

## CHAPTER VI

### ARID FOREST RESEARCH INSTITUTE JODHPUR

Arid Forest Research Institute (AFRI), situated at Jodhpur is one of the eight institutes under the control of Indian Council of Forestry Research and Education (ICFRE). The objective of the institute is to carry out scientific research in forestry in order to provide technologies, increase the vegetative cover in the region and conserve the biodiversity in the hot arid and semi-arid region of Rajasthan, Gujarat and Dadra and Nagar Haveli.

#### PROJECTS COMPLETED DURING THE YEAR 2002-2003

**Project 1 : Investigation of soil water plant relationship in respect of different tree species [AFRI-5 /FEDD-5/W.B./1998-2001].** For technical report contact, Principal Investigator - Dr. G. Singh.

**Experiment 1: To screen tree species for efficient water use and growth under arid conditions.**

**Findings:** Data recorded in last four years suggest that the most efficient water user species were *Dalbergia sissoo* at 36.2 mm and 26.5 mm irrigation, *Eucalyptus camaldulensis* at 20.2 mm and 18.1 mm irrigation and *Acacia nilotica* at life saving irrigation. *E. camaldulensis* produced 12.05- 31.05 kg per seedling dry biomass as compared to 8.12-18.07 kg per seedling in *A. nilotica* and 7.98-25.88 kg per seedling in *D. sissoo* whereas life saving irrigation produced only 1.51, 3.62 and 0.74 kg per seedling dry biomass in the above species respectively. One and 1.5 fold higher biomass was obtained in 48 months applying 26.5 mm and 36.2 mm irrigation, respectively as compared to the seedlings raised under rainfed for 78 month. *A. nilotica* was better tolerant to severe water stress whereas *D. sissoo* was the least tolerant. Water losses from the *E. camaldulensis* plot irrigated at the rate of 36.2 mm per irrigation was 4.75 mm per day (19 lit. per day) during summer as compared to 3.45 mm per day (13.8 lit. per day) in *A. nilotica* and 2.62 mm per day (10.56 lit. per day) in *D. sissoo* plot. Simple mulching saved the water loss by 0.15 mm per day.



**Experiment 2: To study the effect of varying level of sewage water on the growth of the plants.**

**Findings:** Data recorded in the experiment indicate that application of municipal effluent at  $\frac{1}{2}$  PET (potential evapo-transpiration) and canal water at 1 PET produced same biomass at the age of 2 and 3 years when water requirement of plant was less. *E. camaldulensis* produced 20.1- 9.7 kg per plant as compared to 13.3 - 7.9 kg per plant in *A. nilotica* and 14.8- 9.1 kg per plant in *D. sissoo* by irrigating seedlings with municipal effluent at the rate of 2 PET to  $\frac{1}{2}$  PET rate of transpiration was highest in *E. camaldulensis* as compared to the other two species. The ratio of N/P and N/Mg was low and that of Mg/Na, Mn/Zn and N/Na was high in the seedlings irrigated at 2 PET level as compared to the corresponding values in T<sub>5</sub> treatment. Plants had ameliorative influence on soil properties as indicated by less nutrient status in the soil without plants as compared to the soil with plant.

**Project 2: Integrated development of neem in different agro climatic zones of Gujarat [AFRI-21/FGTB-6 (NOVOD)/1999-2002].**

**Components:** Selection of CPT/sample trees, phenological observations, development of model plantation and model villages. For technical report contact, Principal Investigator - Dr. U.K. Tomar.

**Findings:** A total of 537 CPTs were identified on the basis of seed bearing capacity and over all growth performance in three different agro climatic zones of Gujarat and winter flowering trees at Jodhpur. On the basis of their performance 50 CPTs were finally screened in for high Az (more than 5000 ppm) and high oil contents. Germplasm (370 seed samples) of above CPTs are preserved. About 3,00,000 neem quality seedlings were raised for plantation, distribution to farmers and selling. 15 ha of model plantation was established at different location with experiments on water harvesting technique, VAM interaction, type of seedling and spacing trials. 12 ha seedling seed orchards cum progeny trial have also been raised from progenies of high Az and high oil contents.

**Project 3: Studies on the crude protein content and leaf protein concentrates of arid zone shrubs and trees [AFRI-15/NWFP-3/1995-2005]. For technical report contact, Principal Investigator - Dr. Mala Rathore.**

**Findings:** Crude Protein Content (CPC) of seeds, deoiled seed meals, leaves and shoots of various arid zone plants including the famine food species was determined. Variation in the CPC of neem (deoiled seed meals and leaves), *Pongamia pinnata* (deoiled seed meals) and *Dalbergia sissoo* (pods) from different areas/provenances was studied and regression model developed for interdependence indicated inverse relationship incase of oil and protein content. Leaf Protein Concentrate (LPC) studies revealed that *Moringa oleifera* and *Azadirachta indica* were found suitable for LPC extraction.

**PROJECTS CONTINUED DURING THE  
YEAR 2002-2003**

**Project 1: Agroforestry research for sustainable production in arid regions of Rajasthan [AFRI-2/FEDD-2/1999-2003]. Principal Investigator - Dr. G. Singh.**



**Status:** In 2003, due to drought only plant growth variables and soil properties were monitored. Percent height increment in 2002-03 as compared to that in 2001-02 did not differ both for *Prosopis cineraria* and *Tecomella undulata* plants whereas increment in collar girth of *T. undulata* was significantly more. Soil moisture recorded in top 0-75 cm soil layer did not differ between the species.

In the year 2002, density was reduced to 208 SPH, 139 SPH, and 104 SPH from 416 SPH, 278 SPH and 208 SPH, respectively. Due to drought, data on plant growth and soil properties were recorded. Soil water content was high at 139 SPH as compared to the other two densities. Utilizable dry biomass of *P. cineraria* at 12 years of age was 91.8, 56.6 and 24.7 kg per plant at 208, 278 and 416 SPH densities whereas dry leaf fodder production was 4.1, 2.4 and 1.2 kg per plant at the respective plant densities.

Data recorded in the experiment indicated thicker collar diameter and higher soil water content under rotational cropping plot than in fixed crop plot (*Vigna radiata*). Soil organic matter in 0-75 cm soil layer showed increasing trend at the age of six years in *Emblica officinalis* plot and eighth year in *Hardwickia binata* and *Colophospermum mopane* plots. Pruned biomass of *C. mopane* was 160 kg per ha (400 plant per ha) with 27% leaf dry biomass whereas *H. binata* produced 122 kg per ha dry biomass with 30% leaf contribution. Pooled available nutrients were generally higher during summer and low during spring season. Fruit production of *C. mopane* in 2002-03 was more in rotational crop (1.25 kg per plant) than in fixed crop (0.89 kg per plant). Litter production was high in *E. officinalis* plot and low in *C. mopane* plot.



*Colophospermum mopane* in agroforestry

**Project 2: Studies on the pest problems in forest nurseries and their management in arid and semi-arid region [AFRI-12/FP-2/1993-2003].**

*Principal Investigator - Smt. Seema Kumar.*

**Status:** Insects and non-insects recorded were *Myloccerus nepalensis* and *Myloccerus* sp. on *Eucalyptus* sp., *Myloccerus dalbergiae* on *Dalbergia sissoo*, *Myloccerus* sp. on amrud and *Myloccerus tenuicornis* on *Azadirachta indica*. Data was further recorded on molluscs *Macrochlamys indica* and *Laevicaulis alte*. Nine stages of *M. indica* were collected.



**Project 3: Identification of mortality factors of *Prosopis cineraria* and development of suitable management strategies [AFRI-26/FP-3/2001-2005].** *Principal Investigator - Dr. S.I. Ahmed.*

**Status:** Preliminary investigations have revealed that this devastating problem has primarily been originated with the combined effects of indiscriminate and successive lopping followed by a secondary infestation of a shoot borer, *Derolus discicollis* Gahen. Epidemic of this species has been recorded for the first time in the year 2000-01. An unidentified root and shoot cerambycid borer has also been recorded infesting khejri trees in almost all the study sites in the four districts of north western Rajasthan. The borer attack is followed by a tertiary infection of fungus disease. The infected samples reveal the presence of three highly infective species of *Fungi imperfectii* viz., *Alternaria* sp; *Phoma* sp. and *Botryodiplodia* sp. which ultimately cause the die-back disease in mature trees of khejri as a result of which the tree starts drying from the top.

Farmers have been advised through different forums for control measures. Judicious lopping application of AFRI paste and removal of heavily infected trees are the main management recommendations.

Advanced studies on the khejri mortality in north- west Rajasthan have been taken up and the observations on various biotic and abiotic aspects have been collected. Out of 859 total localities in four districts viz., Nagaur, Sikar, Churu, and Jhunjhunu, 140 localities have been selected for sample studies. These units/localities have been divided in 16 study sites for the collection of data on biotic and abiotic aspects in order to study the interaction of various factors with the khejri mortality. Of them, 10 sites in different districts have been visited and the required data has been collected.

**Biotic stresses:** Studies on the collection, identification, augmentation and updating of checklist of insect pests of *P. cineraria* with particular reference to the insect borers is in progress. Study on the bionomics of potential insect borers with particular reference to *Derolus discicollis* is in progress. Studies on the collection and identification of plant pathogens and preparation of a check-list of potential pathogens infecting *P. cineraria* is in progress.

**Abiotic stresses:** Collection of various relevant abiotic factors and studies on their interaction with the khejri mortality is in progress. Study on the nutritional factors for soil (N, P, K, Cu, Fe, Mn, Zn) and plant nutrients (N, P, K, Ca, Mg, Cu, Fe, Zn, Mn) and study their correlation with the concerned problem is in progress. Study the physical and chemical quality of water samples are being collected from the various study areas is in progress.

**Project 4: Provenance trial on arid zone species [AFRI-16/FGTB-3/1992-2003].** *Principal Investigator - Mr. C.J.S.K. Emmanuel.*

**Status: Neem -** The provenance trial of *Azadirachta indica* with 39 seed sources from all over India was laid out in 1992. The studies conducted on floral morphology reveals that maximum mean of inflorescence length was recorded in Palanpur provenance with 23.28 cm. and minimum Kanpur provenance with 11.15 cm. Maximum mean number of flower per inflorescence was found in Palanpur provenances 79.07 and minimum in Kota provenance with 23.28. Maximum mean number of fruits per inflorescence was recorded in Palanpur provenances with 9.27 and minimum in Kanpur provenance with 2.93. Studies



on floral biology revealed that anthesis starts in the evening from 5.30 pm and continued upto 9.30 pm. The maximum percentage of anthesis of flowers occurred between 8.30 to 9.30 pm. The dehiscence of anthers started in closed flowers at 9.30 am and continued upto 3.30 pm. Maximum percent of anther dehiscence occurred from 12.30 to 1.00 pm. Initiation of pollen germination started at 1.15 pm in closed flower. Maximum pollen germination takes place from 1.30 - 3.00 pm. Fertilization time was notice after 36 hours at 2.00 pm in opened flower. Duration of stigma receptivity goes from 1 pm to 2.30 am. The data has also been recorded on the oil and azadiractin content of all the provenances. The promising provenances screened for azadiractin are Palanpur 93, Shivpuri 0.92, Mulug 92 and lowest Bikaner 0.11 percent. The promising provenances for oil are Palanpur 50, Satra 49.4, Shivpuri 49.1 and the lowest from Ranchi 37 per cent.

**Rohida** - The provenance trial of *Tecomella undulata* was planned in the year 1992 with 13 seed sources from Rajasthan. Though the state is facing severe drought but no mortality has been observed in this trial, this indicates that Rohida adapt itself even in drought conditions. The growth data collected indicates that the Sunderpur Bir (Sikar) is superior in growth with a height of 3.81 m followed by Nagaur 3.55 m and Goshala 3.39 m and the lowest in height is Jaisalmer 1.97 m. The Girth is maximum in case of Barmer (Chotan) 30.73 cms followed by Nagaur 29.13 cms and Bhinslana 29.00 cms.

**Shisham:** Provenance trial for *Dalbergia sissoo* has been laid out in August 1995, from the seeds sent by FRI, Dehradun in the year 1994. This year best performance has been recorded for height in Etawah 8.07 m followed by Pilibhit 7.81 m, Allahabad 7.35 m. Pratapgarh 6.14 m and Kasganj 6.13 m and the lowest is Agra 4.00 m. In case of girth Pilibhit has given the best result 77.00 cms followed by Lalitpur 46.99 cms, Allahabad 45.30 cms, Pratapgarh 45.00 cms and the lowest by Agra 30.25 cms.

**Project 5: International neem network provenance trial [AFRI-17/FGTB-2/1995-2005].** *Principal Investigator - Mr. C.J.S.K. Emmanuel.*

**Status:** The International provenance trial on neem was initiated by the FAO Neem Network and the seeds were exchanged between the participating countries during 1995. The field trials have been laid out during the July - August 1996 at Jodhpur, Jaipur, Palanpur, Jabalpur, and Coimbatore, with 18 provenances including control. At present the trial is continuing only at Jodhpur, Jaipur and Coimbatore. The performance of the International Neem Provenance Trial at Jodhpur is good, though lot of mortality has been observed during this year due to severe drought and low humidity in the atmosphere. The best performing provenances in the trial I for height are Ramanguda (IND) 2.76 m followed by Sagar (IND) 2.73 m, Jodhpur (Control) 2.46m, Yezin (MYN) 2.42 m, Geta (NEP) 2.35 m and the lowest is Allahabad (IND) 1.56 m. The best performing provenances for girth are Sagar (IND) 19.46 cms followed by Ramanaguda (IND) 19.18 cms, Jodhpur (Control) 17.67 cms, Kulapachra (IND) 16.27 cms, Doi Tao (THA) 15.57 cms and lowest is Ghati Subramanya (IND) 9.35 cms. In the trial II also some of the plants have died due to drought but the general condition is good and the best performing provenances for height are Sunyani (GHA) 5.26 m followed by Myne (MYN) 4.74 m, Multan (PAK) 4.58 m, Tibbi Laran (PAK) 4.53 m and Chittagon (BAN) 4.74 m. The best performing provenances for girth are Sunyani (GHA) 41.42 cms followed by Myne (MYN) 37.38 cms, Multan (PAK) 35.14 cms, Tibbi Laran (PAK) 31.11 cms and Chittagon (BAN) 24.25 cms.



**Project 6: Provenance trials on *Acacia nilotica* and *Ailanthus excelsa* [AFRI-18/FGTB-3/WB/1995-2005].** *Principal Investigator - Mr. C.J.S.K. Emmanuel.*

**Status:** Provenance trial of *Acacia nilotica* was laid out in the year 1992 with 28 provenances collected from major states of India. The trial has also been affected due to the prolonged drought conditions in the state, some mortality has been observed in the trial. The data on growth parameter have been recorded and best performing provenances for height are Shivpuri 3.26 m followed by Manikpur 3.20 m, Gurgaon 3.17 m, Hastinapur 3.13m, Haldwani 3.13 m and the lowest height was recorded in Akola 2.57 m. The best performing provenances for girth are Makdampur 30.33 cms followed by Parlekhmundi 29.42 cms, Shivpuri 29.17 cms, Gurgaon 29.05 cms, Jhabua 28.32 cms and the lowest girth was recorded from Manikpur 24.14 cms. The studies on fodder value has also been conducted on all the 28 provenances.

Provenance trial of *Ailanthus excelsa* was laid out from the seeds collected from 13 different seed sources, sown in the nursery and transplantable seedlings could be obtained from 8 provenances, only. The provenance trial was laid out at two different sites at Jaipur and Jodhpur. This trial has also been affected by the prolonged drought and low humidity conditions prevailing in the state. The data collected during this year shows that the Varanasi (3.95 m) was the best followed by Sonbhadra (3.59 m), Kazipeth (3.50 m) and Pinjore (3.40 m), Mirzapur (3.41 m) and lowest in height was Jodhpur with 1.84 m. The best performing provenances for girth are Sonbhadra 53.2 cms followed by Kazipeth 52.59 cms, Mirzapur 47.07 cms, Pinjore 46.62 cms, Varanasi 44.54 cms and lowest in girth is Jodhpur 28.89 cms.

**Project 7: Market survey on selected species [AFRI-24/FRME-2/1994-Continue].** *Principal Investigator - Dr. V.P. Tewari.*

**Status:** The data regarding prices of various forest produce viz., timber, fuel-wood, bamboo were collected from the markets of Jaipur and Ahmedabad on quarterly basis.

**Project 8: Stand dynamics of some important tree species of Gujarat [AFRI-25/FRME-3/2001-2006].** *Principal Investigator - Dr. V.P. Tewari.*

**Status:** A reconnaissance survey of the plantations of *Eucalyptus hybrid* and *Acacia nilotica* in various parts of Gujarat was conducted and suitable stands were identified for laying out of sample plots. 32 sample plots of *E. hybrid* and 19 of *A. nilotica* have been laid out in Godhara, Vadodara and Nadiyad divisions, Anand and Rajpipla sub-divisions and Panam irrigated plantation project area, Godhra to carry out growth and yield studies on these species.

**Project 9: Screening of exotic and indigenous plant species for their performance on salt affected soil with different management project [AFRI-6/FRME-4/1997-2003].** *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 2001).

Trial on *Atriplex lentiformis* was laid in 1997 with three levels of gypsum and six nitrogen levels leading to 18 treatment combinations. Analysis of biomass data taken in December 2001 on 52 months old bushes



showed that contribution of leaf component to the total biomass is decreasing. This year the leaf to branch ratio was 3.8:7.8 in different treatments for fresh biomass. Regenerative growth was very poor in the bushes, which were cut for above ground biomass in Dec., 2001, due absence of rainfall. No irrigation was provided despite very severe drought. Bush survival was recorded in March, 2003 and decrease in survival was observed ranging from 8 to 47 % in different treatments compared to survival in Nov 2001. Analysis of soil salinity status in May, 2002 showed that EC values are in normal range in the plant pit except where waterlogging persisted. However, salinity status was high in the inter row spaces.. Weed evaluation indicated that only 8 plant species appeared this year. *Sueda fruticosa* was the dominant herb and *Sporobolous* sp. was the dominant grass. 0.25 kg per m green weed biomass was available from inter row spaces in the month of October, 2002, 90 % of which was from *S. fruticosa*.

Trial of *Salvadora persica* was planted in 1997 with two levels of gypsum and four levels of nitrogen (0, 20, 40 and 60 g of urea). Plant survival recorded in September, 2002, five years after planting, showed no appreciable decrease in survival in all the treatments despite very poor monsoon years. Absolute growth data at 60 months of age showed that due to very low rainfall, there is slight decrease in mean height and crown diameter of *Salvadora persica* in July, 2002 over its values in October, 2001. However, treatments were significantly influencing the growth.



Five year old *Salvadora persica* plantation

*Acacia ampliceps* was planted with and without gypsum in Sept., 1998. Trees of *Acacia ampliceps* suffered some causality in summer months. Phyllodes started yellowing in April and gradually tree died. Irrigation (40 lit/plant) was given in April, October, January and March. Presently casualties are under control. The overall survival was 76% for gypsum treated plants as compared to 69% in control for deep soil area and 61 and 67.5% in shallow soil area, respectively. Growth status recorded at 52 months (for the 1998 planted trees) showed there was almost no increase in growth this year. Data indicated that soil depth is positively influencing the plant height and crown diameter.

A trial of *A. lentiformis* was planted in August, 1999 on double ridge mound with three levels of gypsum from two nitrogen sources, urea and calcium ammonium nitrate were applied in August, 2000. Survival of 30 month old bushes of *A. lentiformis* ranged from 33% to 72% in different treatments.





Three years old *Acacia ampliceps* plantation on salt affected soils in Gangani

An experimental trial of *A. amnicola* was laid out in August, 2000 with three planting treatments and two gypsum levels. In spite of severe drought there was no casualty height on double ridge mound and bund planting was same for both the gypsum levels, which was higher than elevated slope planting.



30 months old *Atriplex amnicola*



*A. amnicola* on double ridge mound

Another trial was laid with 3 salt tolerant species namely *A. lentiformis*, *A. nummularia* and *Sueda nudiflora* and three planting techniques in August 2000. Due to severe drought, irrigation (25 lit/plant) was provided in Nov, Jan and March. Circular Dished Mound (CDM) structure recorded overall 83% survival followed by 81% in double ridge mound and 47% in control in March 2003. Species wise *Sueda nudiflora* recorded highest survival in all the three treatments. Plant growth was also significantly higher on soil structures as compared to control.

A trial with two tree species, *Acacia colei* and *Azadirachta indica* was laid with three treatments of planting in August 2001. Due to very severe drought, fortnightly irrigation of 25 l/plant was provided from October, 2002 to March, 2003. Highest mean percent survival was recorded for DRM (69.0%) followed by CDM structure (52.7 %) and control (23.8%) after 18 months of planting. Species wise *Acacia colei* showed better survival than *Azadirachta indica*. Rodent control measures: Experimental area suffered with serious rodent problem. Periodic rodent control measures were applied.

## NEW PROJECTS INITIATED DURING THE YEAR 2002-2003

**Project 1: Studies on the role of trees in reclamation of water logged area and their impact on soil [AFRI-29/FEDD-6/2002-2006].** *Principal Investigator - Mr. N. Bala.*



**Status: Transpirational capabilities of different species and their impact on soil at different age** - Survey was conducted along the IGNP area for plantation sites in waterlogged area. Block plantations by Eco Task Force and State Forest Department were identified. 8 plots were laid in *Eucalyptus camaldulensis* plantations. Soil samples were collected from the plots and tree height and GBH were recorded from the plot.

**Performance of some *Eucalyptus* and *Casuarina* species under water logged condition** - Survey was conducted all along the IGNP area for suitable waterlogged site for experimental purpose. 5 ha waterlogged area at 1357 RD IGNP near Nachna has been selected.

Seeds of *Eucalyptus camaldulensis*, *E. fastigata*, *E. grandis*, *E. nitens*, *E. platypus*, *E. regnans*, *E. rudis*, *E. saligna*, *E. spathulata*, *Casuarina cunninghamiana*, *C. glauca* and *Corymbia tessellaris* have been procured from CSIRO Australia and seedlings are being raised in AFRI model nursery. Fencing work of the area is in progress.

**Project 2: Litter dynamics and soil changes during stand development in plantation forest [AFRI-30/FEDD-7/2002-2006].** *Principal Investigator - Mr. N. Bala.*

**Status:** Survey was conducted along the IGNP area for availability of plantations of different species and age groups. Accordingly four age groups were classified (0-5 year, 6-10 year, 11-15 year and >16 years) and six species were selected for the study. 76 litter plots of 10 x 10 m<sup>2</sup> area were laid in plantations of *Eucalyptus camaldulensis*, *Acacia nilotica*, *Acacia tortilis*, *Tecomella undulata*, *Prosopis cineraria* and *Dalbergia sissoo* at Nachna, Bikampur, Sada and Ramgarh area along IGNP. 152 soil samples were collected from 76 litter plots. Tree height and GBH were recorded for trees inside the plot.

**Project 3: Multilocational trials of *Eucalyptus* and *Dalbergia* clones [AFRI-31/FGTB-7/2002-2006].** *Principal Investigator - Dr. U.K. Tomar.*

**Status:** Areas have been finalized for raising 16 ha clonal trial of *D. sissoo* and *Eucalyptus camaldulensis* in Gujarat and Rajasthan 8 ha in each state. Clonal material of *D. sissoo* (approx. 6000 cuttings) and *Eucalyptus camaldulensis* (approx. 2000 cuttings) has been raised from 61 and 22 clones, respectively. In *D. sissoo*, 95 % sprouting was recorded, whereas, in *Eucalyptus* it was only 5%. In *D. sissoo*, 4300 plants were transferred for hardening and at present 3400 plants are surviving after three months of hardening period. Therefore, average 72% rooting is recorded after one month and hardening success is about 79%. Therefore over all out put in *D. sissoo* is about 57%. No success was achieved in *Eucalyptus* clonal material. Fresh 9000 stem cuttings of each *D. sissoo* and *Eucalyptus* were raised in mist polyhouse. This time some of the *Eucalyptus* stem cuttings were rooted. Data on rooting response will be recorded in April 2003. About 3400 clonal plants of *D. sissoo* are growing well in greenhouse.

**Project 4: Micropropagation of an important medicinal plant of the arid and semi-arid regions *Commiphora* [AFRI-32/FGTB-8/2002-2006].** *Principal Investigator - Dr. Tarun Kant.*

**Status:** Survey of the areas in and around Jodhpur were conducted to mark the *Commiphora* plants naturally growing. Explant material was collected from



the mature plants growing in and around the Kailana lake area. The material was subsequently cultured on MS tissue culture media with the aim to test the bud-break response. Some of the material was also used for vegetative multiplication by rooting of cuttings. Cutting raised plants were procured from JNV University, Jodhpur and SFD Nursery, Jaisalmer and are being maintained under laboratory conditions and used as explant source. 50 seedlings were procured from Guggul Herbal Farm at Mangliawas (Ajmer district) and are being maintained at the green house presently and is serving as a source of juvenile explants. Surface sterilization procedure has been standardized. Experiments have been conducted using stem nodal- and inter-nodal segments and leaves. The explants were cultured on MS media supplemented with varying levels auxins viz, NAA, IAA, IBA and 2, 4-D with the aim to achieve callus induction. It was observed that callus induction took place from the stem segments cut at the internodes and only in media supplemented with NAA and IBA. No callus induction could be achieved so far on media supplemented with 2, 4-D and IAA. It was observed further that callus induction occurred from the stem segments that were juvenile rather than the one which were woody, hard and appeared mature. Callus induction started from inside the stem as evident from swelling of the stem segments from followed by bursting up of the outer surface of the stem. Later on the entire stem segment gets converted into callusing mass. Callus induction from small juvenile leaf starts from the entire leaf lamina. The orientation that is adaxial or abaxial side up does not make any difference. The entire leaf explant initially swells up and then callusing starts. However in case of older large leaves, callus induction starts from the mid rib prominent veins only. This is an interesting observation not reported earlier. Experiments on subculturing the primary callus obtained from various explants is being carried out and a proper and optimized subculture regime is being worked out with the aim to finally achieve somatic embryogenesis and shoot morphogenesis. Experiments on micropropagation through bud-break by culturing nodal segments is underway and is being optimized.

**Project 5: Genetic improvement of *Tecomella undulata* [AFRI-33/FGTB-9/2002-05].** *Principal Investigator - Mr. C.J.S.K. Emmanuel.*

**Status:** Survey has been conducted for the selection of Candidate Plus Trees (CPTs) in both irrigated and unirrigated areas. So far 30 CPTs have been selected in the irrigated areas and 3 CPTs have been selected in unirrigated areas.

**Project 6: Screening of high oil and azadirachtin in neem [AFRI-34/FGTB- 10/2002-05].** *Principal Investigator - Mr. C.J.S.K. Emmanuel.*

**Status:** CPTs were identified under NOVOD Project and the CPTs found with high Az and high oil were used for collection of vegetative propagules for raising germplasm bank and their further multiplication. So far 8500 cuttings from 31 CPTs from Gujarat have been collected. All these cutting are planted in mist polyhouse for rooting experiments. Sprouting and rooting has been observed in some of stem cuttings.

**Project 7: Raising of arboretum cum botanical garden for native flora of Rajasthan [AFRI-34/Silvi-6/2002-06].** *Principal Investigator - Mr. K.K. Chaudhuri.*



**Status:** Work for the clearance of the site for raising the plants at the site for raising proposed arboretum cum botanical garden for native flora of Rajasthan has been completed. Seed collection and raising of planting stock of the identified species to be planted at the proposed arboretum cum botanical garden has been initiated.

**Project 8: Studies on seed quality improvement in respect of various tree species of arid and semi-arid areas [AFRI-35/Sil-7/2002-07].**

*Principal Investigators - Dr. D.K. Mishra.*

**Status:** Agro-climatic zones together with seed zones and districts falling under each zone have been tabulated for the selection of trees of target species. Seeds of *Dalbergia sissoo* have been collected from all the agroclimatic zones of Rajasthan. Cleaning and upgrading of seed lots is in progress.

Seeds of neem were collected from trees of various age groups and germination and storability studies were performed. Physiologically mature green, greenish yellow and yellow fruits of neem showed more than 90% germination. However, in storage, seeds from yellow green fruits performed better. Sun, shade and electrical heat drying do not affect seed germinability initially, however, shade dried seeds performed best in storability. Neem seeds sown horizontally and down ward in the germinating media gave better percent germination than upward orientation.

Seeds of *Capparis decidua* have been collected and extracted. Seeds were found extremely dormant probably due to physical reasons. Untreated seeds showed less than 10 percent germination. However, scarified seeds gave above 70 percent germination. Seeds collected in summer season showed above 95% viability, while seeds collected in winter season gave only 40 percent viability. Around 60% seeds were found infected/defuncted due to insect attack.

**Project 9: Studies on improving tree productivity of *P. cineraria* through VAM/biofertilizers [AFRI-36/Silvi-8/2002-06].**

*Principal Investigator - Dr. K.K. Srivastava.*

**Status:** Rhizosphere soil and root sample were collected to identify different VAM fungi associated with *P. cineraria* plantations from four districts of western Rajasthan viz., Nagaur, Sikar, Jhunjhunu and Churu. Rhizosphere soil sample were found rich in VAM fungi but spore density ranged between 70-346 spores / 100 gm soil. The rhizosphere soil collected from agroforestry site were found rich in spore population as compare to soil collected from disturbed area or road side plantation. The *Glomus fasciculatum* was found dominant genera and isolated from all sites. The associated VAMF genera were namely, *Glomus*, *Gigaspora*, *Scutellospora* and *Sclerocystis*. The major species were isolated and identified as, *Glomus fasciculatum*, *G. aggregatum*, *G. macrocarpum*, *G. microcarpum*, *G. monosporum*, *G. constrictum*, *Gigaspora margarita*, *Sclerocystis indica* and *Scutellospora bionarta*.

The stock culture *Sinorhizobium meliloti*, *Rhizobium trifolii*, *Azospirillum brasilense*, *Azospirillum lipoferum*, *Azotobacter chroocum*, *Paenibacillus polymyxa*, *Bacillus licheniformis* and indigenous strains of *Rhizobium* from *Albizzia lebeck* and *Dalbergia sissoo* were maintained in suitable media for further experimental purpose.



VAM production facility was developed at TRC, Gandhinagar, State Forest Department, Gujarat. The forty pots of VAM inoculum containing five different combinations of species of VAM fungi viz., *G. fasciculatum*, *G. microcarpum* and *G. aggregatum* including Consortium inoculum.

Mass inoculum production of VAM containing different species of VAM fungi by using vermiculite as basal media are being maintained at AFRI, Model nursery, Jodhpur.

**Project 10: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time [AFRI-15/NWFP-4/ 2002-2005].** *Principal Investigator - Dr. Mala Rathore.*

**Status:** Surveys in the districts of Udaipur, Dungarpur, Sirohi, Pali, Jalore, Rajsamand, Jodhpur, Jaipur and Ajmer were conducted to collect information about use of traditional medicinal practices. A total of nearly seven large scale farmers, four practicing Ayurvedic Physicians, fifteen practicing traditional medical practitioners, eighteen officials of the forest department who pursue interest in medicinal plants were contacted and elaborate discussions were held about the potential of various trees/plants for the study. Apart from these, three markets, four universities/research stations, three NGOs and eight forest nurseries/herbal gardens/krishi farms were also visited. The results of the survey are being compiled and the species on which work has to be started will be decided soon and trees will be marked for collection of samples.

**Project 11: Studies on post harvest technologies on non-traditional, under-exploited locally available timber species for suitability to handicraft and other small scale industries [AFRI-37/NWFP-5/2002-2006].** *Principal Investigator - Mr. S.H. Jain.*

**Status:** A survey has been carried out for traditionally used wood by the artisans and handicraft industry in Jaipur and Jodhpur. The industry is consuming about 36-lakh cft. of wood annually and getting wood mainly from neighbouring states of Gujarat, Madhya Pradesh, Punjab. The commonly used species are *Dalbergia sissoo* (shisham) 60%, *Mangifera indica* (mango) 20%, *Acacia nilotica* (babool) 10% and others 10%.

**Project 12: Transfer of technology on forestry through training and demonstration [FRI-38/SF-1/2002-2006].** *Principal Investigator - Dr. S. Mohan.*

**Status:** Lay out plan of interpretation centre prepared. Visited various research institutes and conceived ideas for the development of interpretation centre at AFRI.

**Project 13: Identification of key indicators and suitable strategies for sustainable Joint Forest Management in Gujarat and Rajasthan [AFRI-39/JFM-1/2002-2006].** *Principal Investigator - Dr. Sunil Kumar.*

**Status:** Statistical method of sampling surveys was used in the selection of sites and carrying out various studies related to JFM. Questionnaire of selection of sites and details of questionnaire related to socio-economic study have been prepared. Surveyed JFM areas in Rajasthan and Gujarat. Ten sites have been



selected for detailed survey in Gujarat. Four district viz. Jaipur, Kota, Bundi, Jodhpur have been selected in Rajasthan.

## EXTERNALLY AIDED PROJECTS

### PROJECTS COMPLETED DURING THE YEAR 2002-2003

NIL.

### PROJECTS CONTINUED DURING THE YEAR 2002-2003

**Project 1: Comprehensive community drought preparedness programme to improve quality of life of women and children in Jodhpur district.** *Principal Investigator - Mr. H.C. Chaudhary.*

**Status :** Comprehensive survey covering various aspects like administrative and physical location, present vegetation and legal status, type and extent of encroachment, resource availability and details of past intervention in respect of all the 3,287 community forests called Oran, Gauchars, Parat, Agor etc. and village ponds located in the entire Jodhpur district have been completed.

Detailed physico-chemical analysis and nutrient availability assessment of about 700 soil samples collected from representative community forests during their survey have been partially completed.

**Project 2: Development of suitable models for urban sesthetic forestry suitable for arid and semi arid region of Rajasthan [AFRI-28 / Silvi-4 / UTT / 2001-06].** *Principal Investigator - H.C. Chaudhary.*

**Status:** 1.04 kilometre long experimental avenue plantation has been raised and maintained during the year.

Advance work for raising 3.50 kilometre long experimental avenue plantations have been initiated.

Growth and survival data in respect of the plants raised under the experimental plantations have been recorded. 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* > *Tecomella undulata* > *Pongamia pinnata* > *Alistonia scholaris* > *Casia fistula* > *Delonix regia*.

In respect of *D. regia* even under the liberal irrigation condition, severe die back have been observed during the winter season making the species less suitable for urban aesthetic forestry in arid region.

Under the liberal watering of sewage water exceptionally high average top height have been observed in respect of *D. sissoo*, *C. siamia* and *A. indica* etc.



Foliar spray of dilute monocrotophos solution at an average interval of 15 days has been found very cost-effective solution for controlling browsing of *A. indica* by blue bulls.

**Project 3: Standardization of nursery practices in respect of selected species suitable for arid and semi arid region [AFRI-33/Silvi-5/DRDA/2002-06].** *Principal Investigator- H.C. Choudhary.*

**Status:** About 40,000 superior quality seedlings have been raised and supplied to various government departments, farmers, NGOs etc.

**Project 4: 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 - Mr. K.K. Chaudhury.*

**Status:** Market survey of important medicinal plants traded in Rajasthan has been initiated. A germplasm of 85 medicinal plants has been arranged for establishing herbal garden at AFRI. Initiated germination studies on seeds of *Commiphora wightii*. The germination is very poor mainly due to empty seeds. However, these can be removed by soaking seeds in water and subsequently germination can be improved. Initiated germination studies on *Cassia angustifolia*. The seeds are dormant and germination can be enhanced by mechanical scarification, hot water and acid pre-treatment. Green seeds in the lot showed poor germination as compared to yellow seeds.

Market survey work has been initiated and survey work of Ajmer (21 units), Barmer (2), Banswara (1), Chitorgarh (2), Jodhpur (28), Pali (3), Sirohi (8), and Udaipur (48) has been completed. In all 140 units so far have been surveyed.

About 2 ha of area for the establishment of germplasm/herbal garden and 10 ha area for experimental trial have been selected. Seedlings of more than 85 medicinal plants species have been collected for the establishment of herbal garden and plantation activity is under progress.

Seeds of *Commiphora wightii* were collected from Jaisalmer. Seeding was very poor due to drought period and only a small amount of seed was collected. Only dark brown/black seeds were found viable. The germination was found very poor (10 %) mainly due to empty seeds. However, these can be removed by soaking in water and subsequently germination can be improved. The seeds were non dormant and germinated readily without any pre-treatment.

Seeds of *Cassia angustifolia* were procured from locally grown variety (Sonna) and Thirunelveli Senna (*C. angustifolia*) from Coimbatore. Procurement of seeds of high sennoside content variety from CIMAP, Lucknow is underway. There are around 40,000 seeds/kg. The seeds from Coimbatore contain 10-15% shriveled dark brown seeds, while local lot contains no such seeds. Initial germination studies were performed on local seeds. The seeds were found dormant due to physical reasons and gave only 25% germination without any pre-treatment. The germination can be enhanced (>90%) by mechanical scarification, hot water and acid pre-treatments. Green seeds in the lot showed slightly poor germination as compared to yellow seeds.



**Research achievements**

Name of State	No. of projects completed in 2002-03	No. of ongoing projects in 2002-03	No. of projects initiated in 2002-03
Rajasthan	12	10	3
Gujarat	2	2	1

**Education and trainings****Trainings organised**

1. Two trainings for farmers on "*Kisano Ke Liye Neem Vraksharopan Tatha Iske Bahu Upyogita Par Prashikashan*" were organized from 24<sup>th</sup> - 26<sup>th</sup> September, 2002 under NOVOD Board Project entitled. 100 (50 Farmers/SFD officials participated in each training).
2. A training programme on "Eco-Sensitization on Arid Ecology Environment" for Army troops (Eco- Task Force)" was organized from 9<sup>th</sup> - 13<sup>th</sup> Dec. 2002.
3. Two days training to Non Government Organizations on "*Nursery Technologies*" from 31<sup>st</sup> January'03 to 1<sup>st</sup> February, 03.
4. Five days training programme on "Eco-Sensitization of Cluster Members on Integrated Watershed Management" in four batches, under DDP Jaisalmer, Rajasthan was organized at the Institute from 24<sup>th</sup> - 28<sup>th</sup> Feb., 03<sup>th</sup> - 07<sup>th</sup>, 10<sup>th</sup> - 14<sup>th</sup> and 21<sup>st</sup> - 25<sup>th</sup> March, 2003.

**Trainings attended**

1. Dr. V.P. Tewari attended two months short-term study and research visit (from 1<sup>st</sup> Aug. 2002 to 30<sup>th</sup> Sept. 2002) under DAAD fellowship at the Institute of Forest Management, University of Goettingen (Germany) and worked on "Modelling tree growth in multi-species uneven-aged forests".
2. One day training on the cultivation of medicinal plants by Rajasthan Agroforestry Corporation has been provided to Dr. M.M.S. Rawat, Sh. Prithvi Raj, Sh. Anada Ram and Sh. Sadul Ram Deora.
3. One week UNICEF sponsored training programme on Participatory Learning & Action (PLA) and Micro Planning organised by Trainers of UNICEF at Institute from 01.04.2002 to 06.04.2002.



## Publications

### Books

1. Ahmed, S.I. and Kumar, Shivesh (2002). Role of Environmentally Acceptable Entomopathogens in *Forest Insect Pest Management*. In *Modern Trends in Environmental Biology*. CBS Publishers New Delhi.
2. Kumar, Shivesh and Ahmed, S.I. (2002). Natural enemy complex of insect-pest spectrum and mites of *Prosopis cineraria* Linn and *P. juliflora* Swartz., DC in Indian Thar Desert. In: *Recent Trends in insect pest control to enhance productivity*. (Ed. by P.K. Shukla and K.C. Joshi) Tropical Forest Research Institute, Jabalpur: pp 218-230.
4. Sharma, Meeta and Ahmed, S.I. (2002). Integrated pest management of marwar teak defoliator, *Patialus tecomella*, Pajni, Kumar and Rose (Coleoptera: Curculionidae), in arid and semi arid areas. In: *Recent trends in insect pest control to enhance forest productivity*. (Ed. by P.K. Shukla and K.C. Joshi) Tropical Forest Research Institute, Jabalpur: pp. 199-211.

### Research papers

1. Ahmed, S.I and Khan, Ameen Ullah (2002). A New host record of *Achmaeodera aurifera* Laporte and Gory (Coleoptera:Buprestidae) on freshly felled timber of *Prosopis cineraria* (Linn.) and *Albizia lebbeck* in Rajasthan. *Indian Forester*, 128: 103-104.
2. Arya, Ranjana (2003), Yield of *Cassia angustifolia* in combination to different tree species in a silvi-herbal trial under hot arid conditions in India, *Bioresource technology*, 86(2): 165-169.
3. Paunekar, S. and Ahmed, S.I.(2003) Observation on infestation of five-striped squirrel, *Funambulus pennanti* Wroughton, in the forest nurseries of arid and semi-arid zone, *Rodent Newsletter*, 26(3): 9-10.
4. Singh. G. and Bhati, M. (2003). Mineral accumulation and physiological functions in tree seedlings irrigated with effluents of varying chemistry in sandy soil of dry region. *J. Environ. Sci. Health Part C*, C21: 45-63.
5. Singh, G. and Rathod, T.R. (2002). Plant growth, biomass production and soil water dynamics in a shifting dune of Indian desert. *Forest Ecology and Management*, 171: 309-320.
6. Singh, G. and Singh, Bilas (2002). Changes in soil properties and foliage nutrient composition in different age *E. camaldulensis* plantation. *J. Tropical Forest Science*, 14 (3) : 1-11.
7. Singh, G.; Singh, Bilas; Kuppusamy; V. and N. Bala (2002). Variations in foliage and soil nutrient composition in different age classes *Acacia tortilis* plantation. *Indian Forester*, 128: 514-522.
8. Sundararaj, R.; Sharma, Meeta and Ahmed, S.I. (2003). Aleyrodids infesting rose (*Rosa Chinensis*) in Indian arid zone. *Hexapoda* 12 (1&2): 19-24.
9. Tewari, V.P. and V.S., Kishan Kumar (2003). Volume equations and their validation for irrigated plantations of *Eucalyptus camaldulensis* in the hot desert of India, *Journal of Tropical Forest Science*, 15(1): 136-146.





Inaugural session : Training to cluster members

10. Tewari, V.P. and V.S., Kishan Kumar (2002). Development of top height model and site index curves for *Azadirachta indica* A. juss, Forest Ecology and Management, 165(1-3): 67-73.
11. Tewari, V.P.; Verma, Amit and V.S., Kishan Kumar (2002). Growth and yield functions for irrigated plantations of *Eucalyptus camaldulensis* in hot desert of India, *Bioresource Technology*, 85(2):137-146.

### Brochures and reports

1. Brief writ-up on the importance and distribution and production potential of Khejri, Kair and Kumrat in arid zone of Rajasthan.
2. Ahmed, S.I. (2002). Brochure on " Know your nursery pests and their control" published by the Director, AFRI, Jodhpur.
3. Ahmed, S.I. (2002). Brochure on " Know your nursery pests and their control" .
4. Ahmed, S.I. and K. K. Srivastava (2001). Preliminary report on Khejri (*P. cineraria*) mortality. Submitted to the Director, AFRI & authorities of SFD's.
5. Srivastava, K.K. and Neelam Verma (2002). "Know your nursery diseases and their management".
6. शुष्क वन अनुसंधान संस्थान (आफरी) जोधपुर

### Conferences/meetings/workshops/seminars/symposia

#### Organised

1. Workshop on 'Development of suitable strategy for rehabilitation of Oran and Gauchars in Rajasthan' organized on 16<sup>th</sup>-17<sup>th</sup> April 2002 funded by UNICEF.
2. मानव संसाधन विकास मंत्रालय, भारत सरकार के वैज्ञानिक तथा तकनीकी शब्दावली आयोग के सहयोग से वानिकी प्रशासनिक एवं तकनीकी शब्दावली तीन दिवसीय कार्यशाला २०-२३ मई २००२ का आयोजन संस्थान द्वारा किया गया ।



## Attended

1. Sh. K.K. Chaudhuri participated in workshop on "Regional workshop of the Principal Investigators" organized by MPB at Goa on 21.5.2002.
2. Sh. R.L. Meena participated in seminar on the eve of "World day to combat desertification" on 17<sup>th</sup> June, 2002 at Van-chetna Gandhinagar.
3. Sh. K.K. Chaudhuri and Dr. G. Singh participated in technical workshop on the formulation of field projects for the UNCCD/NAP Implementation at New Delhi from 11-13, December' 2002.
4. Sh. K.K. Chaudhuri and Sh. N. Bala participated in national seminar at TFRI, Jabalpur held on 15-16, December' 02.
5. Sh. R.L.Meena participated in workshop on traditional water harvesting technologies in Arid Zone, their status and prospects on 24<sup>th</sup> December' 02 organized by Gramin Vikas Vigyan Samiti (GRAVIS), Jodhpur.
6. Sh. K.K. Chaudhuri, Sh. Balbir Singh and Dr. Sunil Kumar participated in national workshop on "Technological Innovations and Research Advances for Application in Joint Forest Management" at FRI, Dehradun on 3-4, February' 03.
7. Sh. K.K. Chaudhuri and Sh. C.J.S.K. Emmanuel. National seminar at RFRI, Jorhat on "Expert Consultation on *Gmelina arborea*" on 4-5 March' 03.

## Papers presented

1. Arya, Ranjan (2002). Performance of some important tree species in silvipastoral system in arid Rajasthan. Paper presented in the workshop on Development of suitable strategies for rehabilitation of Orans and Gochers in Rajasthan at AFRI on 16<sup>th</sup>-17<sup>th</sup> April 2002.
2. Chaukiyal, S.P., Singh G., Bala N. and Kumar P. (2002). Floral diversity and carbon stock in common property land resources in some villages of Rajasthan and Gujarat. Presented in workshop on 'Development of suitable strategies for rehabilitation of oran and gauchar in Rajasthan' on 16-17 April 2002.
3. Emmanuel, C.J.S.K. and Tomar, U.K. (2002). Neem Improvement Work at Arid Forest Research Institute, Jodhpur, Paper presented in the World Neem Conference NEEM 2002, Organised by the Neem Foundation Mumbai 27-30, November, 2002.
4. Emmanuel, C.J.S.K. (2003): Role of genetic selection, gene conservation, provenance trials and hybridization with special reference to *Gmelina arborea*. Invited paper presented at the Round table conference on Gmelina at Rain Forest Research Institute, Jorhat, 4-6 March, 2003.
5. Kumar, P.; Bala, N.; Singh, G. and Chaukiyal, S.P. (2002). Status of common access resources (CARs) and socio economic conditions in some villages of Rajasthan and Gujarat. Presented in workshop on 'Development of suitable strategies for reghabilitation of oran and Gauchar in Rajasthan' on 16-17, April, 2002.



6. Kumar, Sunil; Singh, Balbir; Meena, R.L and Baloch, M.R. (2003). Criteria and Key Indicators for sustainable Joint Forest Management at FORSPA - Bangkok sponsored National Workshop on "Technological Innovation and Research Advancements for Application in Joint Forest Management" on 3 - 4, February, 2003 at Dehra Dun.
7. Singh, G.; Bala, N. and Chaudhuri, K.K. (2002). Strategies for rehabilitation and productivity enhancement of degraded land in dry regions of western India. Presented in National Seminar on "Management of degraded forest for productivity enhancement and carbon sink expansion" held at TFRI, Jabalpur on 15-16, January, 2003.
8. Singh, G.; Bala, N., Mutha, Sarita; Limba, N.K. and Rathod, T.R. (2002). Effect of varying spacing regimes of *Prosopis cineraria* on plant growth and associated crops in the arid zone of India. Presented in national seminar on "Agroforestry" held at IFGTB, Coimbatore on 22<sup>nd</sup> November, 2002.
9. Singh, G.; Meena, R.L. and Chaudhuri, K.K. (2002). Agroforestry for sustainable production in dry region of Rajasthan and their role in socioeconomic benefits. Presented in national seminar on "Agroforestry" held at IFGTB, Coimbatore on 22<sup>nd</sup> November, 2002.
10. Tiwari, V.P. (2002). Drought preparedness: Planning, policy and management in arid areas. Paper presented in the workshop on *Development of suitable strategies for rehabilitation of Orans and Gouchars in Rajasthan* at AFRI on 16<sup>th</sup>-17<sup>th</sup> April, 2002.

### Consultancies

1. Integrated Watershed Development Project in Sunel Watershed of Pirawa Panchayat Samiti, District Jhalawar, Rajasthan.
2. Reclamation of wastelands of waterlogged area in Rawatsar, Hanumangarh District, Rajasthan.
3. Reclamation of waterlogged area at Jetsar Farm, Rajasthan.
4. Interim/ final evaluation of watershed projects.

### Linkages and collaboration

Linkages were developed with National Bureau of Plant Genetic Resources, New Delhi, Tata Energy Research Institute, New Delhi, Indian Institute of Technology, New Delhi, Central Arid Zone Research Institute, Jodhpur, National Botanical Research Institute, Lucknow, Chaudhary Charan Singh Haryana Agricultural University, Hissar and Neem Foundation, Mumbai.

Linkages were developed with DANAIDA Forest Seed Centre, Humlebaek, Denmark, International Neem Network, FAO, Rome. and CSIRO, Australia.



## Exhibition

The activities and research findings of AFRI was exhibited in the Swadeshi Mela held in Polo ground, Jodhpur from 21<sup>st</sup> to 30<sup>th</sup> Dec; 2002 and in the Paschimi Rajasthan Hasta Shilp Utsav held at Jodhpur from 2<sup>nd</sup> to 11<sup>th</sup> January, 2003.

## Awards

Dr. S.I. Ahmed has been awarded Dr. Anand Prakash Award-2002, for his outstanding contribution in the field of forest entomological research work by the Applied Zoologist Research Association, Cuttack on 23<sup>rd</sup> Dec., 2002 in a conference held at Cuttack.

## Distinguished visitors

1. Hon'ble Chief Minister, Rajasthan Sh. Ashok Gehlot visited AFRI on 23<sup>rd</sup> June, 2002.
- 2- डॉ. हरीश कुमार, अध्यक्ष, मानव संसाधन विकास मंत्रालय, भारत सरकार के वैज्ञानिक तथा तकनीकी शब्दावली आयोग 20 मई 2002.
3. Dr. D.N. Tewari, Hon'ble Member of Planning Commission on 14<sup>th</sup> Nov., 2002.
4. Sh. M.K. Khanna, Principal Secretary, Rural Development, Govt. of Rajasthan on 22, January, 2003.

