgarh branch and 1357 RD, IGNP in the plantation raised by State Forest Department, Rajasthan and AFRI. At 1357 RD, crown spread and girth at breast (GBH) height of the plants was high in *E. rudis*. Though plant height was more in *E. camaldulensis* but crown spread and GBH were less than *E. rudis* plants. Two and half -year-old *E. camaldulensis* plants at Anupgarh attained average height of 1472 cm. Crown diameter and collar girth was 294 cm and 35 cm respectively. Height, crown diameter and collar girth in three & half- year-old plants was 1808 cm, 378 cm and 48 cm, respectively.

Three year-old *E. fastigata*



Three year-old *E. rudis*

High transpiration (3.11 mmol H_2O m^{-2} s^{-1}) and photosynthesis rate (10.14 μ mol CO_2 m^{-2} s^{-1}) was recorded in *E. rudis*. Soil samples collected and analyzed for pH, EC and organic carbon. Soil pH ranged between 98.3 and 10.3 at different sites. Soil organic carbon was more in surface than the sub-surface. Soil EC, recorded in August 2006 was low at 1357 RD, IGNP in comparison to the observations recorded in December 2005.This may be attributed to leaching effect due to rain. At Anupgarh shakha no such difference was observed because the area received no rainfall this season. Seasonal variation was observed in soil salinity. Slight increase in salinity was observed in the top soil layer. There was no significant difference with regard to soil organic matter in any of the sites.

In another experiment out of the four species planted viz. *Eucalyptus camaldulensis*, *Acacia nilotica*, *Tamarix aphylla* and *Casuarina junghuhniana*, *Tamarix* and *E. camaldulensis* recorded better survival and growth. One year old *Tamarix aphylla* attained height and crown growth of 207 cm and 172 cm at 1357 RD expt. plot out performing *E. camaldulensis* (130 cm, 80 cm and 6.5 cm of height, crown dia and collar girth respectively).

Project 6: Baseline survey study on biological diversity in Mangala, Sarswati and Rageshwari Areas of Rajasthan Hydro Carbon Project.

[AFRI- 75/FED/2006-2008].

Principal Investigator: Dr. G. Singh, Scientist E

The present proposal is formulated in view to: (i) Survey existing bio-diversity and eco-sensitive areas and compile inventory i.e., Ecosystems/areas (terrestrial and aquatic if available), Floral and faunal community/ species assemblages, Eco-sensitive areas like sanctuaries, wildlife habitats, breeding grounds, migratory routes and flocking areas if available; (ii) Identify rare, endangered and threatened species of flora and fauna, as notified by statutory authorities; (iii) Establish biodiversity Indices for flora and fauna identified. Accurate biodiversity indices need to be established for all rare, endangered and threatened species of flora and fauna occurring within the study areas; (iv) Mapping of forest and eco-sensitive areas; (v) Devise management plan based on their diversity and status; and (vi) Comparative analysis of biodiversity based on previous study (if any). Winter season vegetation survey of 372 plot (319 agriculture land, 14 forest land, 23 gauchar land and16 orans /Nadi) covering an area of about 1700 km^2 in Barmer district completed. Data entries, analysis and interim report is in progress. Socio-economic and vegetations in schools, temples and other community lands data have also been collected. About 122 (12 trees. 15 shrubs, 68 herbs and 27 grasses/ sedges) have been recorded. One new variety has been recorded.

Project:7 Productive propagation of remunerative medicinal plants for establishment of Silva-Ayurveda demonstrative models in the arid and semi arid areas, their preservation for further improvement, research, extension, development and diversification.

[AFRI-70/AFE/2006-2009].

Principal Investigator: Dr.R.L. Srivastava

Status:

Literature survey was done. Selected 13 Plots in 10 hectares of targeted area involving eight stakeholders for medi-culture. Analysis of soil and water samples collected from the selected areas completed. MOU signed with the farmers. Nursery site selected and choice of species worked out. 2500 Polybags of size 25X15 cms. and 15000 Polybags of size 20X10 cms. filled with potting mixture (Sand:FYM :: 2:1). Sowing of *Moringa oleifera* in 580 polybags, Ber in 620 polybags, Brahmi plantlets (2500) planted in 2 beds of 12X12 Feet, Tulsi sown in 2 beds of 12X12 Feet and Guggal Cuttings sown in 2300 polybags.

Project 8: Integrated management for qualitative improvement and increased production of rohida *(Tecomella undulata)* in Rajasthan. [AFRI-65/FP/2005-2007].

Status: *Principal Investigator – Dr. R. L. Srivastava*

Component 1: Insect pests and disease studies

Investigator – Dr. S.I. Ahmed

The observations revealed that the tree deformity pertaining to hollowness may initiate with the formation of cankers in the main trunks of the trees. The percentage of canker formation was found in trees having girth range from 80 cm onwards irrespective of age and girth class. The maximum percentage (18.65 %) of cankers has been noticed in the trees with girth range above 121 cm.

Identified 30 rohida trees exhibiting symptoms of hollowness in IGNP area as well as in the farmers' fields. Regular examination was made and studied marked trees pertaining to causal agents responsible for the hollowness problem. Thirty five (35) insect species belonging to 5 insect orders *viz.*, Coleoptera, Hemiptera, Isoptera, Lepidoptera and Orthoptera, have been recorded feeding on *T. undulata*. Important insect pests are grouped as defoliators, sap-sucking insects, stem and root borers, dry wood borers and termites (T). Majority of the insects are polyphagous and infest *T. undulata* in a moderate pattern but some are potential pests and found to cause epidemics in plantations in the selected localities around Bikaner and Jaisalmer. Of them, 12 species of Coleopterous beetles and weevils are found causing the economic damage to the shoot and root system of *T. undulata*. *Aeolesthes holosericea* and *Celosterna scabrator* are the most damaging species and can be termed as the key pests of *Tecomella undulata*. Eggs of these two species are laid on the bark and stem of young plants and larvae bore downwards, hollowing out the main root. Infestation by the larvae affects the plant growth and may cause death of young plants in case of severe injuries. Adults start emerging with the onset of monsoon. Yet another species of Cerambycidae, *Derolus volvulus* is a polyphagous in nature and its damage has been recorded in IGNP areas. Minor infestation of *D. volvulus* was noticed in the old plantation of *T. undulata*. Larvae excavate small tunnel of about 3-5 cm in the sapwood. The tunnels are filled with frass. *Inderbela quadrinotata* is a polyphagous pest, widely distributed throughout Rajasthan. Three species of termites are observed to be associated with the infestation in *T. undulata*. They cause a considerable damage to the dead wood as well as living trees. *Odontotermes wallonensis*, *O. obesus* and *Microtermes obesi* (Termitidae) are subterranean, fungus growing and mound building termites which are recorded to be injurious in the rohida plantations. *Inderbela quadrinotata* is the only lepidopterous insect causing damage as the insect borer of living rohida trees in IGNP area.

18 species of defoliators belonging to the orders Coleoptera, Lepidoptera and Orthoptera are associated with *T. undulata* and cause mild to severe defoliation by feeding on the foliage during the different stages of its development. There are about 7 sap-sucking species belonging to only one order *viz.*, Hemiptera. Insects with sucking or rasping mouth parts may produce extensive chloroses, but feeding has little direct effect on yield and quality of crops. Scale insects and hemipteran bugs are the main sap suckers on *T. undulata*.

adults and nymphs suck the cell sap of phyllodes and tender leaves and shoots as a result of which affected parts are devitalized, resulting shedding of leaves and drying of the attacked branches. Certain species are implicated in inducing physiological reactions. However, these insects are most noteworthy for their role as vector of plant diseases. They equally attack the succulent parts of young as well as old plants. Heavy termite infestation in Rohida trees at 1438 RD, Mohangarh and 1252 RD and 1265 RD at Nachna was also observed. Species responsible for the damage of bark and canker were identified as *Microcerotermes sp.* *Botryodiplodia theobromae* and *Phoma sp.* causing 40% damage. The infection occurs in the form of splitting of bark on the bole which spreads in upward and downward direction. Preparation of detail check-list of insect pests and disease spectrum of rohida is in progress

A management trial was laid out against stem canker disease on Rohida plantation at 1458 RD. Thirty (30) trees were selected randomly, marked and treated with AFRI paste. Observations on DBH, no. of canker per tree, length, depth and width of canker in marked trees were also recorded.

Component II: Rohida Macropropagation

Investigator – Dr. U.K. Tomar

An experiment conducted with following four variables:

- *Conditions: In side polyhouse/out side polyhouse*
- Container: Poly bags/ root trainers
- Treatment: Wax coating/without wax coating
- Stem thickness: (1.0 ± 0.4 cm and 2.0 ± 0.4 cm)

Therefore, a total 16 combinations of treatment were given to Rohida stem cuttings and 60 cuttings were raised with each treatment. Data were recorded after three months on sprouting, root primordia formation, root induction as well as number of cuttings attached by pathogens.

Surviving (1.0 ± 0.4 cm dia thick) stem cuttings exhibited high percentage of sprouting 100%, root primordial formation (72.7%) and rooting (27.0 %) if raised in polybags, treated with wax coating and raised in polyhouse at intermittent misting interval (99 min off, 99 sec. on). Rooting percentage was significantly higher in polybags, wax coated cuttings and 1.0±0.4 cm dia thick stem cuttings as compare to root trainers, without wax coating and 2.0±0.4 cm dia thick stem cuttings.

Component- III: Growth & Yield Studies on Rohida Plantations.

Investigator – Dr. V.P. Tewari

Annual measurements carried out in 22 sample plots of *T. undulata* laid out in IGNP Stage-II of Rajasthan State.

The data collected were compiled and plot computations completed. The summary results also indicated that depending upon age, site and density, average height in the stands varied from 3.45 to 6.24 m, mean quadratic diameter from 6.30 to 12.28 cm, dominant height from 4.56 to 8.54 m, basal area from 1.94 to 14.21 m^2/ha, volume yield from 4.20 to 44.10 m^3/ha, height increment from 0.19 to 0.37 m/yr, dbh increment 0.36 to 0.64 cm/yr and MAI from 0.22 to 2.47 m^3/ha/yr.

Generalised height-diameter equation was developed. Four different equations were compared and best model was selected based on the quantitative statistical tests viz., bias, relative error of prediction, coefficient of determination and Akaike's information criteria differences.

New projects initiated during 2006-2007 (Externally aided)

Project-1: Source variation, extraction and cultivation Practices for *Commiphora wightii* Arn. Bhandari

Investigators: Dr. Dr. D.K. Mishra, Dr. R. Arya and Dr. Tarun Kant

The National Medicinal Plants Board, Ministry of Health and Welfare approved this project for three years in November 2006.

Status:

Component–I: Selection of various clonal accessions (Seed sources) of guggal from different regions of Rajasthan and their performance trial

As a common practice, in general, half mature fruits were collected for seeds, this result into low germination. After depulping these half ripe-fruits gave black and white coloured seeds. Black coloured seeds are viable and gave 75-90% germination. To overcome this problem, we have developed some technology to fasten the process of fruit ripening in guggal. Half ripe-fruits of guggal were collected in the month of November 2006 from naturally growing trees near Ajmer, Rajasthan. Fruits were brought to the laboratory. Individual fruits were removed from twigs and were enclosed and sealed in 200-micrown thick polythene bag and was kept in the lab for 18-24h. All fruits were turned red. Fruits were depulped and almost 80% seeds were of black colour and showed viability. However, unsealed fruits were difficult to depulp and all half red fruits showed white-coloured seeds. Application of this technique has enhanced seed germination and ease in seed collection for guggal propagation.

Material collected from various places was kept in 12x22cm size polythene bags with good soil and FYM in the ratio of 2:1. All bags were kept in polyhouse having misting facility. The places from where, material has been collected is tabulated below.

Sl. No.	Name of the Place	Locational GPS Details
1	Kailana, Jodhpur	26°17'59.54" N; 72°58'10.48"E
2	Kherwa, Ajmer	26°12'00.13" N; 74°26'00.97"E
3	Beawar, Pali	26°05'42.19" N; 74°18'44.61"E
4	Palri, Sirohi	24°54'27.24" N; 72°51'44.53"E
5	Kiradu, Barmer	25°42'58.89" N; 70°46'42.08"E
6	Kaladungar, Jaisalmer	27°00'40.00" N; 71°21'50.00"E
7	Bandikui, Dausa	26°53'05.30" N; 76°20'34.62"E
8	Jhalani Dungari Hill, Jaipur	26°54'19.64" N; 75°44'33.67"E
9	Chhatariwali Pahari, Sikar	27°36'22.01" N; 75°08'18.34"E
10	Dada Phatehpura Dungar, Jhunjhunu	28°07'08.47" N; 75°24'01.88"E
11	BalaKila Hills, Alwar	27°20'07.82" N; 76°23'02.14"E
12	Ladnu, Nagaur	27°38'30.37" N; 74°24'29.21"E
13	Near RAU Campus, Bikaner	28°01'11.94" N; 73°18'56.34"E

Component–II:

Field visits were undertaken to Mangaliawas Guggal Herbal Farm, Ajmer Forest area in Jaisalmer and Kumatia encloser in kailana, Jodhpur. For initiation of experiments at Mangaliawas, a letter has been sent to the Director CCRAS, New Delhi with a copy CCRAS, Jaipur. They informed that transfer of research farm to the national Institute of Ayurveda, Jaipur is underway. So far research farm has not been transferred to NIA. Hence Director, NIA has not agreed for the laying of the trials. Oldage plantations are not available at Jaisalmer. A letter has been written to CF, Jodhpur for laying trials at Kumatia enclosure, Kailana.

Component–III:

Fresh callus cultures have been established from juvenile explants on MS medium. Experiments on applicability of Guar gum, sago granules and powder and isabgoal as viable gelling agents have been initiated and are underway. The results are encouraging and it has been observed that each of these can be used as an alternative gelling agent. Older somatic embryogenic cultures have been revived and cultures are being maintained. Here isabgoal has shown promising results compared to two others tested so far.

Project 2 'Studies on prediction of NTFP availability and potential for extraction in Aravali region of Rajasthan'

Principal Investigator- Dr.R.L.Srivastava

Status :

Project was initiated & submitted to Rajasthan Forest Department on their request. Rajasthan Forest Department has awarded the project to AFRI. Project period is two years and budget sanctioned is Rs.4.50 lakhs out of which Rs3.71 lakh has been received as three installments 42 villages from three forest divisions i.e. Pratapgarh, Udaipur (C) and Banswara were selected for detailed study. Initial as well as post monsoon observations for natural regeneration in 84 plots of 42 villages have been taken. Socio-economic survey of 42 villages has been done. Rapid survey of other villages in study area is being undertaken

Project 3: Enhancing productivity of saline wastelands in Kachchh through improved tree planting techniques and silvipastoral study

Principal Investigator- Dr. Ranjana Arya

Status:

Sub Project A: The experimental area is located in Kordha, Sami Range in Patan (23.83° N latitude 72.12°E longitude) of Gujarat, India. The area is on the fringe of little rann of katchchh. The initial soil status is summarized in Table 1.

Soil depth (cm)	pH_2	$EC_2(dSm^{-1})$	% SOC	% $CaCO_3$
0-20	7.83	4.04	0.18	6.27
20-40	7.78	11.58	0.27	7.02
40-60	7.89	17.12	0.28	7.59
60-80	7.66	18.17	0.36	7.48
80-100	7.60	17.55	0.37	7.0

It is a highly saline silty clay textured black soil (medium) having soil depth 75-100 cm. Trials of *S. nudiflora, S. persica* and *Tamarix dioca* were laid with five treatments T_1 Control; T_2.FYM (@ 5 kg/pit); T_3. FYM (@ 5 kg/pit + Gypsum; T_4. FYM (@ 5 kg/pit + 15% Sand; T_5. FYM (@ 5 kg/pit + 30 % Sand and that of *Acacia ampliceps* with four treatments; T_1.Control; T_2.FYM (@ 5 kg/pit); T_3. FYM (@ 5 kg/pit) + Gypsum and T_4. FYM (@ 5 kg/pit) + 1 kg Wheat husk in : RBD Design with 3 Replication: at spacing: 4 m X 4 m.. There were nine plants pertreatment per replication. Six month old seedlings of *S. nudiflora, S. persica and Acacia ampliceps* were planted in pits of size 60 x 60 x 45 cm^3 while Tamarix was planted bare rooted after uprooting from pond side. As there was no rain after the planting monthly irrigation was provided with normal water (pH 7.71 and EC 0.51 dSm^{-1}. *Salvadora persica* and *Tamarix dioca* did not survive the experimental conditions after three months.

The percent survival of *Sueada nudiflora* after six months was 66.6, 78.6, 58.3, 70.3 and 51.5 for T_1- T_5 treatments respectively. In case of *A. ampliceps* it was 29.6, 33.3, 33.3 and 81.4 and height and crown diameter was 31.7 & 20; 36.1& 30.7; 33.6& 33.6 and 40.5 & 56.1 cm for T_1 to T_4 treatments indicating that application of wheat husk with FYM is the most suitable treatment. There was no change in pH but EC values decreased to 3.29 to 6.21 and 4.29 to 8.4 dSm-1 in upper and lower soil layers due to various treatment application Weed evaluation is done , mostly halophytes dominated by *S. nudiflora* appeared.

Sub Project B: The experimental site was located at Mochirai forest range in Bhuj district (23.15'N latitude, 69.49'E longitude) of Gujarat, India. 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. Organic carbon in 0-25 cm, 25-50 and 50-75 cm soil layer was 0.34, 39 and .36 % respectively. Soil depth to an impermeable underlying calcium carbonate layer was 25-75 cm at different places. Trials with four tree species namely *Cordia gharaf, Prosopis cineraria, Ziziphus. mauritiana* and *Colophospermum mopane* and three grass species, namely, *Cenchus ciliaris, C. cetigerus* and *Dicanthium annulatum* were laid in RBD in three replication at Mochirai, Bhuj in July 06. The six-month old seedlings of tree species in polybgs were planted in pits of size 30 x 30 x 30 cm at a spacing of 6 x 4 m. Among the tree species the percent survival was *P. cineraria* (98.76%), *Z. mauritiana* (100%), *C. gharaf* (100 %), and *C. mopane* (92.59%) for tree control and *P. cineraria* (100%), *Z. mauritiana* (95.67%), *C. gharaf* (100 %), and *C. mopane* (91.35%) with grass species after six months . Growth wise *C. gharaf* recorded maximum growth (height and crown dia) while minimum growth was for *C. mopane* after six month of planting. After fortnightly irrigation with saline water (pH_2 7.4, EC_2 5.6 dSm^{-1}) from October 2006 there is increase in EC in plant furrows now it ranges from 0.5-1.8dSm-1 for 0-25 cm soil layer and 0.33 to2.1 dSm^{-1} for 25-50 cm soil layer while EC in inter row spaces is .0.1 to 0.26 and 0.12 to 0.22 dSm-1 in upper and lower soil layer.

Green (dry) grass yield was estimated in Sept 2006 and an average yield of 1.21 (0.33), 0.67 (0.18), 1.02 (0.28), 0.78 (0.21), and 1.08 (0.29) Kg m^{-2} was recorded for *Z. mauritiana*, *C. gharaf*, *P. cineraria*, *C. mopane* and grass control respectively for *C. ciliaris*. In case of *C. setigerus* these values are 0.59 (0.21), 0.80 (0.29), 0.83 (0.30), 0.69 (0.25) and 0.60 (0.22) Kgm^{-2} respectively. Germination of *D. annulatum* was poor and only 0.37 kgm^{-1} yield was recorded in scattered pockets. However 0.89 kgm^{-2} yield of local vegetation, 60-80 % of which was palatable was recorded. Weed evaluation was under taken in Feb 07, more than 50 native species appeared on the site including halophytes and Glycophytes.

New projects initiated during 2006-2007 (Plan)

Project 1: Assessment of Neem International Provenance Trial

Principal Investigator : Sh. N. Ravi

Status :

The project is started from the month of July 2006. Observations are taken during this period. The growth parameters of the different provenances are taken and flowering observation is made. During the initial observation, i.e. in the month of August few fruits were found in some international provenances, given an indication that the flowering either started late or could be late flowering. This we can conclude after making few observations in the coming year. No flowering is observed in the trial till date.

Project 2: Demonstration trial of male and female *Ailanthus excelsa* plants raised through grafting and tissue culture.

Principal Investigator: Dr. U.K. Tomar

Status:

A. excelsa trees (50 male and 50 female) have been identified and marked and two ha site identified at AFRI (VMG field) for demonstration. Seedlings (200 Numbers) have been raised as root stock for grafting. Grafting work of male female scion on the root stock is in progress. Similarly establishment of in vitro cultures of male female *A. excelsa* trees is also in progress.

Research Achievements statewise under Institutes jurisdiction

Name of state	No. of Projects completed in 2006-07	No. of Ongoing Projects in 2006-07	No. of Projects initiated in 2006-07
Rajasthan	04	26	04
Gujarat	01	06	01

Technology Assessed and Transferred

- Growth & yield functions (volume equations, site index equations, potential density and Basal area projection models) developed for *Acacia nilotica* and *Eucalyptus* hybrid plantations in Gujarat State. The detailed report incorporating these models and results sent to the PCCF, Gujarat and other concerned officials for using them in sustainable management of the plantations of the two species in the state.

Education and Training:

Education:

- Mr. Pradeep Chaudhry was awarded Ph.D degree from FRI, Deemed University , Dehradun on the topic of Forest management i.e. " Valuing recreational benefits of Urban Forestry- A case study of Chandigarh city" under the supervision of Dr. V.P. Tewari, Scientist- E, Silviculture Division, AFRI, Jodhpur.

- Ms. Neelam Verma was awarded Ph.D degree from FRI, Deemed University , Dehradun on the topic of Forest Pathology i.e. " Dependacy, evaluation and selection of efficient strains of a –mycorrhizal fungi for *Prosopis cineraria* (L) Druce. In Western Rajasthan." under the supervision of Dr. K.K. Srivastava, Scientist-E, Forest Protection Division, AFRI, Jodhpur.

- Mr. Sandeep Kaushish was awarded Ph.D degree from FRI, Deemed University , Dehradun on the topic of Forest Genetics i.e. " Assesing variability of seed, seedling and sapling on some morphological and chemical traits of superior germplasm of *Azadirachta indica* A. Juss. In hot arid environment" under the supervision of Mr. C.J.S.K. Emmanuel, Scientist-F, Head, Forest Genetics and Tree Breeding Division, AFRI, Jodhpur.

- Mr.. Devender Kumar was awarded Ph.D degree from FRI, Deemed University , Dehradun on the topic entitled " Studies on viability and performance potential of neem (*Azadirachta indica* A. Juss)." under the supervision of Dr.D.K. Mishra, Scientist-E, Silviculture Division, AFRI, Jodhpur.

(b)Training attended by AFRI Scientists

International: Nil

National:

Dr. S.I.Ahmed attended a training programme on *"Intellectual Property Rights and World Trade Organization Related Issues"* sponsored by Department of Science and Technology, Government of India from July 31 to August 4, 2006 ay Administrative Staff College of India, Hyderabad.

(c) Training imparted by Institute:

- A training programme was organized from 12th to 16th September,'06 for Watershed Development Team consisting of 42 participants, including 9 Technical members, 11 Agricultural Experts, 6 Animal Husbandry experts and 16 Social Workers ; on Watershed Development sponsored by Zila Parishad Jodhpur under Hariyali-2003 programme of Ministry of Rural Development, Govt of India. Lectures cum discussions on the topics related to Hariyali document guidelines, forestry, soil and water conservation, medicinal plants, horticulture and animal husbandry were organized. Field trips to experimental areas on above topics were also undertaken.

- A training programme was organized at AFRI from 17th to 22nd December, 2006 for Watershed Development team members consisting of 60 participants, which included Agricultural experts, Animal husbandry experts, Social workers and Junior engineers; sponsored by Zila Parishad Jalore, Rajasthan under Hariyali-2003 programme of Ministry of Rural Development, Govt of India. Lectures cum discussions on the topics related to Hariyali document guidelines, forestry, soil and water conservation, medicinal plants, horticulture and animal husbandry were organized. Field trips to experimental areas on above topics were also undertaken.

- One week IFS officers' refresher training course was organized at AFRI, Jodhpur from 21st -25th August, 2006 on **"Integrated approach for sustainable development of fragile desert ecosystem"**. The training was sponsored by Ministry of Environment and Forests, Government of India, New Delhi. Eighteen (18) IFS officers from different states participated in the refresher course. Besides class room interaction, participants were taken to Indira Gandhi Nahar Pariyojna (IGNP) area and Desert National park in Jaisalmer District. They were also taken to a Zizyphus based agri-horti field of a progressive farmer in Jodhpur district to show them utility of such agroforestry system in improving productivity and income generation in arid region. Eminent resource persons from AFRI and other reputed organizations delivered talks/lectures and interacted with the participants. Sh. Abhijit Ghose, PCCF, Rajasthan addressed the participants in concluding session.

- Training on pure multiplication of VAM inoculum and isolation techniques of Rhizobium was imparted to the freshly recruited JRFs under Boifertilizer project of SFD, Gujarat at Training and Research Centre, Gandhinagar by Dr. K.K.Srivastava, Sceintist-E of Forest Protection Division during 11th & 12th August 2006.

- A training on VAM technology was conducted for 35 members (ACFs, Rangers, Foresters, Progressive farmers and JRFs) by AFRI team under the consultancy

project entitled" Identification of mycorrhizal and rhizobial association, establishing gene bank and technology transfer to farmers in field" funded by Gujarat State Biotechnology Mission at Training & Research Centre, Gandhi Nagar.

- Desert Learning Programme was organized during 12th-14th December, 2006 at AFRI in collaboration with Ashoka Trust for Research in Ecology and the Environment (ATREE), N.Delhi. Director, AFRI, Head Forest Ecology and Head Forest Protection Divisions addressed/gave inputs to the 45 school students, who were from Ambala district of Haryana.

(d) Educational visits at the Institute:

- As a part of their training programme, 38 IFS Probationers including 3 ladies (2006 Batch) from Indira Gandhi National Forest Academy, Dehradun visited Jodhpur on 26th and 27th February, 2007. They were got acquainted with A.F.R.I. research -facilities, activities and services on 27-02-2007 with a briefing by the Group Coordinator (Research) and a power point presentation by the Head, A.F. & E.D. They also had a visit to the Extension & Interpretation Centre and AFRI Model Nursery, Arboretum and Germ Plasm bank of Medicinal Plants.

- As a part of their training programme, 37 Forest .Range Officers Trainees including 15 ladies of 2006-2007 Batch with one faculty member from S.F.S. College Dehradun while on West India Tour visited the institute. They were got acquainted with A.F.R.I. research-facilities, activities and services on 01-03-2007 with a briefing by the Group Coordinator (Research) and a power point presentation by the Head, A.F. & E.D. They also had a visit to the Extension & Interpretation Centre and AFRI Model Nursery, Arboretum and Germ Plasm bank of Medicinal Plants.

- As a part of their training programme, 21 Range Forest officer trainees (including 8 lady trainees) with two Faculty Members from Range Forest Officer Course Trainees of Eastern Forest Rangers' College, Kurseong while on North India Tour Programme visited Jodhpur with effect from 02-02-2007- to 04-02-2007 .They visited various research facilities and experimental fields at A.F.R.I. They were also briefed about the activities of the institute with a power point presentation by the Director A.F.R.I. on 02-02-2007.

- As a part of their training programme, 28 numbers of RFO trainees from Eastern Forest Rangers' Training School, Kurseong (W.B) visited AFRI on 19th and 20th April, 2006. They were briefed about the research achievements of the institute and were taken to Extension & Interpretation Centre and Research fields of the institute.

- As a part of their training programme, A class of !7 Forest Guards from different forest divisions of Rajasthan visited AFRI model nursery on 19.07/06 .
- As a part of their training programme, forty Forest Guards accompanied by their Training Incharge Shri S.K.Wason, H.F.S. from Natural Resources Management Centre, Sohna, Distt. Gurgaon (Haryana) were in the Institute from 26th (evening) to 27th (morning) of August,'06 .They visited AFRI model Nursery, experimental plots and were acquainted with arid zone forestry research/technology in the field of plantation on stress sites, VAM, integrated pest management etc.
- As a part of their training programme, thirty Forest Guards with one faculty member from N.R.M.C., Sohna, Gurgaon of Haryana Forest Department visited the Institute on 04-01-2007 and were got acquainted with AFRI facilities, activities and services, as also, a tour to Khejarli Village of Jodhpur District where 363 people laid their lives to save trees from felling in 1760 A.D. and a power point presentation was given on the topic "Eco-Tourism in Dry Areas", which also encompassed institutional attributes, by Head, Agroforestry and Extension Division (A.F &E.D)A.F.R.I. Jodhpur on 05-01-2007.
- As a part of their training programme, nineteen foresters undergoing refresher course cum training at Maru Van Prashikshan Kendra, Jodhpur; visited AFRI model nursery and Medicinal Plants Germ-plasm bank on 16/01/07. They were briefed about importance of medicinal plants, their cultivation, harvesting and uses by Silviculture division staff.
- More than forty farmers from different districts of Rajasthan visited AFRI model nursery and medicinal plants germ plasm bank on 16/02/07 in a training programme sponsored by IFFCO and were given demonstration of nursery technology, field planting. They were also briefed about importance of medicinal plants cultivation in arid conditions.
- One hundred farmers, from different Panchayat samitis while on study tour under Watershed Development Project, were got acquainted with AFRI facilities, activities and services including a talk by Shri C.S. Dange, I.F.S., Conservator of Forests, Head, A.F. & E.D., A. F. R. I., Jodhpur on the topic of "Development of Multi-tier Farm Forestry with Watershed Development" on 03rd Nov.,06. They visited AFRI model nursery and were told about arid zone species plantation and nursery technology by Sh.A.Apte,DCF, Silviculture division.
- Twenty officers from different departments like Horticulture, Agriculture and Animal Husbandry visited AFRI model nursery and Medicinal Plants Germ-plasm bank on 19/01/07 along with Dr. Ramesh Mittal, Dy.Director, National Institute of Agricultural Marketing, Jaipur.

- About 160 students of Aravali Institute of Management, Jodhpur visited AFRI for the whole day. A power point presentation was given by the Director of the Institute Dr. R.L. Srivastava. The group was divided into five batches and visited Tissue culture lab and vegetative propagation unit; Silviculture Nursery; Interpretation Centre; Neem Provenance Trial and Soil, Seed and Protection laboratories. On the completion of visit an interaction session was also organised with AFRI Scientists and AIM's faculty.

- A group of 56 Students of Class IX with 7 Faculty and supporting staff members from Balika Adarsh Vidyamandir Madhyamik Jodhpur visited the AFRI Extension & Interpretation Centre, Model Nursery, Arboretum and Germ Plasm bank of Medicinal Plants. They were also got acquainted with A.F.R.I. facilities, activities and services on 08-03-2007 with a power point presentation by the Head, A.F. & E.D.

- One hundred twenty students of Central Academy Senior Secondary School, Ratanada, Jodhpur along with their 6 teachers visited AFRI Jodhpur in the forenoon of 28th September,'06 and were got acquainted with AFRI facilities, activities and services including a power point presentation by Shri C.S. Dange, Conservator of Forests, Head, A.F. & E.D., A. F. R. I., Jodhpur on the topic "Eco-Tourism In Dry Areas."

- Fifty Swayam Sevak Students of different schools along with their two teachers visited AFRI Jodhpur on 31st October,'06. They were got acquainted with AFRI facilities, activities and services including a briefing on the same by Shri C.S. Dange, I.F.S., Conservator of Forests, Head, A.F. & E.D., A. F. R. I., Jodhpur. They visited AFRI model nursery and were told about arid zone species plantation and nursery technology by Sh.A.Apte,DCF, Silviculture division.

- Sixty eight students of Sir Pratap senior secondary school, Jodhpur with their teachers visited AFRI Jodhpur on 10th Nov.,'06 and were got acquainted with AFRI facilities, activities and services including a power point presentation by Shri C.S. Dange, I.F.S., Conservator of Forests, Head, A.F. & E.D., A. F. R. I., Jodhpur on the topic "Eco-Tourism in Dry Areas."

- Fifteen students of M.Sc. Biotech, final year with two faculty members of B.N (P.G.) College Udaipur, Rajasthan visited A.F.R.I., Jodhpur on 30th Nov.2006 and were got acquainted with AFRI facilities, activities and services by Agroforestry & extension and Silviculture divisions, A. F. R. I., Jodhpur.

- Twenty Students of B.Sc. Forestry Final Year with two faculty members of Dr.Y.S. Parmar University of Horticulture & Forestry, Nauni, Solan (H.P.) while on Educational Tour were got acquainted with AFRI facilities, activities and services, as also, Arid/Semi-Arid perspectives of A.F.R.I.'s mandated areas

through a power point presentation by Dr. R.L. Srivastava, I.F.S., Addl. P.C.C.F., Director A.F.R.I., Jodhpur and HODs, A.F.R.I. on 20-01-2007.

- Twenty students of Mahesh Senior Secondary School Jodhpur visited A.F.R.I. model nursery on 15-01-2007. They were given demonstration of tree planting by the staff of Silviculture division. They also collected A.F.R.I. brochure and were also given a briefing about A.F.R.I. facilities, activities and services by staff of A.F & E. Division.

Linkages and Collaboration:

National:

- Tata Energy Research Institute, N. Delhi
- Central Arid Zone Research Institute, Jodhpur
- Jai Narayan Vyas University, Jodhpur
- Council of Scientific and Industrial Research, N. Delhi.
- National Medicinal Plants Board, N. Delhi.
- Department of Biotechnology, Govt. of India, N. Delhi.
- National Mission on Bamboo Application, N. Delhi
- Ministry of water resources, N. Delhi.
- Rajasthan Forest Department
- Gujarat Forest Department.

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Chapters in Books

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Research Papers in Scientific Journals:

International

Chaudhry, P. and Tewari, V.P. (2006). A comparison between TCM and CVM in assessing the recreational use value of urban forestry. P., *International Forestry Review* 8(4), 439-448.

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Arya, Ranjana and Shukla Upendra (2005). Growth and water use of some important forestry species after 52 months of age under irrigated conditions in hot arid zone, *Current Agriculture* Vol 29 :113-119.

Singh, G. and Rathod, T.R. (2006). Rehabilitation of degraded drylands of Indian arid zone through seeding. *Indian Forester*, 132(7): 2006, 809-817.

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Kumar, Shivesh and Ahmed, S.I. (2006). Seasonal occurrence and population of Eriophyes prosopidis Saxena, a leaf and inflorescence gall mite of *Prosopis cineraria* (Khejri) in Rajasthan. *Indian Journal of Forestry*, 29(3): 287-292.

Srivastava K.K. and Srivastava H.P.(2006). Selection of Efficient isolate of VAMF for *Tecomella undulata* (SM.). *Indian Journal of Forestry*, 29 (3): 335-337.

Gour, V.S. and Tarun Kant.(2006). Optimized callus production in *Balanites aegyptiaca* (L) Del. - A potential source of Diosgenin. *Journal of Phytological Research*. 19 (1).

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Tarfdar, J.C. , Yadeo, R.S. Bareza , M. and. Singh ,G .(2006). Phosphorus fractionation under crop, tree and grasses. *J Indian Son. Soil Science*, 54(1): 38-44.

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Employment Generation and Rural Development held on August 29-30, 2006 at FRI, Dehradun

Tewari, V.P. (2006). "Current approached in modeling growth and yield in forestry plantation" Paper presented in the International Conference on "Planted Forests: Ecosystem Good and Services" organized at FRI, Dehradun during 13-15 Dec. 2006.

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U. K Tomar and A.K. Sinha (2006) Determining an minimizing cost of micro propagated tree species, In Proceedings National Symposium on Plant Biotechnology, held at Forest Research Institute, Dehradun

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Tewari, V.P. , J.J. Corral Rivas, F. Vilcko and K.v. Gadow (2006).Height-growth and site index equations for *Acacia nilotica* and *Eucalyptus hybrid* plantations in Gujarat State of India. *Forests, Trees and Livelihoods* (in press).

Tewari, V.P. and K.v. Gadow (2006).Modelling potential density, mean stand density and basal area growth for pure even-aged *Dalbergia sissoo* stands in a hot arid region of India. *Forests, Trees and Livelihoods* (communicated).

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Pramod Kumar, Bala, N. and Bohra , N. K. (2006). Carbon Sequestration Potential in Degraded Soils of Arid and Semi-Arid Regions of India through People's Participation. Submitted to *Int. J. For. Usuf. Mngt.* 7(1):17-25.

Singh, G. (2006). Effects of irrigation on growth and on biomass and nutrient partitioning in *Eucalyptus camaldulensis* seedlings. *J. Forestry,* (submitted).

Singh, G.,. Rathod, T.R Singh, Bilas and Chouhan, Manoj (2006). Interactions and Productivity in *Emblica officinalis* Based Agri-horticulture System in Indian Desert. *Biological Agriculture & Horticulture* (submitted).

Chaukiyal, S.P. and. Singh, G. (2007). Naturally growing nitrogen fixing species enhances soil enzyme activity in and fertility of degraded soils of dry areas of north western India. *Biology and Fertility of Soils* (submitted).

N. Kaushik, G. Singh, U.K. Tomar, S.N. Naik, S. Vir, S.S. Bisla K.K. Sharma, S./K. Banerjee and P. Thakkar (2007) Regional and habitat variability in azadirachtin content of Indian neem (*Azadirachta indica*), Current Science (accepted)

Extension brochure/pamphlets

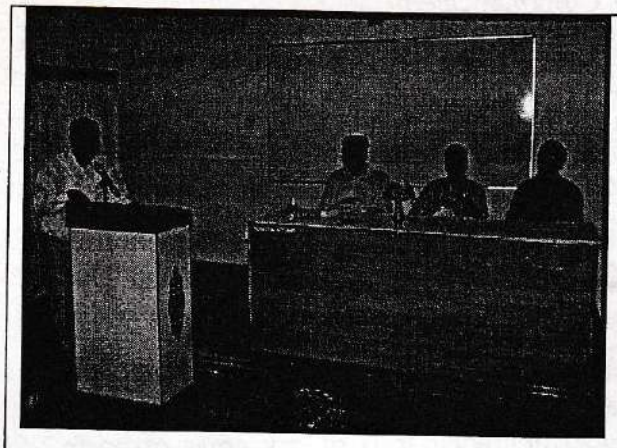
Brochures:

Brochure on `Food from forests' published and released during National Workshop on "Forestry for Food Security in dry zones" held at AFRI, Jodhpur from 6-7 Oct 06.

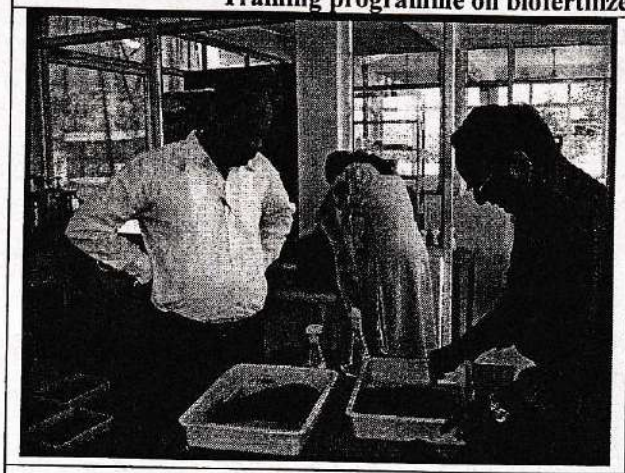
A bilingual brochure on '*Desertification: its significance, challenges and solutions'* published and released on 17th June 2006, the World day to combat desertification..

Consultancy

Consultancy on "Identification of mycorrhizal and rhizobial association, establishing gene bank and technology transfer to farmers in field" funded by SFD, Gujarat. Under this consultancy, training was imparted to SFD officials, seven different species of AM fungi & Rhizobial strains were isolated and mass multiplied, and AM inoculation experiments on six different tree species were laid out in nursery at Gandhinagar.



Training programme on biofertilizer organized at TRC, Gandhinagar



Preparation of inoculum

AM inoculation in nursery

Patents Obtained/filed

Nil

Commercialisation of technology

Nil

Organised and participation in conference/meeting/workshop/ seminars/symposia/exhibitions/awareness programme Organised

Celebrated 57th Van Mahotsava on 7th July, 2006 at AFRI Model Nursery. Air Commodore J. Kumbhat, Air Officer Commanding, 32 Wing Air Force, Air Force Station, Ratanada, Jodhpur was the Chief Guest in the function in which Director, CAZRI presided over. Ten thousand leaflets in Hindi mentioning importance of local trees was distributed among different NGOs, progressive farmers and public representatives up to village Panchayat level to generate public awareness and mobilize the masses to get associated and for their active cooperation in tree plantation A painting and quiz

competition was organized for school children on this occasion. Apart from AFRI personnel; 196 students from 11 different schools of JODHPUR participated in the Painting competition and 28 students participated in Junior and Senior Quiz Competitions.

Celebrated World Environment Day on 5th June,2006. Ceremonial Planting was done in AFRI campus. A one page pamphlet highlighting DOs & DON'Ts in the form of slogans for the citizens/general public on environmental issues was issued in Hindi and distributed among the public for mass awareness about environment and related problems. Organised Quiz and Painting competition on the occasion . About 75 students from 10 local schools participated in Quiz and Painting competition.

Celebrated World day to Combat Desertification on 17th June 2006. Prof. L.K. Shekhawat, Vice Chancellor, Jai Naraian Vyas University, Jodhpur was the Chief Guest while Dr. Pratap Naraian, Director, Central Arid Zone Research Institute, Jodhpur presided over the function. Eminent persons, administrators, planners, NGOs, farmers and public attended the function and took part in planting programme organized in the experimental field of AFRI.

Five different flex-charts and ten laminated photographs highlighting research achievements of AFRI were prepared and sent to Head, Extension division, FRI for displaying at 21st Asia Pacific Commission Meeting at ICFRE, Dehradun during 17-21 April 2006.

A day long brain storming session on "Floods in Thar and Challenges of Natural Disaster: Prevention, Relief and Rehabilitation" was organized jointly by Arid Forest Research Institute (AFRI), Jodhpur and The School of Desert Sciences (SDS), Jodhpur at AFRI seminar hall on 19/09/06. The programme was divided in to four sessions. Session-I: Response to Flood; Session-II: Satellite Support in Disaster Management; Session-III: Climatic and Geological Oscillations and Session IV: Human Health, Biological & Ecological Challenges. The sessions were chaired by Shri B.L. Arya, IAS - Divisional Commissioner, Jodhpur, Shri V.N. Mathur- Chief Engineer, Ground Water Department, Jodhpur, Dr. Pratap Narian- Director, Central Arid Zone Research Institute (CAZRI), Jodhpur and Dr. Lalit K. Panwar, IAS- Principal Secretary, Department of Urban Development & I/C Flood Relief Operations, Government of Rajasthan, respectively. Fifty five numbers of Scientists from CAZRI, Desert Medicine Research Centre, Centre for remote sensing of ISRO and Govt of Rajasthan, ZSI, BSI etc; officers like collectors from Barmer, Jaisalmer districts, CGWB, irrigation, agriculture, animal husbandry departments and NGOs participated in the session. Finally a plenary session of open house discussion was held having the panel of experts viz., Dr. Lalit K. Panwar- Principal Secretary, Department of Urban Development & I/C Flood Relief Operations, Government of Rajasthan, Shri B.L. Arya-Divisional Commissioner, Jodhpur, Dr. R.L. Srivastava- Director, Arid Forest Research Institute, Jodhpur and Prof. S.M. Mohnot- Director, The School of Desert Sciences, Jodhpur.

A consultative meeting on *Commiphora wightii* (Guggul), an endangered medicinal plant, was held at AFRI on 20/02/07, which was chaired by Sh.B.S.Sajwan, Chief Executive Officer, National Medicinal Plants Board, N.Delhi. The main aim of the meet was to have a discussion to prepare a preliminary road map for availability of Guggul on sustainable basis for Ayurveda, Sidha and Unani industry in the country. The meeting was attended by General Secretary, Ayurveda drugs manufacturer association, Mumbai; Director, National Institute of Ayurveda Jaipur; Director, CAZRI Jodhpur; Member Secretary, Rajasthan state medicinal plants board; C.F, Jodhpur; and other prominent Scientists of CAZRI, AFRI and Rajasthan Ayurveda university, Jodhpur. Latest research works being done on this species by AFRI and CAZRI were discussed. Field trials raised by AFRI on Guggul were also inspected by the participants

The Institute has been given the responsibility by ICFRE Hqrs. for the Mid Term Evaluation of Forest Developmental Agencies (FDA) projects funded by NAEB, N. Delhi to assess the ecological/biological /technological/social and economic impact due to the project intervention. Two teams were sent for the pilot study for this purpose. The first team went to Gujart – Kutch West forest division and the second team to Udaipur Central forest division in Rajasthan. The data collection information has been sent to ADG (EIA), ICFRE, Dehradun.

Organised National workshop on "Forestry for food security in dry zone" during 6th and 7th October 2006, to commemorate International Year of Deserts and Desertification.

Participation

Sh. CJSK Emmanuel, Scientist-F participated as resource person for UGC refresher course on "Plants and Microbes as Natural Resources" organized by Department of Botany, JNV University, Jodhpur.

Dr. R.L.Srivastava, Director & Dr. G. Singh, Scientist-E, attended a meeting to finalize 3rd National report on implementation of provisions and processes of United Nations Convention to Combat Desertification (UNCCD) in India at Indian International Centre, Lodhi Estate, New Delhi – 110003 on 13.07.2006.

Dr. R.L. Srivastava, Director attended Agri Conclave 2006, organized by Confederation of Indian Industry, at Kota, Rajasthan during 14th-15th July, 2006 and chaired the plenary session on "Soil Mapping and Quality Inputs" during the conference-cum-showcase on Agriculture & Food Products. He also addressed the farming community during plenary session VIII on Soil Mapping with special reference to Hadauti region.

Dr. R.L. Srivastava, G. Singh and Dr. D.K. Mishra participated in International conference on 'Biofuels Vission 2015' at engineering college, Bikaner, Rajasthan during 13-15th October 2006. and special invited talk was delivered by Dr. R.L. Srivastava on the topic "Jatropha: As environment friendly fuel and an opportunity for employment generation in rural urban India"

Dr. R. L. Srivastava, Director, AFRI attended 3rd meting at DBT, New Delhi on 11th and 12th October 2006.

Dr. R.L.Srivastava, Director AFRI, undertook evaluation tour of Raipur (Chattishgarh) under DBT network programme on "Production and demonstration of high quality planting Jatropha" during 30/10/06 to 02/11/06 along with other DBT team members.

Dr. R.L.Srivastava, Director AFRI attended National symposium on "Tree improvement for sustainable forestry" at Jawahar Lal Nehru Krishi Vishwa Vidalaya, Jabalpur during 04/11/06 to 06/11/06. He delivered key note address and chaired two technical sessions on the themes namely "Production of genetically improved forest tree species products" and "Sustainable management of man made forest using improved planting stock".

Dr. R.L.Srivastava, Director, AFRI attended a DBT meeting at N.Delhi on 14th December, 2006 to discuss and workout modalities of "DBT bioresources and biotechnology awareness generation clubs for school children".

Director, AFRI attended Second meeting of Scientific Advisory Committee on Biofuels and Bioenergy at Department of Biotechnology, New Delhi on 28th and 29th March 2006.

Dr. R.L. Srivastava, G. Singh and Dr. D.K. Mishra participated in International conference on 'Biofuels Vission 2015' at engineering college, Bikaner, Rajasthan during 13-15th October 2006. and special invited talk was delivered by Dr. R.L. Srivastava on the topic "Jatropha: As environment friendly fuel and an opportunity for employment generation in rural urban India"

Dr. R.L.Srivastava, Director, AFRI attended the meeting of stakeholders on "Proposed policy reforms to remove the barriers to CDM Afforestation & Reforestation (A/R) Projects" at ICFRE, Dehradun on 14th and 15th Sep, 2006 and took part in panel discussions to discuss various barriers which have been identified as impediments in smooth implementation of CDM A/R projects and to recommend to the GOI and CDM Executive Board the proposed policy reforms.

Dr. R.L.Srivastava, Director, AFRI attended a workshop on Desert and Desertification on 21/09/06 at Jaipur, organized by Ministry of Environment and Forests, GOI, N.Delhi. A presentation on "Innovative Technologies and Extension Mechanism for combating desertification" was made by him.

Dr. R.L.Srivastava, Director, AFRI participated in two days Regional conference, organized by Gujarat Institute of Desert Ecology on " Natural Resource Conservation, use and sustainability in dry lands " at Bhuj, Gujarat on 18-19, December,2006 and presented a paper on " Strategies and technical interventions for natural resource conservation and management of dry lands".

Sh.N. Bala, Scientist-D attended Regional Conference on Scope of Production Forestry for Carbon Sequestration at IIFM Campus, Bhopal on 23-24th November, 2006.

Dr R. L. Srivastava, Director AFRI presided over the inaugural session of one day seminar on "Recent Advances in Natural Resource Appraisal for Sustainable Management" on 15.3.07 and held at State Remote Sensing Application Centre, Jodhpur.

Dr. R.L.Srivastava, Director AFRI was the chief guest in a crop consultative meeting on "Horticulture and medicinal plants" organized by IFFCO on 16/03/07 at Govt. hospital, village Borunda, District Jodhpur. More than three hundred farmers participated in the said meeting/fair where they were told about the benefits of raising medicinal plants and horticultural plants along with traditional agricultural crops.

Dr R. L. Srivastava and Pradeep, Chaudhry participated in two days National Seminar on " Trees outside Forests: Potential for socio-economic and ecological development " at Chandigarh, organized by Punjab Forest Department on 25-26th April, 2006.

Dr. G. Singh, Scientist E participated in two days training programme on 'Concept and Approach to Combat Desertification' for Rajasthan Forest Department conducted by Indian Institute of Bio-Social research and Development (IBRAD) held at AFRI on 24-25th April 2006.

Dr. P. Chaudhry, GCR and Dr. V.P. Tewani, Sci-E participated in the International Conference on "Planted Forests: Ecosystem Good and Services" organized at FRI, Dehradun during 13-15 Dec. 2006.

Dr. R.L. Srivastava, Director, AFRI delivered a talk on the theme "Desert Bioresources" at Ashoka Trust for Research in Ecology and Environment (ATREE) N.Delhi on 18th May, 2006.

Dr. R.L. Srivastava, Director, AFRI made a presentation before screening committee of National Medicinal Plants Board, N.Delhi on 19th May,2006 on a project proposal entitled "Production Propagation of remunerative medicinal plants for establishment of Silva-Ayurveda demonstrative models in arid and semi-arid areas".

Dr. R.L. Srivastava, Director, AFRI attended an International Conference on "Environment & Globalization" at City Palace, Udaipur during January 5-6, 2007 and chaired the valedictory session. The Conference was jointly organized by New England Business Administration Association (NEBAA), Southern Connecticut State University, USA and Laxpra Foundation, Socio-Educational Charitable Trust, Udaipur

Exhibition

AFRI participated in the Paschimi Rajasthan Udyog Hastshilp Utsav-2007 from 05th to 14th January, 2007 through a stall with mobile display exhibits about A.F.R.I. Jodhpur facilities, activities and services attributes.

Awards

Dr. Tarun Kant, Scientist D, FGTB Division was felicitated by the Botanical Society of India by awarding Dr Y.S. Murthy Gold Medal for the year 2006.

Distinguished visitors

Sh. D.D. Verma, IAS, Joint Secretary, Ministry of Environment and Forests, N. Delhi visited the institute on 13/08/06 and discussed about the research work related to management & improvement of Desert Ecosystem being carried out at AFRI and CAZRI, Jodhpur and various other aspects related to the UNCCD.

Mr. N.P.Nawani, IAS (Retd.), former Secretary (Information and Broadcasting), Government of India and currently Secretary General, Indian Broadcasting Foundation, N.Delhi visited AFRI, Jodhpur on 26/12/06. A presentation on institute's activities was given by Director in the meeting taken by him with all the Scientists and Officers. He visited institute's laboratories and was impressed by the research done by the institute.

Dr. Prabhakar Dubey, AIGF (R&T) visited institute on 16th and 17th, January 2006 and attended Friday presentation in seminar hall regarding tours undertaken by different scientists to project sites.

Sh. Jagdish Kishwan, DG, ICFRE visited AFRI on 08th and 09th of Feb, 2007. He inspected various experimental research fields, visited AFRI model village in Jodhpur district and addressed Scientists/ other staff of the institute during the visit.

Sh.B.S.Sajwan, Chief executive officer, National Medicinal Plants Board,N.Delhi visited AFRI,Jodhpur on 20/02/07. He visited AFRI model nursery, Medicinal Plants Germ Plasm Bank and Guggul field trials. He also chaired a consultative meet on Guggul (an endangered medicinal plant) held in seminar hall of the institute on 20/02/07.

Dr. (Mrs) Kiran Soni Gupta, IAS, and Divisional Commissioner, Jodhpur visited the institute on 04.03.2007, visited experimental fields & labs and interacted with the scientists about the research work being carried out at AFRI.

Miscellaneous:

- Smt. Sangeeta Tripathi, R.A.I delivered lecture on "Role of women in JFM and allied Forestry activities" and "SHG: Constitution, Strengthening and Functioning" at Maru Van Prashikskan Kendra, Jodhpur on 12-12-06 in a refresher course for foresters.
- Dr Hemant kumar, RA-II, NWFP, delivered a lecture on "Important Non wood forest products of Rajasthan" and "Cultivation of some medicinal plants" at Maru Van Prashikshan Kendra, Jodhpur on 17.10.06 in a refresher course for foresters.
- Dr. N.K. Bohra, R.A.I delivered lecture on "Soil & Water Conservation in Arid Region " at Maru Van Prashikskan Kendra, Jodhpur on 20-01-07.
- A Film on Khejri Mortality and its control measures was telecasted on ETV, Rajasthan and Dr. S. I. Ahmed, Scientist-E, was interviewed as an Expert on the Khejri Mortality on 9-3-07.
- Dr. Pradeep Chaudhry ,GCR, gave a Radio talk on " Cultivation of medicinal plants of arid region" at Radio Station, Jodhpur on 20/03/07.