

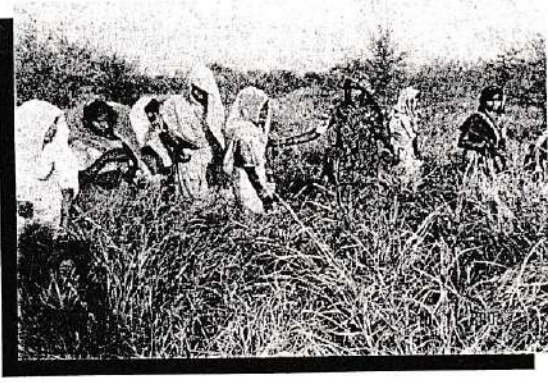
ANNUAL REPORT

2005-2006



ARID FOREST RESEARCH INSTITUTE

P.O. Krishi Mandi, New Pali Road,
Jodhpur- 342 005 (Rajasthan)



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ARID FOREST RESEARCH INSTITUTE, JODHPUR

A.F.R.I. - *At A 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 and to conserve the biodiversity in Rajasthan, Gujarat and Dadra & Nagar Havelli with special emphasis on the hot arid and semi-arid region and also to develop the technologies for the end users in the mandated area.

The main thrust areas of the institute are soil, water & nutrient management, technologies for afforestation of stress sites, management of plantations, growth and yield modelling, planting stock improvement, bio-fertilizers and bio-pesticides, Agroforestry, JFM and extension, photochemistry and non-timber forest products, integrated pest and disease management and forestry education.

During the year 2005-06, thirty-five projects were executed, out of which ten have been concluded. The institute has taken up six externally aided new projects during the period funded by DBT, GOI, New Delhi, National Mission on Bamboos and Rajasthan State Forest Department.

Training programmes on "*Capacity building and eco-sensitisation of farmers and rural poor for development and sustainable management of life supporting systems*" for Village Sarpanches, Up-Sarpanches, Panches, BDOs, Gram Sevaks, Gram sabha members, farmers and SFD officials, of the nine Desert districts of Rajasthan during Phase II were organized by AFRI, with the financial collaboration of Rajasthan Forest Department; to acquaint them with the forestry techniques, development and management of livelihood resources and institute research findings for enhancing rural economy. A total number of 1963 participants including 185 women participated in these 27 practical- cum-demonstrative training programmes.

PROJECTS COMPLETED DURING 2005-2006

Project 1: Provenance trial on *Acacia nilotica* and *Ailanthus excelsa* [AFRI-40/FGTB/1994-2006].

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

Findings:

Acacia nilotica: Seeds of 28 provenances from different agro - climatic zones of the country were collected for the trial. Seed morphology and germination studies were carried out and observations were recorded daily for the calculation of germination percentage, germination energy and energy period for the each provenance.

The parameters for tree growth characters of different provenances were recorded initially at six-month interval and later on yearly basis. Tree height varies from 44.59 cm to 72.53 cm in the first year and from 386.00 cm to 270.00 cm in the eighth year. The ranking of height also varies from one year to another; Gurgaon is the only provenance which has come under first three since the beginning of the trial followed by Agra, Etawah, Hastinapur, Aligarh, Haldwani and Jhabua. Observations recorded in 1999 shows that the best performance is from Shivpuri, followed by Agra and Gurgaon; this is for the second consecutive year that these provenances are the same as in 1998. Observations recorded in the year 2000 have a set back due to prolonged drought in the state, resulting in the damaging of the trees by the villagers for fodder purposes. This has resulted in reducing the height of the trees though the collar diameter has increased. The mineral values of different provenances to be used as fodder were also estimated. The phosphorous varies from 4522.30 ppm to 1849.30 ppm; nitrogen varies from 3233.2 ppm to 5656.50 ppm; manganese varies from 308.40 ppm to 65.60 ppm and copper varies from 71.90 ppm to 21.20 ppm.

Ailanthus excelsa: The seeds of were collected from thirteen seed sources during the first quarter of the 1995-96. The morphological characters of the seeds of the different provenance were recorded in terms of seed length, seed width and test weight. The highest test weight recorded in Jodhpur provenance was 120g. The provenance from Jodhpur and Kajipet also had fairly good test weight of 105.8g and 105.1 g. The lowest test weight 55.5 g was recorded from a provenance of Bilaspur. The seed length was highest (6.6 ± 0.5 cm) in the provenance from Kajipet. The seed length of other provenance varied from 5.60 to 2.52 cm. The seed width of different provenance varied from 1.46 cm to 0.78 cm, which is at for different provenances. The maximum seed width was claimed by Bikaner provenance which was 1.46 ± 1.7 cm and minimum was 0.78 ± 0.1 cm of Bilaspur provenance. The germination percentage was especially in the hot arid and semi arid region of Balaghat provenance, which was 50.7%. The next in order was Jodhpur provenance, which had 40.1% germination percentages. The poorest germination performance was displayed by Jaipur provenance (0.41%).

Project 2: Studies on post harvest technologies on non-traditional, under-exploited locally available timber species for suitability to handicraft and other small scale Industries [AFRI-51/NWFP/2002-2006].

Principal Investigator: Dr. S.H. Jain

Findings:

Preservative treatment and seasoning schedule has been developed for three species. *Prosopis juliflora* wood exhibits good turning, finishing and polishing properties. In India use of this wood in furniture industries is very limited, because of non availability of straight bole trees and also to some extent because of lack of knowledge. This calls for immediate attention to better manage the trees with clear bole of around 2-3 m length and 0.5 -1 m girth.

A. tortilis wood is moderately hard and heavy, pale yellow to reddish brown in colour with fairly good grain pattern having very good turning, carving, finishing and polishing properties. This wood is highly susceptible to wood deteriorating agents. After treatment this wood resisted to insect borer and fungus attack.

P. cineraria species is well known for fodder and food but it lesser known for its timber use. Its usefulness is limited as timber due to high infestation to pests, insects, termites and fungus. Wood is pale white light in weight having moderate to poor finishing and polishing properties as compared to *A. tortilis* and *P. juliflora*.

Prosopis juliflora can be grown as clear bole tree by proper management. Quality of this wood is equal to that of *Dalbergia sissoo*. *Acacia tortilis* plantation raised by Forest Department in large scale (about 0.5 million ha.) may be utilised by value addition of preservative treatment and seasoning for better durability. These two plantation grown timbers may be popularised to use in place of traditionally used wood of *T. undulata*.

Project 3: Survey of sandal population in Rajasthan and Gujarat states and evaluation of heartwood content and oil content [AFRI-52/NWFP/2002-2006].

Principal Investigator: Shri S.H. Jain

Findings:

Data of sandal population, heartwood and oil content collected during the survey in Rajasthan state has been compiled and analysed. The oil content in trees of Rajasthan varies between 0.9 to 3.0 %. The heartwood content is found better in naturally grown trees than trees grown on agricultural/ farmlands.

Project 4: Identification of mortality factors of *Prosopis cineraria* and development of their suitable management strategies in north-western Rajasthan [AFRI-46/FP/2001-2005].

Principal Investigator: Dr. S.I. Ahmed; Co-investigator: Dr. K.K. Srivastava

Findings:

It has been examined that this devastating problem has primarily been arisen with the cumulative effects of indiscriminate and successive lopping followed by a secondary infestation of four species of root and shoot borers viz., *Aeolesthes holoserecea* Feb, *Derolus iranensis (discicollis)* Gahan, *Acanthophorus serraticornis* and *Hypoeshrus indicus* Gahan. The infected samples reveal the presence of five highly infective species of *Fungi imperfectii* viz., *Alternaria alternata*; *Phoma* sp; *Ganoderma lucidum* and *Botryodiplodia theobromae*, which cause the die-back disease in mature trees of Khejri as a result of which the tree starts drying from the top. Maximum percentage of Khejri mortality in the four northwestern districts of Rajasthan has been recorded as being 36.30, 42.78, 41.00 and 37.69 respectively. Maximum mortality was observed in 71-100 cm girth class in which 2122 trees were killed followed by 1570 in 31-70 cm girth class, 850 in 101-130 cm, 700 in 21 – 29 cm, 165 in 131-160 cm and only 47 in 161 cm and above girth class.

Amongst the other probable contributory factors: (i.) Continuous depletion of water table in Rajasthan; (ii.) Increasing number of tube wells or over exploitation of ground water; (iii.) Effect of low rainfall; (iv) Change in soil properties and agricultural practices and (v) over maturity of trees are some of the suspected causes which also play their role in mortality of Khejri in north- western zone of Rajasthan.

Project 5: Identification of key indicators and suitable strategies for sustainable Joint Forest Management in Rajasthan and Gujarat [AFRI-53/AFE/ 2002-2007].

Principal Investigator: Dr. Sunil Kumar

Findings:

- **Homogeneity of population:** More the heterogeneity of caste and creeds, more difficult is the implementation of the programme. On the contrary homogeneous caste composition of the villages ensures greater success owing to an almost similar socio-economic status.
- **Dependency on nearby forest:** JFM plantation is successful where the major proportion of villagers or JFMCs are solely or partly dependent on nearby common forest for their daily requirement of fuel wood and fodder.
- **Availability and free collection of MFP:** Non-wood forest products (NWFPs) have a key role in the success of JFM. It supplements income by collection of medicinal herbs, tendu leaves, forest seeds, Mahua flowers, Aonla fruits and Acacia gum up to Rs.10, 000 to 15,000 per season in tribal belt of Gujarat. Availability and free collection of MFP by the people from adjoining forests increases the success of JFM programme.
- **Literacy rate has positive effect on JFM.** Very thin participation was observed in the committees where the literate or leading personality was conspicuously absent.

Success to manage the JFM plantation was dependent on the existence of literate persons in the executive committees.

- **Micro-planning and site condition:** The degree of success was found to be linked with micro-planning and site condition optimistically for favourable ones.
- **Economic status:** Higher the income of the household, lower was its participation. Thus, lower income people were more interested in doing the activities related to JFM. Higher total income household discarded JFM.
- **Dependency on forests for timber, fuelwood & fodder:** The involvement of people who are heavily dependent on forests for meeting their livelihood needs, can provide vital inputs and strive for a balance between the ecological and economic roles of forests.
- **Awareness and extension:** The peoples' awareness and programme with commitment and dedication play an important role in the success of JFM. As the peoples' awareness increased, more areas were put under plantation and previous plantation was protected.
- **Liaison of forest officials with villagers:** The attitude of forest official plays positive role in influencing and involving people in Joint Forest Management. The role of other departments has been very crucial as they not only provide financial help but also provide livelihood opportunity in lieu of reducing the pressure and protection of forest and/or community land.
- **Adequate and timely flow of funds:** With increasing JFMC's, funding has resource crunch. Most of the new JFMC's do not have adequate funds. Timely release of fund is also a problem.
- **Self Help Groups with emphasis on women:** SHGs created with revolving funds for micro-credits and micro-enterprises, particularly focusing on women, brought effective change. The easy identification of incentives required the ability to arrive at equitable distribution of benefits that helped in bringing about perceptible changes.
- **Motivation, recognition & capacity building of Forest Officials:** The government officers' and field functionaries' attitude change through training and persuasion is necessary as it changes their ideas to adopt the participatory approach of forest management rather than their previous approach of protection of forest with penalty and force of law in authoritative manner, which the rural poor cannot afford to pay, has contributed a lot in the process.

Project 6: Studies on improving tree productivity of *P. cineraria* through VAM/Biofertilizers [AFRI-47/FP/2002-2006].

Principal Investigator: Dr. K. K. Srivastava

Findings:

- The maximum number (36) of AM fungal species was identified from Jodhpur whereas only 13 species were recorded from Jaisalmer.
- Maximum spore population was recorded after rain *i.e.*, in July- Sept and minimum in summers.
- Maximum (313) spore population was recorded from Jodhpur and minimum (155) at Jalore.
- Seedlings of *P.cinaria* inoculated with VAM+rhizobium performed better as compared to other treatments in all parameters including nutrients.
- Rhizosphere soil samples were collected from Basan (Gandhinagar), Kheralu (Mehsana), Deesa (Banakatha, Bawnagar), Junagarh (Surashtra), Anjar (Kacch). The tree species were *Ailanthus excelsa*, *Azadirachta indica*, *Prosopis cineraria*, *Commiphora mukul*, *Eucalyptus sp.*, *Salvadora sp.*, *Acacia, catechu*, *Acacia Senegal*, *Sapindus indica*.
- The genera of AM fungi were identified as *Acaulospora*, *Glomus*, *Scerocystis* and *Scutellospora*.

Project 7: Ethanomedical Property of Phyto pathogenic Fungi: Screening And Isolation of Therapeutic Products.[AFRI-48/FP/2002-2006]

Principal Investigator: Ms. D. Thangamani

Findings:

- Screening of *Ailanthus excelsa* leaf and stem for wound healing property against the wound caused by *Fusarium* in *P. cineraria* has been worked out, using crude extract *Ailanthus exelsa* leaves. The partially purified fractions showed positive effect though inhibition spore germination of *Fusarium* species.
- From the pathogenic fungi viz,*Fomes species*, *Aspergillus ochraceous*, *Aspergillus niger* and *Aspergillus flavus*, the sumerged , in stagnant and in shaking condition the products production and standardization studies is progress and the data analysis also in progress.
- Using different substrates and buffers purification through affinity chromatograpy studies has done it showed the Sephadex 200 very fine affinity column eluted fractions showed component elution better than other similar columns.

PROJECT CONTINUED DURING THE YEAR 2005-2006

Project 1: Multilocal trials of Eucalyptus and Dalbergia clones [AFRI-41/FGTB/2002-2006].

Principal Investigator: Dr. U.K. Tomar

Status:
Multilocal clonal trials of *Eucalyptus camaldulensis* and *Dalbergia sissoo* were established in August 2003 at four different locations namely Deesa, Kheralu, Gandhinagar, Rajapala in Gujarat state. These clones are superior germplasm selected under WB project and other sources. First data recording was carried out in February 2004 and second in February 2005. Initial data were recorded on growth parameters (height and girth in cm). Best clones for *Dalbergia sissoo* are G5, 20, 66, G1 and 32 and in *Eucalyptus* are 83, 128, 99, 32 and 93.

Project 2: Micropropagation of an important medicinal plant of the arid and semi arid regions - *Commiphora* [AFRI-42/FGTB/2002-2006].

Principal Investigator: Dr. Tarun Kant

Status:
Somatic embryogenesis has been successfully achieved in the endangered *Commiphora* species. Somatic embryogenesis initiation and multiplication has been standardized. It has been observed that somatic embryos multiply on the same MS medium supplemented with NAA. Somatic embryo germination has also been achieved and it is being optimized. It has been also observed that activated charcoal at 5% concentration gives a good response. Hardening experiments have been carried out both in vitro and ex vitro in mist chamber with 90 misting at 10 minutes interval. So far about 20 plants have been hardened. These plants have been produced by both somatic embryogenesis pathways as well as from cotyledonary node. Somatic embryo germination as well as hardening experiments is continuing for increasing the frequency of both.

Project 3: Genetic Improvement of *Tecomella undulata* [AFRI-44/FGTB/2002-2006].

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

Status:

Plus trees have been marked both in the canal-irrigated area and the non-irrigated farmers field. Seeds have been collected from 48 plus trees of Rohida. The Rajasthan Forest Department was contacted for the allotment of land where the trials could be laid out. They have agreed for providing the area in Govindpura Experimental Station, Jaipur to raise plantations.

Project 4: Screening of high oil and azadirachtin in Neem [AFRI-45/FGTB/2002-2006].

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

Status:

Two trials have been laid out from the CPTs selected for high oil and high azadirachtin content during the NOVOD project. One trial is at plot No. 729 AFRI, Jodhpur and the second

trial is at Govindpura Experimental Station, Jaipur. Both the trials are being maintained. So far the trials have not come to flowering.

Project 5: Market survey on selected species in selected markets [AFRI-58/Silvi/1994-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. After compilation, the same were sent to the ADG (Stat.), ICFRE, Dehradun on prescribed format for publication of Timber and Bamboo Trade Bulletin.

Project 6: Stand dynamics of some important tree species of Gujarat [AFRI-57/Silvi/2001-2007].

Principal Investigator: Dr. V.P. Tewari

Status:

Annual measurements carried out in 30 sample plots of *E. hybrid* and 17 of *A. nilotica*. Data compilation and plot computations have been completed which include information about stems/ha, BA/ha, Dominant height, average height, quadratic mean diameter, volume/ha, MAI, Form factor etc.

Statistical distribution functions applied to define size class distribution in the stands. Johnson distribution performed better compared to Normal and Weibul distribution based on statistical tests like absolute residual, Chi-square and Kolmogorov-Smirnov test.

Developed height-growth and site index equations for *A. nilotica* and *E. hybrid*. Five algebraic difference equations were used to develop site index equations. Generalized non-linear least square method was used to take into account the error structure. Autocorrelation was corrected expanding the error term to allow a first-order autoregressive model that was adequate for the data structure. Different weighting factors were employed to satisfy the constant variance assumptions for the error structure. Bias, root mean square error and Akaike's information criterion were calculated and cross validation residuals were used to evaluate the performance of the equations. Difference among the site index equations of the two species was examined using the non-linear sum of squares method. Based on the analysis, best approximating model has been recommended for both the species for site index modelling.

Project 7: Studies on seed quality improvement in respect of various tree species of arid and semi-arid areas [AFRI-59/Silvi/2002-07].

Principal Investigator: Dr. D.K. Mishra

Status:

Seeds of *Acacia nilotica*, *Prosopis cineraria* and *Azadirachta indica* were collected during the year and were graded, stored for testing. Seeds of *Dalbergia sissoo* and *Ailanthus excelsa* were collected during 2003 were stored at various moisture and temperature levels and were tested for moisture and germinability during 2005 also. In *Ailanthus excelsa* seeds stored at 5% moisture content gave significantly higher percent germination than seeds stored at 10%

moisture level. Seeds can be stored safely up to three years without significant loss of germination. Low temperature storage is not suitable for this species. Seeds can be stored in gunny bags.

Stored seeds of *Dalbergia sissoo* lost germination capacity after three years of storage at room temperature. However, when seeds were stored at low temperature, 46% germination was retained. Three-year old stored seeds of *Caparis decidua* showed lesser percent germination in all the treatments. Stored moisture content does not affect percent germination.

Seeds of *Commiphora wightii* collected from six seed sources (Kailana, Ramsar, Bisbala, Hathma and Kiradu) have been cleaned and germinated. Seeds were separated into two categories and were kept for seed germination studies. Black seeds are heavier (3.2g/100seeds) than white (2.16g/100seeds) and a kilogram of seed contains 35000-40,000 seeds at moisture content of 7.5%. Black seeds collected from Kailana area showed higher germination (45%) followed by Nakoda (30%).

Project 8: Development of suitable nursery technologies for arid and semiarid areas [AFRI-64/Silvi/DRDA/2002-2006].

Principal Investigator- Arvind Apte

Status:

In AFRI model nursery improved planting stock for research projects of AFRI & other stakeholders is being raised as per requirement. Medicinal Plants Germ plasm Bank has been established under NMPB funded project, which is now being maintained under nursery programme.

Experiment has been laid out to study effect of different potting mixtures on growth of seedlings of Mopane, Khejdi, Ardu & Ratanjot.

Project 9: Screening of exotic and indigenous plant species for their performance on salt affected soil with different management project [AFRI-49/NWFP/1997-2003].

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 and 2,3 and 6 were concluded in 2004 and 2005 respectively. Experiments no 5 and 7 will be concluded in 2006-07.

Exp. 5: Performance of *A. amnicola* with or without gypsum on diff. modes of planting. An experimental trial of *A. amnicola* was laid out in August 2000 with three planting treatments (double ridge mound S_1 , elevated slope planting S_2 and simple bund planting S_3) with full gypsum requirement G_1 and control G_0 . Treatment combinations were $T_1 = S_1 G_0$, $T_2 = S_2 G_0$, $T_3 = S_3 G_0$, $T_4 = S_1 G_1$, $T_5 = S_2 G_1$, $T_6 = S_3 G_1$.

Survival of bushes was ranging from 75 to 88.8% after 60 months of planting. There was a slight decrease, ranging from 3.1 to 6.9, in various treatments. Four numbers of bushes in each treatment were cut to 50% of their height in Sept 04. Total cut fresh biomass was more in non-gypsum treated bushes (0.18 t ha^{-1}) as compared to gypsum treated bushes (0.14 t ha^{-1}), however change was not significant. The growth data recorded in Sept-2005 showed that bushes recovered up to 96.6 to 85.5% of their height and 95 to 81.6% of their crown diameter in different treatments, in a deficient monsoon year. After cutting treatments effect (Gypsum application and different soil structures) are not significant for height and crown diameter.

Exp. 7: Performance of exotic and indigenous tree species on different types of mounds A trial with two tree species, *Acacia coleii* and *Azadirachta indica* was laid with three treatments of planting in August 2001. Decrease in survival was observed between a periods from 36-48 months after planting. Decrease was minimum in CDM (2.3%) followed by DRM (11.8%) and control (39.2%). It was due to deficient rainfall (273 mm) in the year 2005 though supplemental irrigation of 25 l/plant was provided in the summer months of April to July 2005. Species wise *Acacia coleii* showed better survival than *Azadirachta indica* on all the three structures. However percent incremental growth in height, crown diameter and collar girth was more for neem. It was ranging from 15-26% for height, 24-45 % in crown diameter and 4.7-8% for collar girth compared to 9-15% for height, 0-15% for crown diameter and 0.8 to 5% for collar girth for *A. coleii*. Green weed mass of one t ha⁻¹ dominated by *Sporobolus helvolicus* and *Chloris virgata* was recorded from the experimental area.

Exp. 8: Performance of *Z. mauritiana* and *C. mopane* with management practices 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 97 % survival on CDM and 89 % in control after two year of planting while it was 72 and 71% for *Z. mauritiana*. Ber and mopane recorded better mean height (67 & 63 cm) and crown diameter (57 & 89.7 cm) on CDM as compared to control (63 & 58 cm and 52 & 85.5) respectively. Over all mopane recorded 64 % and 8 % more crown on CDM and control than Ber. Nitrogen application increased both height and Crown dia for both the species on CDM. For ber 22.5 % more mean height and 27 % more mean crown on CDM. For mopane the influence was 19% for height and 9% for crown diameter.

Flowering was observed in 20 % plants of *C. mopane* and 650g seed was collected. 25 % pruning was carried out in Dec 05 and mean 649.35 g green mass/treatment was recorded for the CDM compared to 443.7 g green mass /treatment for control. Fertilizer (urea) doses were repeated in Jan 2006. Rodent control measures: Experimental area suffered with serious rodent problem. Periodic rodent control measures were applied.

Project 10: 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:

Total amount of extraction was found highest in monsoon and lowest in summer season for *Calotropis procera* flowers. Bioactive compound viz. sterols, alkaloids and flavonoids were present in the extractives. Yield of alkaloids was highest in summer and sterols are higher in winter season in the MeOH extract. *Calotropis* flowers collected for the second year for study of active secondary metabolites. Monsoon and winter season flowers were extracted with petroleum ether and MeOH. Total extractives were determined. Steroid content of flowers collected for these two seasons was also determined. The total methanol extract for summer season was found only slightly higher than winter season.

Project 11: Litter dynamics and soil changes during stand development in plantation forest [AFRI-35/FED/2002-2006]. *Principal Investigator: N Bala*

Status:

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 m² 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. Tree height and GBH were recorded for trees inside the plot. Monthly litter collection is being made. Litters are separated into different components and dry weight is recorded. Annual litter production (kg/ha) from different trees in IGNP area indicated highest litter accumulation under *E. camaldulensis* followed by *D. sissoo*.

Soil samples were collected from the plots and were analysed for organic carbon content. Soil organic carbon storage was found highest in *D. sissoo* followed by *E. camaldulensis*, *A. nilotica*, *P. cineraria*, *A. tortilis* and *T. undulata*. Analysis of soil and plant samples is in progress. The project report will submitted September 2006.

Project 12: 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*

Status:

Thirty beds of the size 5 x 5 m were prepared for seed sowing. 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 analysed. Soil nitrogen content estimated before sowing of seeds in the beds. Standardization of buffers and substrate has been completed for *Mimosa hamata*. Highest Nitrate Reductase (NR) activity was recorded at 0.2 M buffer (pH 7.7) and 0.2 M substrate concentration. Standardization of buffers and substrate for *Clitoria ternatea* is in progress.

Project 13. Screening Different Phenotypes of *Dalbergia sissoo* and *Acacia nilotica* for their Tolerance to Salinity and Sodicity [AFRI-37/FED/2002-06].

Principal Investigator: Dr. Pramod Kumar

Status:

Seeds collected from 14 selected phenotypes of *Acacia nilotica* and *Dalbergia sissoo*. Plantations were raised as per experimental design at Tharad range, Palanpur (Gujarat) with the help of State Forest Department. Growth and survival data was recorded six month after planting. Highest survival (30%) and growth (16.12 cm) *A. nilotica* was recorded in phenotype collected from *Harethar* and *Lakhani*. The survival and growth of *Dalbergia sissoo* phenotypes was very poor because of high salinity level. Salinity of the experimental site was in the range of 8.80 to 10.88 dSm⁻¹.

Soil pH and organic carbon was 7.66-8.86 and 0.23-0.28% respectively. RAG- 2005 suggested taking up the experiment on a less saline land. Accordingly site has been selected in Kutchh (Gujarat).

Project 14: Transfer of forestry technology through demonstration and training for increasing productivity and sustainable management of natural resources (Establishment of Interpretation centre) [AFRI-54/AFE/2002-06].

Principal Investigator: C.S. Dange, I.F.S.

Status:

The extension and interpretation centre is open to the visitors for technology dissemination. The activities like 3-Dimensional models for activities of the various Divisions of the Institute, and culture and dependency on forests of the mandated area, providing railings around the semi-circular and circular platforms, enlargement and lamination of photographs of national tree, flower, animal and bird of Gujarat State and Dadra and Nagar Haveli Union Territory for Extension & Interpretation Centre are yet to be carried out. Further activities shall be under taken from April 2006 with due provision of budget.

Project 15: Development of suitable multi-tier farm-forestry models in IGNP Command area [AFRI-55/AFE (A)/2003-08].

Principal Investigator: Dr. B.M. Dimri

Co-investigator: Shri A.K. Chattopadhyay

Status:

The survey in IGNP Command area has been conducted to select suitable site for initiating trial. But no suitable sites could be finalised. Hence, the project activities have been deferred for the next financial year.

Project 16: Development of economically viable and integrated Agroforestry models for arid region [AFRI-55/AFE (B)/2003-08].

Principal Investigator: Dr. Sunil Kumar

Co-Investigator: Dr. B.M.Dimri

Status:

Field visit was conducted at village Harsh, Bilara, Jodhpur to find out the modalities for implementation of the project on the site selected earlier. Choices of horticulture and silviculture species with interaction of agricultural crops had been finalized with the farmer. One horticultural crop had already taken by the farmer and next crops preparation was going on and hence the activities of soil works may not be taken before next crop is over by April 2006.

The activities for raising seedlings of silviculture and horticultural species have been initiated in AFRI nursery. Some grafted plants of horticulture species would be procured from CAZRI nursery. The seedlings being raised in AFRI nurseries are: *Prosopis cineraria* (Khejri) 124 seedlings; *Ailanthus excelsa* (Ardu) 634 seedlings and *Colophospermum mopane* (Mopane) 144 seedlings (Total 1902 seedlings). The 180 seedlings of *Zizyphus mauritiana* (grafted Ber) will be procured from CAZRI nursery. The seedlings of other selected horticultural species viz., *Albizia leonensis* (grafted Nimbu) 180 seedlings and *Emblia officinialis* (grafted Aonla) 180 seedlings will be procured from private nurseries because of their non-availability in AFRI as well as CAZRI nurseries.

Project 16: **Development of economically viable and integrated Agroforestry models for arid region [AFRI-55/AFE (B)/2003-08].**

Principal Investigator: Dr. Sunil Kumar

Co-Investigator: Dr. B.M. Dimri

Status:

Field visit was conducted at village Harsh, Bilara, Jodhpur to find out the modalities for implementation of the project on the site selected earlier. Choices of horticulture and silviculture species with interaction of agricultural crops had been finalized with the farmer. One horticultural crop had already taken by the farmer and next crops preparation was going on and hence the activities of soil works may not be taken before next crop is over by April 2006.

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**PROJECTS COMPLETED DURING THE YEAR 2005-006
(Externally Aided)**

Project 1: Survey and silvicultural management practices for commercially exploitable medicinal plants of arid and semi-arid areas of Rajasthan [AFRI 35/Silvi 8/MPB/2002-05]

Principal Investigator: Dr. D.K. Mishra

Status:

The project was started in April 2002 and concluded in the month of Sept. 2005. The main objective of the study was to assess requirement of medicinal plants in Rajasthan. Manufacturers account for over 90% of demand. We have surveyed 435 units/ traders involved in the trading of medicinal plants in 26 districts of Rajasthan.

The total requirement of surveyed districts revealed that 9,36,110kg of various medicinal plants is traded annually. Jaipur tops among the surveyed districts with 27.24% trading of medicinal plants followed by Jodhpur (16.54%), Ajmer (14.12%), Bhilwara (9.91%), Udaipur (8.98%) and Sri Ganga Nagar (4.58%). The trade share of Banaswara is only 0.002% of the total trade.

Cultivation practices for *Aloe vera* (L.) Webb. & Berth. (Guar patha), *Asparagus racemosus* Willd. (Satavari), *Catharanthus roseus* (L) G. Don. (Sadabahar, *Ocimum sanctum* Linn. Tulsi) and *Withania somnifera* (Linn.) Dunal (Ashwagandha) and senna in arid areas under rainfed and irrigated conditions have been developed.

Our Observation indicated that *Ocimum sanctum*, *Catharanthus roseus* and *Asparagus racemosus* have 96-98% survival and *Withania somnifera* and *Aloe vera* suffered maximum causality. The initial percent survival of *Aloe vera* was 70% and for *Withania somnifera*, it was 74 percent. All species responded to irrigation and fertilizer application.

Cultivation trial of guggal indicated that plants raised either through seed or cuttings performed better at Kayalana (good soil) site than at Karwad (saline soil) site. The growth was higher at Kayalana (mean height 48.37cm) against mean height of 28.89cm at Karwad site. A germplasm bank with 150 medicinal plants has been established at Jodhpur.

Project 2: Capacity building & eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems [AFRI/56/AFE/2002-07].

Principal Investigator: Shri Balbir Singh, I.F.S.

Findings:

Field training programmes were successfully conducted in phase II of the project with financial collaboration of the Rajasthan Forest Department at three different places of Forest Divisions' Range Headquarters which comprised all the Panchayat Samitis in each of the remaining nine Desert Districts of Rajasthan i.e. Sikar, Jhunjhunu, Jaisalmer, Bikaner, Barmer, Churu, Jalore, Nagaur and Pali Districts to educate and uplift the socio-economic status of stakeholders, especially, the farmers, Forest field staff, Gram Sevaks, Panchayat Functionaries, NGOs, SHGs, women and children on the latest forestry technology and other allied eco-

value addition activities. A total number of 1963 participants including 185 women participated in these 27 practical- cum-demonstrative training programmes.



Director, A.F.R.I. addressing the participants



Practical Demonstration at nursery

Project 3: Development of silvipasture model for rehabilitation of Oran/Gauchers [AFRI-27/Silvi-3/UNICEF/2001-2003].

Principal Investigator: Arvind Apte

Status:

The rehabilitation model was developed at Tulesar and Ostran villages of Jodhpur district. The indigenous and fodder species like *P. cineraria*, *Tecomella undulata*, *Zizyphus spp.*, *Colophospermum mopane*, *Hardwickia binnata*, *Alilanthus excelsa* were planted along with seed sowing of local grasses.

Since October 2004, balance fund has not been released by DRDA due to non-availability of funds under Maru Gaucher Project of Central Government. Hence further work is stagnated since then.

**PROJECTS CONTINUED DURING THE YEAR 2005-06
(Externally Aided)**

Project 1: Study of Characteristic Features Pertaining to Bio-drainage Potential of Some Selected Tree Species [AFRI-38/FED/2004-2008].

Principal Investigator: N. Bala

Status:

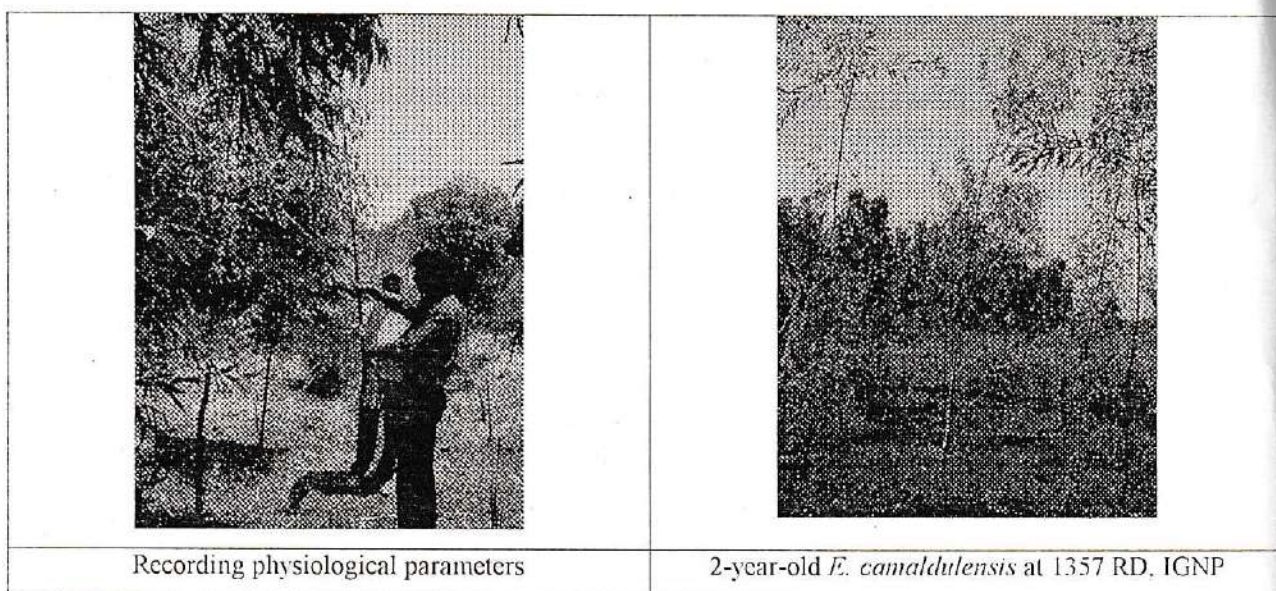
This is an externally funded project that has been funded by the Ministry of Water Resources (MoWR), New Delhi. It has been initiated in 2004. Three sites have been selected for the experiment. One is near Masitawali head of IGNP. This site is having extremely high salinity ranging from 37 dSm^{-1} to 42 dSm^{-1} . The other sites are located at 1357 RD and Anupgarh branch of IGNP having low salinity regime.

Experiment A. Transpirational response of some selected tree species to different water regimes

Restructuring of 54 Lysimeters has been completed. The lysimeters are being made leak proof for the purpose of the experiment. Seedlings are ready for plantation.

Experiment B. Transpirational behaviour of *Eucalyptus* species of different age class and their impact on soil

Sample plots have been laid out at Anupgarh branch of Indira Gandhi Nahar Pariyojana (IGNP) and 1357 RD, IGNP main canal. Plantation of *E. camaldulensis* was raised by the State Forest Department, Rajasthan. Arid Forest Research Institute, Jodhpur, raised experimental plantation of *Eucalyptus* species in 2003 (seed source CSIRO, Australia) at 1357 RD, IGNP. Growth and Physiological parameters recorded for three quarters. At 1357 RD experimental site height of the plants was highest in *E. camaldulensis*. However, crown spread and collar girth was high in *E. rudis*.



One-year-old *E. camaldulensis* plants at Anupgarh shakha, IGNP, attained average height of 424 cm. Crown diameter and collar girth was 155 cm and 21.7 cm respectively. Height, crown diameter and collar girth in two year old plants was 844 cm, 213 cm and 38.3 cm respectively. High transpiration rate of 6.8 and 6.4 mmol H₂O m⁻² s⁻¹ was recorded in *E. camaldulensis* and *E. rudis* respectively. Rate of photosynthesis was high in *E. camaldulensis* followed by *E. rudis*, *Corymbia tessellaris* and *E. fastigata*. Soil samples collected and analyzed for pH, EC and organic carbon. Salinity level is normal except at Lunawala Dhani, Masitawali where it was very high. Soil pH ranged between 9-8.0-9.1 at different sites.

Experiment C. Effect of density on performance of some tree species and their role in reclamation of water logged area

05 RD, IGNP experimental site

The experimental site was cleared and prepared for plantation. Plantation of four species viz. *Eucalyptus camaldulensis*, *Acacia nilotica*, *Tamarix aphylla* and *Casuarina junghuhniana* has been done. Average height of the seedlings at the time of plantation was 75 cm, 65 cm, 50 cm and 75 cm in *Acacia nilotica*, *Eucalyptus camaldulensis*, *Tamarix aphylla* and *Casuarina junghuhniana* respectively. Soil samples have been collected for analysis. Ground water level was recorded from the observation pits.

Lanawala Dhani, Masitawali (0 RD, IGNP)

Soil and water samples have been collected and analysed. Fencing of the site has been completed. The mean soil pH was found to be 8.8, 8.6 and 8.5 at 0-25 cm, 25-50 cm and 50-75 cm soil depth. Electrical conductivity was very high in the topsoil layer. Organic carbon was also found to be high in the 0-25 cm soil layer. Soil ammonical nitrogen ($\text{NH}_4 - \text{N}$) and phosphorous was 12.2 and 22.73 ppm respectively.

Project 2: 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

Status:

Growth and survival data in respect of the plants raised under the experimental roadside plantations at seven different locations (6.3 km length) have been recorded. Plants were planted in different phases from 2001 to 2004 as per funds provided by local government agencies like Urban Improvement Trust, Jodhpur Pradushan Niwaran Trust and Rajasthan Urban Infrastructure Development Project. 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 siamiae* > *Tecomela undulata* > *Pongamia pinnata* > *Alistonia scholaris* > *Casia fistula* > *Delonix regia*.

Project 3: Raising of Arboretum cum Botanical Garden for Native Flora of Rajasthan [AFRI-61/Silvi/2002-2006].

Principal Investigator: Sh. A.S. Apte

Status:

Plants belonging to 84 native tree species of Rajasthan and Gujarat have been maintained. Complete boundary wall construction has been accomplished to provide protection to the Arboretum cum Botanical Garden.

**NEW PROJECTS INITIATED DURING THE YEAR 2005-2006
(Externally Aided)**

Project 1: Integrated management for qualitative improvement and increase production of Rohida (*Tecomella undulata*) in Rajasthan.[AFR/65/FP/SFD/2005-07].

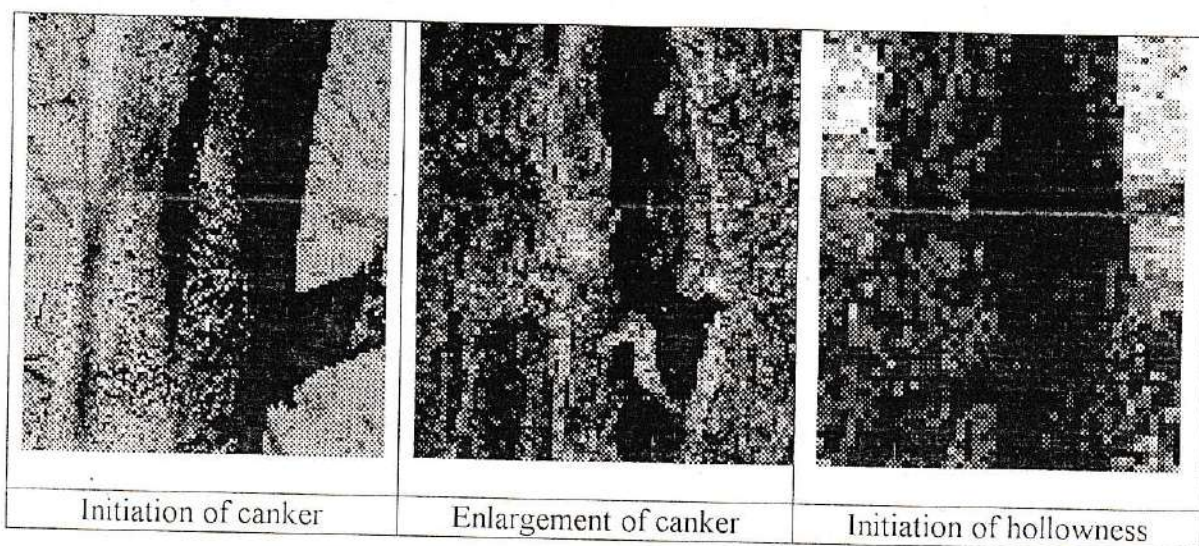
Principal investigator: Dr. R.J. Srivastava, IIT

Status:







I. Insect pests and diseases:

Three species of wood boring insects and two species of wood decaying fungi have encountered so far. Further study on the identification of these factors is in progress. It was observed that no hollowness problem was seen in the rohida plantations raised in the IGNP area except in a few trees, which exhibited the initiation of canker formation in the main trunk of the trees. Water blisters problem was noticed in trees along either side of the canal and exhibiting borer attacks and mechanical injuries. The problem of termite attack and cracking of bark has prominently been observed in almost all the plantations. Besides, severe defoliation by *Patalus tecomella*, leaf minors and leaf spot disease, dying of branches has been encountered in most of the trees.

The preliminary observations revealed that the tree deformity pertaining to hollowness might 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.



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Flowing of sap in trunk	Oozing from a branch	Termite attack
		
<i>Paralshus tecomella</i> attack	Aphid attack	Fungus attack

III. Macropropagation studies:

Fifteen trees were marked as resource stock for collecting plant material (Stem cuttings) for macropropagation studies at AFRI experimental Area. These trees were grouped into three different classes (5 trees in each class) for managing them in three different ways to induce juvenile sprouts. Three methods adopted were lopping of main-branches, pollarding at 1.5-meter height and ground cut (30 cm height from the ground). These managed trees were watered at 15 days interval to increase the number of new sprouts and reduce the time span. Trees were also treated with fungicide and insecticide to prevent the attack of pathogens and insects.

Exp 1: Responses stem cuttings collected from differently managed trees

Stem cuttings collected from three differently managed trees (A: lopped, B: pollard and C: coppice) were raised in mist polyhouse under intermittent misting in Sept 2005. Observations collected on sprouting at two weeks interval. After two months final observations were recorded on sprouting, relative growth of callus at basal cut ends and root primordia formations. Callusing was higher in B type of cuttings, followed by C and A type cuttings. Root primordia were also recorded in cutting showing callus formation.

Exp 2: Effect of Rooting Hormone

Stem cuttings were also raised in mist polyhouse after giving 1000 ppm IBA treatment along with a control (with out IBA treatment). No significance difference was recorded in sprouting and root primordia formation between treated cutting and control.

Exp 3: Effect of Soil mixture

Stem cuttings were raised in sand and vermiculite for each class. Percentages of cuttings producing callus were just double when raised in sand (13.75%) as compared to cuttings raised in vermiculite (7.5%).

III. Growth and yield studies on Rohida plantations:

A reconnaissance survey of the IGNP area was conducted to select suitable stands for conducting the study. Sample plots were laid out at 22 locations in IGNP Stage-II covering all available ages and stand densities.

Variable area plots were laid out. All the trees inside plots were numbered and cross-marked at dbh. Dbh of all trees inside plot was measured and height of 10% or more trees inside the plots taken to generate height-dbh equation. Five representative sample trees felled from each plot and measurements taken for estimating volume yield. A total of 110 trees were felled.

The data collected were compiled and plot computations completed. Plot area varied from 0.032 ha to 0.067 ha while the range of stems/ha was from 450 to 2188. The age of the plantations was from 14 to 19 years.

The summary results also indicated that depending upon age, site and density, average height in the stands varied from 3.35 to 6.47 m, mean quadratic diameter from 6.12 to 12.24 cm, dominant height from 4.24 to 9.30 m, basal area from 1.84 to 13.88 m²/ha, volume yield from 3.90 to 47.78 m³/ha, height increment from 0.20 to 0.36 m/yr, dbh increment 0.36 to 0.65 cm/yr and MAI from 0.22 to 2.65 m³/ha/yr.

Total wood volume equations constructed and validated. A total of 8 equations were compared and best model selected based on the bias, relative error of prediction, coefficient of determination and Akaike's information criteria differences.

Project 2: Studies on prediction of NTFP availability and potential for extraction in Aravali region of Rajasthan [AFRI-67/Silvi/SFD/2006-2008].

Principal Investigator: Dr. R.L. Srivastava

Status:

Project has been initiated at the request of Rajasthan Forest Department for a period of two years. MOU between AFRI and state forest department has been signed. Budget sanctioned is Rs.4.50 lakhs, out of which Rs. 1.50 lakhs has been received as first installment in March 2006. Preliminary survey for selection of villages has been undertaken.

Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges [AFRI-39/FED/SFD/2005-2008].

Principal Investigator: Dr. G. Singh

Funded by the State Forest Department, Rajasthan with a total outlay of Rs. 13.46 Lacs, the project was started in May 2005 with the objectives (i) to study the potential of different rainwater harvesting (RWH) devices in controlling run-off losses in different topographical conditions, (ii) to study the effect of different rainwater harvesting devices on biomass productivity, and (iii) to study the economic viability of RWH devices for their adoption in large hilly site was selected in Banswara forest division covering slopes of 0-10%, 10-20% and 20-30%. Rainwater harvesting devices are contour trench (CT), gradonie (G), box trench (BT), V-ditches (V) (Fig 1) along with a control plot. Seventy-five plots (three slopes x five treatments x five replicates) of 700-m² area in completely randomised block design were laid. Twenty-five number of run-off measuring devices along with flow control wall fitted with pipes were constructed to control water flow and collect run-off.

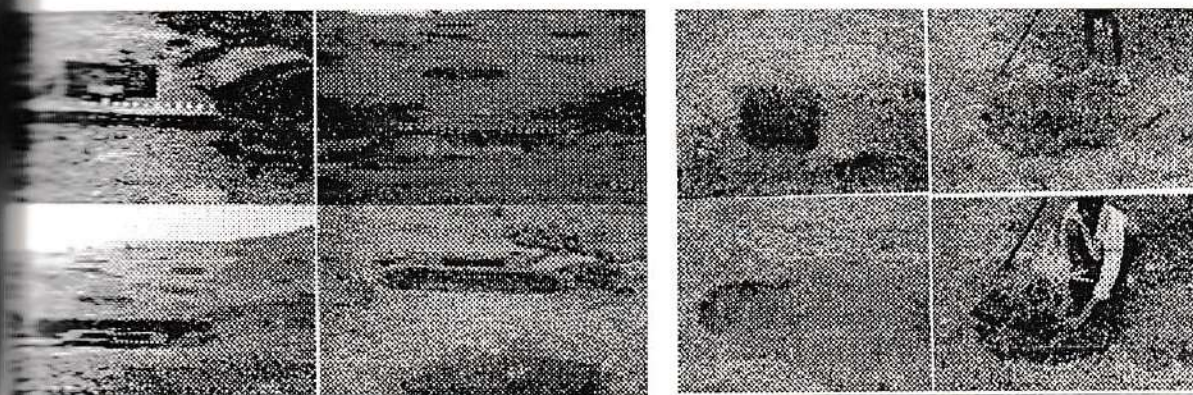


Figure: Rainwater harvesting devices (top), run-off measuring devices (lower four left) and plantation activity at the site (lower four right).

Observations in the first year indicated that slope gradient had significant effect on soil nutrients, vegetation status and their biomass, soil water content and surface run-off losses. Treatment effect was not significant on water loss and soil water content (SWC) except in 0-20 cm soil layer of lower reach sampling points in a plot, in which SWC was significantly ($P < 0.05$) greater in contour trench plots as compared to Gradonie and V-ditch plots. Steep slopes resulted in higher water and PO_4 -P loss. Study needs further data recording to find out a clear trend and the effect of the treatments on biodiversity improvement, growth of the planted seedlings and soil water and nutrient status.

Project 4: Implementation of Bamboo Locational Trials (BLT) Project [AFRI-43/FGTB/NMBA//2005-2007].

Principal Investigator: Dr. U.K. Tomar

Status:

Three trials namely Species, Water Management and Spacing Trails are established at Bhapore Nursery and at Gaupara in Banswara District Fourth trial on macro and micro propagation could not be established due to inability of coordinating agency to supplying planting material.

Casualty is lesser in the species in which the plants have grown well at the time of planting viz. *B. balcooa*, *D. hamiltonii*, *D. strictus* and *B. tulda*. Whereas, casualty is more (50% and above) in plants which are smaller at the time of planting viz. *D. asper* and *B. bambos* (they are tissue culture raised also). Probably the absence of well-grown rhizome may be the reason for their poor survivability. In case of *B. nutans*, in which the plants are medium sized, the survival is better than *D. asper* and *B. bambos*. (Mortality is 11%). In case of *B. giganteus*, the rhizomes could not produce new shoots.

Project 5: Multiplication and field trial of Bamboos through tissue culture in Rajasthan and Gujarat [AFRI-68/FGTB/DBT/2005-2007].

Principal Investigator: Dr. U.K. Tomar

Status:

Site (50 ha) identified in both states viz. Rajasthan and Gujarat. The identified sites in Rajasthan are Kushalgarh (20 ha), Banswara and Saira (5 ha), Udaipur. Only one site i.e. Chakhalia (25 ha), Dahod is identified in Gujarat. Planting material (8000 TC Plants) of *Bambosa bambos* procured from TERI and *Dendrocalamus strictus* are being raised at AFRI, Jodhpur. Advance work of pitting as per field design is in progress. Polyhouse repair work is in progress. Appointment of a JRF and a Field assistant has been completed.

Project 6: Co-ordinated Project: Genetic improvement of *Jatropha curcas* for adaptability and oil yield (Component: Performance of *Jatropha curcas* accessions under arid environment) [AFRI-69/Silvi/CSIR/2005-2010].

Principal Investigator: Dr. R.L. Srivastava

Status:

22 accessions have been collected/received against target of 27 accessions. Two new accessions from Haryana have been identified and seed has been collected from them. Twenty accessions from Tamil Nadu (10) and Kerala (10) have been collected and are under the process of propagation. Seeds of Udaipur and Banswara area have also been collected and sent to FRI for provenance trial. Seeds were also collected from one-year-old irrigated trial. Total fruit yield/tree, seed/fruit ratio, seed/kernel ratio and optimum solvent extraction time for oil estimation and type of solvent has been worked out for *Jatropha*. Performance trial has been laid out with 17 accessions. Design for all new trials to be laidout under this project has been finalized and sent for approval to the co-ordinator.

[AFRI- **Research Achievements: State-wise under AFRI's jurisdiction**

Name of State	No. of Projects completed in 2005-06		No. of ongoing projects in 2005-06		No. of Projects initiated in 2005-06	
	Plan	Externally Aided	Plan	Externally Aided	Plan	Externally Aided
Rajasthan	5	3	12	2	-	5
Gujarat	-	-	2		-	
Common to both Rajasthan & Gujarat	2		2	1		1
Total	7	3	16	3		6

EDUCATION AND TRAINING

(a) Education

Mr. Ranjeet Singh Yadav under the supervision of Dr. G. Singh, Head, Division of Forest Ecology was awarded Ph. D. degree from FRI deemed University.

(b) Trainings attended by AFRI Scientists

I. International

- Dr. Tarun Kant, Scientist-C successfully completed one year Post Doctoral Fellowship from 16th August, 2004 to 15th August, 2005 under Biotechnology Overseas associateship 2003-04, Govt. of India, Dept. of Biotechnology at the Department of Plant Sciences, University of Cambridge, U.K.
- Dr. V.P. Tewari, Scientist-E successfully completed two months study cum research visit from 15.12.05 to 15.02.06 at the Institut für Waldinventur und Waldwachstum, Georg-August Universität, Göttingen (Germany) under the German Academic Exchange Programme (DAAD) and worked on the project "Modelling Growth and Yield in Forestry Tree Species".

II. National

- Sh. Balbir Singh, IFS attended the five days compulsory training programme for IFS officers on "Management of Tropical forests- Issues and challenges" held at Kerala Forest Research Institute, Peechi.
- Dr. G. Singh, Scientist E attended six days training programme on 'Participatory management of natural resources for sustainable livelihood' at National Institute of Rural Development, Hyderabad from 11th to 16th April 2005.
- Km. Sarita Mutha, R.A. I, of Forest Ecology Division attended two days training/workshop on 'Essentials of achieving forest certification: the process and the requirement' from 4-5, April 2005 organised by SGS, India Private, Ltd. at New Delhi.

(b) Trainings imparted by institute:

1. Organised ten nos. of three-days training programmes on "Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems" in desert districts of Rajasthan.
2. As a multidisciplinary approach of watershed management, inputs on nursery and plantation techniques, biofertilizers, agroforestry models, soil and water conservation techniques, horticulture, pasture management, disease and pest management etc. were given by the resource persons from both within and outside the institute in above training programmes.
3. Technical staff of the institute delivered lectures/talks on various forestry topics at Nehru Yuva Kendra, Maru Van Prashikshan Kendra, Jodhpur for the benefits of students, NGOs and foresters from time to time during the year.
4. Training on VAM technology was imparted to 25 participants, which include ACFs, RFOs JRF & Field Supervisors, at TRC, Gandhinagar (Gujarat). Training on Isolation of VAM & identification techniques were given to JRF time to time at AFRI, Jodhpur.

(c) Educational visits at the institute:

- As a part of their training programme, 33 IFS probationers (2005 batch) from IGNFA Dehradun visited institute on 14th & 15th Jan, 2006 and were briefed about research activities being carried out by the institute. Field visits to AFRI Experimental fields, model nursery & germ plasm bank of medicinal plants were undertaken.
- As a part of their training programme, 28 SFS trainees from SFS College, Dehradun visited institute on 23rd Nov. 2005 and were briefed about the various research activities of the institute and taken to different experimental fields.
- As a part of their training programme, 34 Forest Guard Class trainees from NRMCA, Sohna of Haryana Forest Department accompanied by A.C.F. Incharge visited institute on 6th January 2006 and were briefed about research activities being carried out by the institute. Field visits to AFRI Experimental fields were undertaken.
- 13 students from FRI (DU) Dehradun visited AFRI Model nursery and Medicinal Plant germ plasm bank on 14th February, 2006 along with Dr. P. K. Gupta, Scientist.
- 40 school children from School of Desert Science, Jodhpur visited institute and were briefed about AFRI activities on 8th July 2005.
- Students of 45 Navodaya Vidyalayas of the states of Haryana, Rajasthan and Delhi visited institute on 18th, November, 2005 and were briefed about various research and extension achievements, facilities and activities of A.F.R.I.
- More than 500 farmers from different parts of Rajasthan visited AFRI model nursery and Medicinal plants germ plasm bank of the institute during the year 2005-06 and were imparted training on nursery technology of medicinal plants and other arid zone species.
- A Desert Learning Programme was organized at AFRI, Jodhpur from 21st to 24th December 2005 in collaboration with Ashoka Trust for Research in Ecology and the Environment (ATREE), New Delhi. Director AFRI & Head, Ecology Division addressed and gave inputs to the 42 students & 4 teachers of Salwan Public School, Gurgaon, Haryana and 3 staff member of ATREE, N. Delhi. Students were taken to nearby areas of desert floral/faunal and historical importance.

LINKAGES AND COLLABORATION

National

1. Tata Energy Research Institute, N. Delhi.
2. Central Arid Zone Research Institute, Jodhpur
3. Jai Narayan Vyas University, Jodhpur
4. Council of Scientific & Industrial Research, N. Delhi
5. National Bureau of Plant Genetic Resources, N. Delhi
6. National mission on Bamboo, N. Delhi
7. Department of Biotechnology, Govt. of India, N. Delhi
8. Ministry of Water Resources, N. Delhi
9. Rajasthan Forest Department
10. Gujarat Forest Department

International

1. Institute of Forest Inventory & Forest Growth, George-August University, Goettingen, Germany
2. Department of Plant Sciences, University of Cambridge, U. K.

PUBLICATIONS

Papers in Proceedings/Chapters in Books

1. V.P. Tewari. Individual tree growth models for an *Ailanthus excelsa* roxb. plantation in the hot arid region of India. Pp. 428-436. In: V.P. Tewari and R.L. Srivastava (eds.). 2005. Multipurpose Trees in the Tropics: Management and Improvement Strategies. Scientific Publishers, Jodhpur (India), pp. 762.
2. P. Chaudhry and V.P. Tewari. Estimating Use Value - a case study of Mahatama Gandhi Marine National Park, Andaman & Nicobar Islands, India. Pp. 200-207. In: V.P. Tewari and R.L. Srivastava (eds.). 2005. Multipurpose Trees in the Tropics: Management and Improvement Strategies. Scientific Publishers, Jodhpur (India), pp. 762.
3. K. K. Chaudhuri, D. K. Mishra, Ved Pal Singh and J. K. Shukla. Analysing the availability of medicinal plants and their export potential in India. Pp. 364-369. In: V.P. Tewari and R.L. Srivastava (eds.). 2005. Multipurpose Trees in the Tropics: Management and Improvement Strategies. Scientific Publishers, Jodhpur (India), pp. 762.
4. D. K. Mishra, K. K. Chaudhuri and Ved Pal Singh. Effect of pre-treatments on seed germination in *Cassia angustifolia* Vahl. Pp. 301-305. In: V.P. Tewari and R.L. Srivastava (eds.). 2005. Multipurpose Trees in the Tropics: Management and Improvement Strategies. Scientific Publishers, Jodhpur (India), pp. 762.
5. K. K. Chaudhuri, D. K. Mishra and J. K. Shukla. Market survey on the demand of medicinal plants: A case study of Jaipur, Rajasthan. Pp. 295-300. In: V.P. Tewari and R.L. Srivastava

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 7. Ranjana Arya and R.R. Lohra. Growth And Biomass Yield From *Salvadora Persica* with Management Practices On Salt Affected Soil Under Hot Arid Conditions In India. Pp. 102-108. In: V.P. Tewari and R.L. Srivastava (eds.). 2005. Multipurpose Trees in the Tropics: Management and Improvement Strategies. Scientific Publishers, Jodhpur (India), pp. 762.
 8. S.I. Ahmed and Shivesh Kumar. Biology and efficacy of *Tetrastichus spirabilis* and *Eupelmus sp.*, the potential bio control agents of gall forming insects of *Prosopis cineraria* (L) Druce. Pp. 232-237. In: V.P. Tewari and R.L. Srivastava (eds.). 2005. Multipurpose Trees in the Tropics: Management and Improvement Strategies. Scientific Publishers, Jodhpur (India), pp. 762.
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15. N.K. Bohra, S. Mutha and P. Kumar. Bio-ecology of potable water. Pp. 361-369. In: A. Kumar and G. Tripathi (eds.). 2005 Water Pollution: assessment and management. Daya Publishing House, New Delhi.
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Research Papers in Scientific Journals

International

1. Ranjana Arya, K.R Chaudhary and R.R. Lohara (2005) Effect of Nitrogen and Gypsum on Establishment and Early Growth of *Salvadora Persica* (L) in Salt Affected Soils Under Hot Arid Conditions In India. *Forests, Trees and Livelihoods* 15: 291-306.
2. R. Arya (2006) A silvipastoral study combining *Cenchrus ciliaris* and three species of tree in arid India.. *Journal of Arid Environments* 65: 179-191
3. G. Singh and M. Bhati (2005). Growth of *Dalbergia sissoo* in Desert regions of western India using municipal effluent and the consequent changes in soil and plant chemistry. *Bio-Resource Technology* 96(9): 1019-1028.
4. G. Tripathi, S. Ram, B.M. Sharma and G. Singh (2005). Faunal biodiversity and its role in nutrients turnover in different silvipasture systems of Indian dry zone. *Environmental Conservation* 32(2): 178-188.
5. B. Singh and G. Singh (2006). Effect of controlled irrigation on water potential, nitrogen uptake and biomass production in *D. sissoo* seedlings. *Environment and Experimental Botany* 55(1&2): 209-219.
6. V.P. Tewari and K.v. Gadow (2005). Basal area growth of even-aged *Azadirachta indica* stands in the Gujarat State of India. *Journal of Tropical Forest Science* 17(3): 349-361.
7. V.P. Tewari and V.S. Kishan Kumar (2005). Growth and yield functions for *Dalbergia sissoo* plantations in hot desert of India grown under irrigated. *Journal of Tropical Forest Science* 17(1): 87-103.
8. D.K. Mishra (2005). Germplasm variability in Neem. *Journal of Tropical Forest Science* 17(2): 224-227.

National

1. K.K. Srivastava, M.E. Ostry and Sunil Kumar. (2005) Effect of ArmicarbTM100 against *Sirococcus clavaganti jugladacearm* (A butternut canker pathogen). *Indian Journal of Forestry* 28: 162-163.
2. V.P. Tewari (2006) Generalised diameter-height equations for even-aged stands of *Azadirachta indica* in Gujarat State of India. *Indian Forester* 132(1): 79-90.
3. V.P. Tewari and Bilas Singh (2005). Comparison of Bruce's formula and other methods for log volume estimation. *Indian Forester* 131(7): 417-423.
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5. K.K. Chaudhuri, D.K. Mishra, V.P. Singh and J.K. Shukla (2005). Harnessing thar biodiversity for medicinal uses. *Indian Forester* 131: 288-307.
6. G. Singh (2005). Carbon sequestration under an agri-silvicultural system in the arid region. *Indian Forester* 131(4): 543-552.
7. G. Singh and M. Bhati (2005). Effect of mixed industrial effluent on soil properties and survival of tree seedlings. *J. Indian Soc. Soil Science* 53(1): 137-141.
8. S.P. Chakiyal and T.C. Pokhariyal (2005). Nitrogen fertilization vis. a.vis nitrate assimilation in different plant parts of *P. pinnata* Pierre seedlings. *Annals of Forestry* 13: 130-43.
9. B. Singh and G. Singh (2004) Influence of soil water regime on nutrient mobilization and uptake by *Dalbergia sissoo* seedlings. *Tropical Ecology* 45 (2): 337-340.
10. Gunjan Prakash, C.J.S.K. Emmanuel and Ashok K. Srivastava (2005) Variability of Azadirachtin in *Azadirachta indica* (Neem) batch kinetics studies of cell suspension culture. *Biotechnology and Bioprocess Engineering* 10: 198-204.

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2. Ranjana Arya, G.R. Kachhwaha, K.R. Choudhary and R.R. Lohara (2006) Growth and biomass production of important fodder species in various agroforestry systems under hot arid conditions. Paper presented at National symposium on Livelihood securities and diversified Farming systems in arid regions at CAZRI, Jodhpur, 14-16 Jan 2006.
3. Ranjana Arya, Mala Rathore, S.H. Jain, Hemant Kumar, R.R. Lohara and R.K. Meena (2005) Strategies for Extension of Important Non-wood products Technologies. Paper presented in the workshop on "Challenges in forestry research extension" at AFRI, Jodhpur from 18 to 19 Oct. 2005.

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7. D. K. Mishra, J. K. Shukla and R.L. Srivastava (2005). Rare and threatened medicinal plants of Rajasthan and their conservation concern. Paper presented in the National symposium on Emerging technologies and their application in assessment, conservation and management of threatened wild medicinal plants and their habitats, SFRI, Jabalpur, 23-25th Feb. 2005.
8. R. L. Srivastava, N. Bala, G. Singh and P. Chaudhry (2005). *Grassland development strategies dovetailed with planner's perspective in dry region of India*. Paper presented in the workshop on 'Grassland Management -Gene Pool Conservation' organised by forest department, Rajasthan at Jaipur from 26-28th September 2005.
9. P. Chaudhry, R.L.Srivastava and A.S. Apte (2005). Successful demonstration of urban forestry model in Jodhpur city and strategies for its extension in other urban areas of arid region. Paper in the workshop on "Challenges in forestry research extension" held at AFRI, Jodhpur from 18 to 19 Oct. 2005.
10. G. Singh and N. Bala (2005). Role of tree litter in organic farming. Presented in the workshop 'Dry Land Organic Farming in Rajasthan' organized by the Jodhpur chapter of the Indian Society of Soil Science at CAZRI, Jodhpur from May 10-11, 2005.
11. G. Singh (2005). 'Strategies of tree integration to control land degradation and to increase agricultural productivity of dry lands'. In regional workshop on "Challenges in Forestry Research Extension" held at AFRI Jodhpur during 18-19 October 2005.
12. G. Singh, N. Bala and Thanaram Rathod (2006). Process and control of desertification for improved productivity in dry areas. Presented in the workshop 'Desert and Desertification in Western India' at Gandhinagar, Gujarat on 19-20th January 2006 organized by State Forest Department, Gujarat.
13. G. Singh and Thanaram Rathod (2006). Productivity of *Hardwickia binata* based agroforestry in Indian desert. Presented at a National seminar on 'Recent Advances in Forest Science, to be held on 30-31 January 2006 at Guru Ghasidas University, Bilaspur, Chattishgarh.
14. G. Singh, N. Bala, P. Kumar and T.R. Rathod (2006). Biodiversity and productivity of tree associated pastureland and their probable management strategies in dry areas. Submitted in National Conference on 'Forest Ecology and Environment-priorities in 21st century' held at FRI, Dehradun during 27-28th February 2006.

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16. R.L. Srivastava and N. Bala (2005). Wasteland and their management with special emphasis on problem soils of western Rajasthan. Presented in 'Agri-conclave 2005', organised by Confederation of Indian Industry and Government of Rajasthan, Jaipur.
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18. U.K. Tomar, Usha Negi and A.K. Sinha, 2006 Economics and Factors Influencing Cost of Micropropagated Plants. In: National Conference on "Tree Biotechnology: Indian Scenario" held at TFRI, Jabalpur on Feb 9-10, 2006.
19. N. K. Sharma, R. K. Gupta & U.K. Tomar (2006) Standardization of Micropropagation Technique for *Ailanthus excelsa* Roxb. Adult Tree. In: National Conference on "Tree Biotechnology: Indian Scenario" held at TFRI, Jabalpur on Feb 9-10, 2006.
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23. G. Singh, U.K. Tomar and Tarun Kant (2005) Compilation of Abstracts of Regional Workshop on Challenges in Forestry Research Extension (October 18-19, 2005) held at AFRI, Jodhpur.
24. R.L. Srivastava, D.K. Mishra, V.P. Tewari, & U.K. Tomar (2005) Document of Micropropagation Mission on *Jatropha*. DBT, Govt. of India.
25. C.S. Dange, Genda Singh and Sunil Kumar (2006). Role of integrating site specific vegetative and water harvesting measures, and thereby, establishing productive Silvopastoral Ayurveda demonstrative models for arid regions. In the National symposium on "Livelihood security and diversified farming systems in arid regions" at CAZRI, Jodhpur on 14-16 Jan. 06.
26. C.S. Dange, G. Singh and Sangeeta Tripathi (2005). Road to Ecotourism in Dry Areas. In 2nd National Workshop on Youth Enterprise Development in Tourism Sector organised at Hotel Abhay Days, Jodhpur on 22-27, November 2005.

27. C.S. Dange, Sunil Kumar and Sangeeta Tripathi (2006). Sustainable strategy for establishment and development of productive Silva-Ayurveda demonstrative models for semi-arid and arid region. In the Regional workshop on Combating Desert and Desertification For Western Region organized by State Forest Department, Gujarat held at GCERT, Gandhi Nagar on 18th -21st January, 2006.
28. Sunil Kumar and C.S. Dange (2005). Success indicators of sustainable Joint Forest Management in Rajasthan and Gujarat. In workshop on Community Based Forest Management, Centre for land and Water Management, National Institute of Rural Development, Hyderabad, Dec 19-21, 2005.

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1. V.P. Tewari and Bilas Singh. Provisional equations for estimating total and merchantable wood volume of *Acacia nilotica* trees in Gujarat State of India. *Forests, Trees and Livelihoods* (in press).
2. V.P. Tewari and Bilas Singh. Total and merchantable wood volume equations for *Eucalyptus hybrid* trees in Gujarat State, India., *Arid Land Research and Management* (in press).
3. V.P. Tewari and K.v. Gadow. Mortality and basal area projection models for pure even-aged *Dalbergia sissoo* stands in a hot arid region of India. (Submitted to *Forest Ecology and Management*).
4. V.P. Tewari, J.J. Corral Rivas, F. Vilcko and K.v. Gadow. Height-growth and site index equations for *Acacia nilotica* and *Eucalyptus hybrid* plantations in Gujarat State of India. (Submitted to *New Forests*).
5. V.P. Tewari. Total wood volume equations and their validation for *Tecomella undulata* plantations in hot arid region of India. (Submitted to the *International Forestry Review*).
6. K.K. Srivastva, H.P. Srivastava and Sunil Kumar (2004). Standardization of inoculum dose in *Tecomella undulata* Sm Seem. *The Indian Forester* (In press).
7. P. Chaudhary, V.P. Tewari and B. Singh (2006). Non-market economic valuation in developing counties: Role of Participant observation method in CVM analysis. (Submitted to *Journal of Forest Economics*)
8. P. Chaudhry and V.P. Tewari (2006). TCM Vs CVM in assessing recreational use value of urban forestry: An example from a black money laden developing country (Submitted to *International forestry review*).
9. P. Chaudhary, V.P. Tewari and B. Singh (2006) .WTP Vs WTA for assessing recreational benefits of urban forestry: A case from a modern and planned city of India. (Submitted to *Journal of Tropical Forest Science*).
10. P. Chaudhary, V.P. Tewari and B. Singh (2006) Quantification of economic use value of urban forestry of Chandigarh: A modern and planned Indian city. (Submitted to *Journal of Parks and Recreation Administration*).
11. G. Singh and S. Mutha (2005). Effect of tree density on productivity of a *Prosopis cineraria* agroforestry system in the arid zone of India. *J. Arid Environment* (Revision).

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14. G. Singh and B. Singh (2005). Productivity and nutrient uptake in *Dalbergia sissoo* seedlings grown at varying irrigation levels in Indian Desert. (Submitted to *Irrigation Science*).
15. G. Singh (2005). Effects of irrigation on growth and on biomass and nutrient partitioning in *Eucalyptus camaldulensis* seedlings. (Submitted to *European J. Agronomy*).
16. G. Singh and T.R. Rathod (2005). Resource use and crop productivity in a tree based agroecosystem of Indian Desert. (Submitted to *Agriculture, Ecosystem & Environment*).
17. G. Singh, T.R. Rathod, Bilas Singh and Manoj Chouhan (2006). Interactions and Productivity in *Emblica officinalis* Based Agri-horticulture System in Indian Desert. (Submitted to *Biological Agriculture & Horticulture*).
18. G. Singh and T.R. Rathod (2006). Productivity and soil resource availability in *Hardwickia binata* based agroforestry system in Indian desert. (Submitted to *Agroforestry Systems*).
19. U.K. Tomar and D. Prem Kumar, (2006) Protoplast Culture and Somatic Hybridization. In: G. Tripathi (ed.) Cellular and Biochemical Science. (Submitted)
20. D. Prem Kumar and U.K. Tomar (2006). Somatic Embryogenesis. In: G. Tripathi (ed.) Cellular and Biochemical Science. (Submitted).
21. Ranjana Arya, K.R. Chaudhary and R.R. Lohara (2006). Studies on mound practices for establishment and growth of various plant species on saline and waterlogged soil in hot arid zone of India. *Indian Forester* (accepted).
22. Ranjana Arya, G.R. Kachhwaha, K.R. Choudhary and R.R. Lohara (2006) Performance of various plant species on water harvesting structures under frost prone arid conditions in India (Communicated to *My Forest*).

Extension brochure/pamphlets

- 1 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Giloe, *Tinospora cordifolia* (Willd.) Miens: The Climber of Longevity. Extension brochure
- 2 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Sarpgandha, *Rauwolfia serpentina* Benth. Ex. Kurz: Bitter root to better high blood pressure. Extension brochure
- 3 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Isabgol, *Plantago ovata* (Forsk.) Natural defence to digestive disorders. Extension brochure.
- 4 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Bhui Amla, *Phyllanthus amarus* Schum & Thonn.: The wonder herb. Extension brochure.
- 5 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Tulsi, *Ocimum sanctum* Linn: The sacred plant. Extension brochure.
- 6 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Ratanjot, *Jatropha curcas* L: The bio-diesel plant. Extension brochure.
- 7 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Mulhatti, *Glycyrrhiza glabra* Linn: Sweet Root sweeter than sugar. Extension brochure.
- 8 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Shatavari, *Asparagus racemosus* Willd. Extension brochure.
- 9 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Kalmegh, *Andrographis paniculata* (Wall.) Nees. The king of bitters. Extension brochure.
- 10 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Guar Patha, *Aloe vera* (Linn.) Burm.f., Lily of the Desert. Extension brochure.
- 11 K. K. Chaudhuri, D. K. Mishra and J. K. Shukla (2005). Ratanjot, *Jatropha curcas* L. Biodiesel Plant. Extension brochure.
- 12 रतनजोत जेट्रोफा कर्कस लि.
- 13 सर्पगंधा रावेलफिया सर्पेन्टिना लि. बेन्थ एक्स कुर्ज
- 14 कालमेघ एन्डोग्राफिस पेनिकुलेटा वाल नीस
- 15 भुई आंवला फाइलेन्थस अमेरस शुम एवं थोन
- 16 सफेद मूसली क्लोरोफाइडम बोरिविलिएनम सांतापउ व फरनानडिस
- 17 मुलैठी ग्लाइसीराइजा ग्लैबरा लिन
- 18 अकाल के समय जीवन रक्षक पेड़ : कैर कैपेरिस डेसिडुआ एडज्यु
- 19 आयुर्वेदिक औषधि के लिए वरदान : अश्वगंधा विदानिया सोम्नीफेरा डुनाल
- 20 मारवाड़ का टीक : रोहिड़ा टेकोमेला अन्ड्रुलेटा सीम.
- 21 अरेबिक गोंद का एक मात्र स्रोत : कुमट अकेशिया सेनेगल विल्ड.
- 22 रेगिस्तान का कल्पवृक्ष : खेजड़ी प्रोसोपिस सिनेरेरिया मैकन्न.
- 23 कई मर्ज की एक दवा : गुग्गुल कोम्मीफेरा विगटाई अर्न.
- 24 शक्तिवर्धक औषधीय गुणवाला : शतावरी एस्पेरेगस रेसीमोसस विल्ड
- 25 शुष्क रेतीले क्षेत्र में मृदा कटाव व ईंधन का मुख्य स्रोत : फोग केलिगोनम पोलीगोनाईडिस लिन
- 26 आर्थिक उन्नति का आधार : सोनामुखी कोसिया आंगस्टीफोलिया बहल.
- 27 कई बीमारियों की एक दवा : ग्वारपाठा (घृतकुमारी) एलोय वेरा लिन
- 28 इसबगोल प्लान्टेगो ओवेटा फोर्सक
- 29 तुलसी ओसिमम सेन्कटम लिन
- 30 गिलोय टीनोस्पोरा कार्डीफोलिया विल्ड. मियर्स

CONSULTANCY

Consultancy was taken up for "Landscaping and arboriculture job" at two housing construction sites of Air force station, Jodhpur, for M/S National Building Construction Corporation Ltd. (NBCC), a govt. of India enterprise, under Ministry of Urban development and poverty alleviation, N. Delhi, who has been appointed executing agency for Defence Housing Project for armed forces at different locations in Rajasthan.

CONFERENCE / MEETINGS / WORKSHOPS / SEMINARS / SYMPOSIA AWARENESS PROGRAMMES

Organised

- 56th Van mahotsava was celebrated at AFRI on 16th July, 05 in collaboration with Rajasthan forest Department Jodhpur. Sh. Laxmi Narayan Dave, Hon'ble Forests & Environment Minister, Govt. of Rajasthan was the chief guest and Smti. Amita Choudhary, Chairperson Zila Parishad, Jodhpur presided over the function. About 175 school children from five schools of the city participated in the function. Ceremonial plantation of different species was undertaken and *Aloe vera* demonstration cum production area was inaugurated by the chief guest. As an awareness campaign, painting and quiz competitions on "Conservation of Forests & wildlife" among the children of AFRI campus were organized.
- One day Workshop on "Combating Desertification Programme" was held on 6th September 2005. It was inaugurated by Shri Kallu Lal Gurjar, Hon'ble Minister for Rural Development & Panchyat Raj Department, Rajasthan. CCF, Jodhpur, CF Jodhpur, CF Sikar, Dy. Secretary, RD(LR), Govt. of Rajasthan, CEOs & DFO's of desert districts of Rajasthan participated in the workshop. The participants also visited Medicinal experimental trials and Germ Plasm Bank at AFRI Model Nursery.
- Research Advisory Group Meeting was organized on 20th September 2005. DDG (Research), Director (Research) from ICFRE, Dehradun, other RAG members and forest officers attended the meeting. Thirty ongoing projects and eight new projects were presented before the RAG members.
- A two-day Regional workshop on "Challenges in Forestry Research Extension" was organised on 18th -19th Oct., 2005. Director (Research), ADG (Media) from ICFRE, Dehradun and more than 30 Scientists/officers/professors/NGOs associated with extension activities in different departments, universities, institutions attended the workshop and presented papers.



Inaugural session



Excursion to Eco park at Tinwari

- A three day workshop on “बानिकी शब्दावली” was held at AFRI, Jodhpur from 28th-30th Sept. 2005, which was sponsored by Commission for Scientific & Technical Terminology, Ministry of Human Resource Development, Govt. of India, New Delhi. All the officers, Scientists and technical staff of AFRI participated in the workshop.
- A one day workshop on “ Strategies for meaningful implementation of Desert Development Programme (DDP), Drought Prone area Programme (DPAP) & Integrated Watershed Development Programme (IWDP) in desert areas” was organized at AFRI on 07/12/2005. Sh S.Parthasarthy IAS (retd.) chairman, expert committee, chaired the workshop. Sh. Anoop Badhwa IFS. Member secretary expert committee, Sh. L.K.Sharma Dy. Secretary of rural development, Govt of Rajasthan, Zila Pramukh, Barmer; CEOs, DFOs, of desert districts of Rajasthan, NGOs, officers/scientists of AFRI participated in the workshop.

Participation

1. Dr. R.L. Srivastava, Director attended 4th meeting of the Reconstituted Programme Steering Committee on Bioengineering for Biofuels and Bioenergy at N.Delhi organized by Dept. of Biotechnology, New Delhi on 7th and 8th April' 2005.
2. Dr. R.L. Srivastava, Director attended IRG-36 Annual Conference on “Protection and efficient utilization of plantation grown lesser-known timbers of arid region in India- *Acacia tortilis*, *Prosopis juliflora* and *Prosopis cineraria*” at IWST Bangalore from 24th to 28th April' 2005.
3. Dr G. Singh, Sh. N. Bala and Dr. P.K. Aggarwal attended two days workshop on ‘Dry Land Organic Farming in Rajasthan’ organized by the Jodhpur chapter of the Indian Society of Soil Science at CAZRI, Jodhpur from May 10-11, 2005.
4. Dr G. Singh attended one day meeting at UNDP office New Delhi ' on May 12, 2005 for presentation of project ‘Integrated ecosystem approach to mitigate land degradation, enhance productivity and reduce poverty in arid and semi arid lands of western India. Dr Ranjana Arya participated in two day workshop on Organic Agriculture in arid zone from 10-11 May 2005 in CAZRI, Jodhpur.

6. Sh. R.L. Srivastava, Director AFRI, visited BITS, Pilani for delivering lecture on Desert Development Technologies from 8th-10th May 2005.
7. Sh. R.L. Srivastava, Director AFRI, attended a meeting at UNDP Office, N. Delhi in connection with GEF Project from 11th-13th May 2005.
8. Dr. R.L. Srivastava attended two days workshop on Agri Conclave 2005 at Jaipur from 11th-12th August organized by CII, Rajasthan and delivered a talk on "Wasteland and their management with special emphasis on problem soils of Rajasthan".
9. Dr. R.L. Srivastava, Director and Dr. G. Singh, Scientist E participated in the workshop on 'Grassland Ecology and Gene Pool Conservation' organized by State Forest Department, Rajasthan on 26-28th September 2005 at Jaipur.
10. Dr. R.L. Srivastava, Director, AFRI attended the workshop on "Challenging Poverty by Enhancing Rural Livelihoods" organized by IFFDC & MKD, IFFCO from 27-29th Sept 2005 at Udaipur and chaired one session.
11. Dr. R.L. Srivastava, Director, AFRI attended "Immersion programme on institution building and livelihood promotion -Learning from the experiences of Andhra Pradesh" held at CRIDLA, Hyderabad and visited collaborative institutes/partners at CRIDA, Hyderabad & PAP Ltd. Bangalore under CSIR, Jatropha Project from 4th-10th December, 2005.
12. Dr. R.L. Srivastava, IFS, Director, AFRI attended International Workshop on Biofuels at New Delhi from 18-19th January 2006.
13. Dr. G. Singh and Dr. Sunil Kumar, Scientist-D participated in Regional level Workshop on the theme "Desert & Desertification for the Western Region" held at GCERT, Gandhinagar (Gujarat) from January 19-20, 2006 organized by the Gujarat Forest Department.
14. Dr. R.L. Srivastava, Director and Dr. U.K. Tomar Scientist-E, AFRI participated in National Conference on "Tree Biotechnology: Indian Scenario" held at TFRI, Jabalpur from 9th-10th Feb., 2006.
15. Sh. C.J.S.K. Emmanuel attended workshop on "Medicinal and aromatic plants development" at Mandore Agriculture Station, Jodhpur organized by the State Agricultural Department.
16. Sh. Arvind Apte DCF attended National workshop on 'Conservation and cultivation of medicinal plants' at Pinjore, Haryana on 15 & 16th Feb-2006 and presented a paper on 'Market Potential of medicinal plants in Rajasthan'.
17. Dr. G. Singh, Head, Division of Forest Ecology, participated in national seminar on 'Recent Advances in Forestry Sciences' Held at Guru Ghasi Das University, Bilaspur on 30-31 December 2005.
18. Dr. R.L. Srivastava, Director AFRI participated and addressed a Technical Workshop in Hindi on National resource conservation as chief guest organized by Oil India Ltd. at Hotel Chandra Inn, Jodhpur on 22.02.2006.

Exhibition

- AFRI participated in the Paschimi Rajasthan Hast Shilp Utsav-2006 at Jodhpur to disseminate the research highlights & achievements of AFRI to the masses from 02-11 January 2006.

DISTINGUISHED VISITORS

1. Dr. J.S.P. Yadav, Former Chairman, Agriculture Scientist Recruitment Board, visited the Institute on 15th April 2005.
2. Hon'ble Minister of Environment and Forests, Rajasthan visited the institute on 16th July 2005 on the occasion of Van Mahotsava and inaugurated *Aloe vera* Demonstration trial in AFRI campus.
3. Sh. B.L. Arya, IAS, Commissioner, Jodhpur Division visited the institute and inaugurated the Regional Workshop on "Challenges in Forestry Research Extension" on 18th Oct. 2005.
4. Smt. Veena Upadhyay, IAS, Joint Secretary, Ministry of Environment and Forests visited institute on 25th Feb. 2006 and interacted with the Scientists/officers on different aspects of research, computerization, administration etc.

MAJOR RESEARCH ACHIEVEMENTS

- Total wood volume equations for *Tecomella undulata* plantations in IGNP area of Rajasthan State have been constructed and validated.
- Base age invariant site index equations have been developed for *Acacia nilotica* and *Eucalyptus* hybrid plantations in Gujarat State.
- Developed mortality and basal area growth models for *Dalbergia sissoo* plantations in IGNP area of Rajasthan State.
- Identified causes of mortality of *Prosopis cineraria* trees and suggested remedial measures for protecting the infested trees.
- Identified key indicators and suggested suitable strategies for sustainable Joint Forest Management in Rajasthan & Gujarat.
- Studied effect of VAM and bio-fertilizers for improving productivity of *P. cineraria*.
- Screened neem tree for high oil yield and azadirachtin contents.
- Studied transpirational of eucalyptus species and their impact on soil in waterlogged IGNP area of Rajasthan.
- Developed urban aesthetic forestry model for arid region of Rajasthan.
- Constructed water-harvesting structures in Aravalli ranges (Banswara District of Rajasthan) for controlling run off losses.
- Developed technologies for afforestation of salt affected areas in arid region of Rajasthan.