

ARID FOREST RESEARCH INSTITUTE JODHPUR

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

An abstract of projects run by the Institute is as follows:

	No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
Plan Projects	05	16	03
Externally Aided Projects	03	07	00
Total	08	23	03

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Assessment of International Neem Provenance Trial [AFRI-78/FGTB/2006-09]

Findings: Provenance trials of Neem were established by AFRI as a collaborating institute in International Neem Network with an aim to improve the genetic quality and adaptability of Neem and to improve its utilization. The materials for the present investigation come from one of these provenance trials located at Jaipur. This trial was initially established with 18 provenances including 8 international and 10 Indian provenances in the year 1996. At the time of initiation of the project, only 12 provenances were present and the other provenances were succumbed to extreme biotic factors like frost and heat. Three of the 12 provenances are from Yezin (Myanmar), Geta, Dhangadhai (Nepal) and Chamnion (Tanzania), and the rest of the 9 provenances are from India. The statistical analysis showed no significant difference between the provenances in terms of growth traits i.e. height and diameter at breast height (dbh). Among the international provenances, the provenance from Nepal (Geta, Dhangadhai) showed good growth in height which was above the mean height during the years 2006 and 2008, except in the year 2007. The mean growth of this Nepal provenance (5.37 m) was the best among all other provenances. Other two introduced provenances showed less height growth than the mean. Most of the Indian provenances, which performed better in growth, did not show stability in the assessment years. Only two provenances viz. Kalyani, Mandore and local seed source (Jaipur) maintained consistency in their growth during the assessment years. The Yezin (Myanmar) and Chamnion (Tanzania) provenances and Ramannaguda and Sagar provenances from India continuously performing poor. The Geta (Dhangadhai) provenance from Nepal showed more growth in both height and dbh than the mean. Except the Ramannaguda provenance, all other provenances from India had higher growth in dbh than the mean.



There is sufficient synchronization in flowering of both the Indian and introduced provenances. The seeds obtained from the provenances showed variation in length and diameter which was ranging from 10.1 mm to 12.5 mm and 6 to 7.5 mm respectively. Among the introduced provenances, the seed size of the Yezin (Myanmar) provenances was almost equal to the size of the Indian provenances. The oil content was ranging from 36.34% to 43.24% in kernel. The variation in oil content amongst the provenances was statistically significant. The provenances from Ramannaguda and local seed source (control) had higher oil content (<43%) and which was followed by the Tanzanian provenance (41.13). The other introduced provenances had oil content on par with other Indian provenances (36% and above).

In the present study, all the introduced provenances had synchronization in flowering and produced seeds. Hence, these provenances can further be best utilized for further improvement programme by introducing more provenances and individual superior trees from tested ecological zone.



Neem tree (Kalyani prov.)
in Peak flowering



Close view of flowering branch



Tertiary branch with fruits

Project 2: Relative resistance of neem provenances to insect pests and mites and their Bio-management in arid areas [AFRI-73/FPD/2006-09]

Findings:

Relative resistance of neem provenances to neem weevil, *M. tenuicornis*: An experiment has been conducted to study the resistance of 39 neem provenances to neem weevil, *Myllocerus tenuicornis*. The provenance from Palanpur and Jhansi exhibited the least preference for the larvae (0.65 and 0.69 cm sq.), wheras the provenance from Mulag was found to be the most favoured or susceptible host as the leaf area consumed by larvae was 3.11 sq cm.

Microbial control agent of neem weevil: Infection of an entomopathogenic fungus, *Beauveria bassiana* has been observed in the adult population of neem weevil, *M. Tenuicornis*. Efficacy of this entomopathogenic fungus has been studied.

Bioecology of neem defoliator: A complete lifecycle under different generations took an average period of 39.75 days which ranges from 29 to 47 days under different conditions of temperature and relative humidity. The population dynamics of *Myllocerus tenuicornis* on 39 neem provenances is in progress. Periodical data are being collected and being analyzed. Seasonal variation of economically important insect pests i.e. sap suckers and defoliators has been studied. The mortality data on pest incidence have been recorded.



Project 3: Developing strategies and methodologies for extension of forestry research technologies in semi-arid and arid areas [AFRI-71/AFE/2005-09]

Findings: Dissemination of research information was ensured by participation in farmers fair held at CAZRI, Jodhpur on 12th September 2008 and Hast Shilp Utsav held from 2nd to 11th January 2009 at Rawan Ka Chabutra, Jodhpur. Designed the material and got 80 bilingual (Hindi-English) research display material prepared for the VVK AFRI, Bichhwal, Bikaner, Rajasthan and the Interpretation Centre, AFRI. Similarly 16 research bilingual display boards were prepared in English & Gujarati for the VVK site at Rajkot, Gujarat. Strengthened Library and Information System resource data base by addition of books related to agroforestry & Extension. Prepared report on the Bamboo training programme under NMB and forestry training held for field functionaries of State Forest Department and farmers of Gujarat held at Rajpipla and Rajkot, Gujarat respectively.

Project 4: Screening of Exotic and indigenous plant species for their performance potential on arid salt affected soils with different level of management [AFRI-49/NWFP/1997-09]

Findings: A total of eight experimental trials were laid out on lithic, calcid, coarse sandy to loamy sand salt affected area of Gangani in Jodhpur district in different years (from 1997 to 2003). 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). *Colophospermum mopane* registered 92.0% survival on CDM and 86.5 % in control after five years of planting. There was no change in survival for mopane for 36 - 60 months period while Ber (*Z. mauritiana*) recorded 17 to 48% survival on thus failing to survive the experimental conditions. Two Factors Analysis showed that there is no effect of planting technique on survival and growth. However, in case of above ground biomass, CDM was significantly superior to control. Application of Gypsum with 9g N recorded higher biomass compared to all other treatments. Root biomass by excavation showed that root penetrated the kankar pan up to the depth of more than one metre.

Other Major findings

- Exotic shrubs of genus *Atriplex* perform well on arid saline alkali lands with FYM and nitrogen. They produce nitrogen rich fodder used for sheep and goat. High salt content necessitate mixing with cereal residue.
- Salvadora persica*, was the best performed indigenous tree with highest survival. It is a slow growing species, application of gypsum and nitrogen gave increase in growth and biomass production.
- Acacia ampliceps* (exotic) tree perform very well on alkali soils with good soil depth (60 cm to 75 cm minimum) and respond well to FYM, gypsum and phosphorus application. It is a very good fodder for all the animals.
- Large pit size is necessary to mix amendments to create less salty environment during seedling establishment. Double ridged and Circular dish mounds enhanced survival of all the plant species. by providing protection from waterlogging and less salty environment. Crescent shaped drainage trenches served dual purpose helped in leaching of salts and harvested water.
- Plantation activities helped in improving the site conditions, promoting growth of natural flora (glycophytes as well as halophytes) and natural germination of *S. persica* is also observed.



- **Distribution of seeds collected from experimental site:** One kg seed *C. mopane* and half kg seed of *Acacia ampliceps* were given to Gujarat SFD during 2008.

Project 5: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time [AFRI-50/NWFP/2002-09]

Findings: Variation of secondary metabolites in *Tribulus rajasthanensis*, *Pluchea lanceolata* and *Cassia angustifolia* in different developmental stages was studied for determining the optimum harvesting time in these species. Analysis of total saponin content in the aerial parts of *Tribulus rajasthanensis* showed that the saponin content high in the vegetative stage (5.45 %), decreases in the flowering stage (4.1%) and then, rises again (5.40 %). Total saponin content in fruits was found to be much less (1.5%) as compared to that present in aerial parts. The secondary metabolite (Plucheoside) content in leaves of *Pluchea lanceolata* was found to be maximum in the flowering stage (7.3%). It was found to increase from vegetative stage to the flowering stage and, then, decrease again. The sennoside content in leaves of *Cassia angustifolia* was found to be maximum in flowering stage (1.98%).

EXTERNALLY AIDED PROJECTS

Project 1: Productive propagation of remunerative medicinal plants for establishment of silva-ayurveda demonstrative models in the arid and semi-arid areas, their preservation for further improvement, research, extension, development and diversification [AFRI-70/ AFE/NMPB/2006-09]

Findings: Plants of some species like *A. indica* (neem), *Cordia mixa* (gunda), *Ziziphus jujuba* (ber), *P. cineraria* (khejeri), *T. undulata* (rohida) *Moringa oleifera* (sahjan), *Caraissa carandas* (karoda) and *Commiphora wightii* (guggal) were raised at AFRI nursery. Plants of some medicinal plant species like *Aloe vera*, *Brahmi* and *Ashwagandha* etc., were procured from outside sources.

Two sites at Tibna and Jadan of Jodhpur and Pali districts respectively were planted & maintained. Fifteen field beneficiaries were selected at Tibna village, two of one hectare and thirteen of one bigha area. Total area planted is 5.75 ha. at village Tibna. The species of *A. indica* (neem), *Cordia mixa* (gunda), *Ziziphus jujuba* (ber), *P. cineraria* (khejeri), *T. undulata* (rohida) *Moringa oleifera* (sahjan), *Caraissa carandas* (karoda) and *Commiphora wightii* (guggal) were maintained at farmers fields.

Some of the farmers have shown their interest to plant *Aloe vera* (guwarpatha), and *Withania somnifera* (ashwagandha). Total area planted is 5.75 ha. at village Tibna. At Jadan, species *T. undulata* (rohida), *P. cineraria* (khejeri), *Cordia mixa* (gunda), *Ziziphus jujuba* (ber), *Emblica officinalis* (aonla) *Commiphora wightii* (guggal) and *Citrus* (nimbu) were maintained over 1.25 ha. The survival percentage in the field ranged 70% to 90%.

At AFRI, Jodhpur nursery 4,20,000 nos. of *Aloe vera* plants were transplanted in thirty five nursery beds, which were procured from SKN College, Rajasthan Agriculture University, Jobner. These are being maintained by providing proper shelter and irrigation. Field nursery at Tibna was maintained by providing watch and ward. It contains about 45,000 seedlings.

An experiment on “Production Study of Medicinal Plants Integrated with tree and shrubs in the Indian Desert” was established at experimental fields of AFRI, Jodhpur with two shrub species i.e. Nimbu and Guggal and tree species Gunda and Khejri in Randomized Block Design.



Project 2: Establishment of a network to facilitate collection, processing and dissemination of statistics pertaining to tropical timber and other forestry parameters in India [AFRI-86/Silvi/ITTO/2007-09]

Findings: Data regarding forestry statistics collected from Rajasthan, Gujarat and Dadra & Nagar Havelli were compiled in various formats and sent to the ADG (Stat.), ICFRE. The revised formats developed in consultation with the ITTO consultant were field tested and comments given by the Forests Departments were forwarded to the ADG (Stat.), ICFRE. Draft manual was finalized and report prepared.

Project 3: Assessment of soil carbon stock and dynamics in forest soils of India (All India coordinated project, funded by MoEF, GoI) [AFRI-91/FED/NATCOM-II, MoEF/2009]

Findings: From July 2008 to January 2009, a total of 111 soil samples (98 from forest areas and 13 from agriculture land) in 0-30 cm soil layer were collected from 26 forest subgroup types identified covering 6 districts of Gujarat and 16 districts of Rajasthan.

Soil Organic Carbon (SOC) was lowest ($P<0.05$) in Desert dune forests (0.04%) and highest in Northern dry mixed deciduous forest (1.16%). But soil carbon density was highest ($P<0.05$) in Dry tropical riverain forest (38.92Mg ha^{-1}) and lowest in Tropical Euphorbia scrub (1.46 Mg ha^{-1}). Thus, carbon density depended upon soil conditions as well as gravel content and rock outcrop in particular type of forests. SOC and carbon density were in reverse order in *A. leucoploea* based and *Salvadora oleoides* based *Cassia auriculata* scrub. *Boswellia* forests (5/E2) occupied highest altitude, whereas Rann Saline thorn scrub (6/E3) occupied lowest altitude. Carbon density was relatively greater in Rajasthan than in Gujarat forests. Lesser carbon density in most of the forest types than in the agriculture land indicates varying degree of degradation resulting in less carbon storage. However, dry tropical riverain forest, dry teak forest, northern dry mixed deciduous forest and desert thorn forests showed highest carbon density than in agriculture land reflecting better soil health in these forest types by maintaining greater soil carbon stock. Wide variability in carbon density between forests and agriculture land indicated scope of carbon stock improvement in forests.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Development of economically viable and integrated agroforestry models for arid region [AFRI-55/Silvi/2003-09]

Status: Agroforestry model is being maintained at farmer's field at village Harsh, Bilara. Survival, growth and crop production data were recorded and compiled. Performance of *Ziziphus auritiana* (grafted ber), *Cordia mixa*, was found best as horticultural species and *Prosopis cineraria* and *Ailanthus excelsa* was best as silvicultural species.

Prosopis cineraria plants obtained average maximum height 155 cm and followed by *Cordia mixa* (150 cm), *Colophospermum mopane* (149 cm), *Ailanthus excelsa* (142 cm) and *Ziziphus mauritiana* (130 cm). Similarly, collar diameter was highest in *A. excelsa* (5.09 cm) and followed by *Cordia mixa* (4.79 cm), *Colophospermum mopane* (3.34 cm) and *P. cineraria* (3.27 cm). The plant growth was higher in agroforestry compared to the control (without crop). The highest survival was observed in *P. cineraria* (98%) followed by *Z. mauritiana* (86%), *C. mopane* (85%) and *Cordia mixa* (77%) and the lowest survival was *Emblica officinalis* (7%) species. Wheat crop production was recorded 19.55 quintal/ha.



Project 2: Market survey on selected species in selected markets [AFRI-24/FRME-1/1994-Continue 1994 to till date]

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

Project 3: Survey, selection, performance trial and estimation of yield potential of *Jatropha curcas* in Rajasthan and Gujarat [AFRI/JU/Silvi/2006-07/RPC 25th-26th February 2007-12]

Status: Carried out measurement in the two sample plots of *J. curcas* laid out at Motiya Research Farm, Rajpipla (Gujarat). Total height, crown width and collar diameter varied from 1.3m to 2.6m, 0.4m to 2.5m and 5.7 cm to 13.2 cm, respectively. Seed yield was varied from 4.6 gm to 189 gm. Similarly, height and seed yield/plant at Lekawada nursery varied from 0.92 m to 1.29 m and 14.75 gm to 138.00 gm. Seeds were collected from 14 CPPs planted in Lekhawada nursery, Gandhinagar. Total seed weight, seeds per 10g, kernel and oil content were estimated. Number of seeds per 10g varied from 17 to 23 percent oil from 27.6 to 41.1 percent. Progeny of 20 CPTs from Rajasthan and 10 CPTs from Gujarat have been raised for establishing progeny trial.

Two progeny trials, one with 5 replications having single plant per replication at AFRI, Jodhpur and another with 15 replications in RBD at Haldughati, Udaipur were established in July 2008. Initial survival varied from 95-100 percent. Rodent infestation was observed at Udaipur site and a total of 30 plants were damaged by rodents. Mechanical treatment by protecting collar with wire mesh was found superior than chemical treatment. Plants have been raised for mortality replacement. Growth data have been taken and analyzed. Initial plant mean height (28-70.60 cm), mean number of branches (1.0-2.40) and collar diameter (0.80-2.20 cm) were observed at AFRI, Jodhpur and 37-52.3 cm, 1.0-1.20 and 1.30-1.76 cm respectively at Haldughati, Udaipur. Preliminary seed yield equation developed, $SY=4.0752-1.096*CD$, where, SY= seed yield, CD= crown diameter.

Project 4: Studies on seed traits of seeds collected from seed stands/SPAs/SSOs/CSOs of important species of Gujarat state [AFRI/JU/Silvi/2006-07 RPC 25th-26th February, 2007]

Status: Due to poor seeding in the Gujarat state, SFD was unable to supply seeds of desired species. Instruction manual for establishing seed certification system has been prepared and submitted to CCF/DCF, Gandhinagar and Rajpipla for implementation.

Seed samples of 12 seed sources (2 seed stands and 10 CPTs) of *Acacia catechu* 14 *Jatropha* CPTs have been tested for seed parameters. Seeds were examined physically and none was defective. All seeds were healthy. Seeds of *A. catechu* were golden brown in colour. *Acacia catechu* seedlot no. 2557 showed 77.5% germination and 143.38 vigour index while seeds collected from outside area (accession no. 2558) showed 77.5% germination and 145.7 of vigour index. Seeds of 10 CPTs of *A. catechu* showed variation in 100 seed weight from 3.79-5.48g, seed germination from 69 to 91.5% and vigour index from 88.14 to 152.73. Removal of seed coat from seeds of *T. chebula* enhanced percent germination from 10% control to 72% after kernel removal. Number of seeds in 10g of seed weight in 14 CPTs of *Jatropha* varied from 17-23 and oil from 27.6 to 41.1% on seed basis.



Status: The project has been initiated in September 2007 with the objective to characterize and classify the forest soils of Rajasthan following the USDA classification system. Soil profiles have been studied at 55 places in Jodhpur, Banswara, Pratapgarh, Dungarpur and Pali districts covering 25 vegetation/forest sub-types in the major forest types of tropical dry deciduous and tropical thorn forests.

Physicochemical characterization of the soils has been done in the field as well as in laboratory. Soil structure, consistency, colour, pH, electrical conductivity, organic carbon, $\text{NO}_3\text{-N}$ and $\text{NH}_4\text{-N}$ and phosphorus have been estimated for 171 samples. Ecological study in an area of 0.1 ha near each of the soil profile pit has been completed.



Shallow, well drain soil with pebbles & stones in *Boswellia serrata* forest at Khed tala, Udaipur



Shallow soil in Heteropogon - *A. Leucophloea* grassland at Sindarli ghas Jod, Desuri (Pali)



Stony shallow soil

A. pendula forest, Sabla

In general, forest soils are found to be very shallow to shallow as most of the forests are located on hilly terrain. Presence of calcium carbonate layer at shallow depth was observed in grassland soils. Deep soils are present along narrow strip of valley. Soils on the hilly area of Banswara, Pali, Dungarpur and Pratapgarh are neutral to acidic in nature with low electrical conductivity, whereas, on grasslands in Pali and Jodhpur District, they are basic with high electrical conductivity.

Project 6: Genetic Improvement of *Tecomella undulata* [AFRI-33/FGTB-7/(2002-09]

Status: Progenies of selected CPTs of *Tecomella undulata* were maintained in the Nurseries of AFRI, Jodhpur and Beechwal, Bikaner. Two progeny trials using 40 progenies were established in the experimental area of AFRI and in the SFD land at Bikaner. These progenies were established in randomized incomplete block design, with a spacing of 3 x 3 m and having 9 plants per plot. The trials were established in the month of August 2008 and fencing was provided to the trial in Bikaner. Regular watering is done for the plants.



A view of the plants in the trial



7 months old healthy progeny

Project 7: Screening of high oil and Azadirachtin in Neem [AFRI-34/FGTB-8/2002-09]

Status: The progeny trial of neem established in Govindpura, Jaipur to study the heritability pattern of selected CPTs for their oil and Azadirachtin content had not produced flowers and fruits. This was due to frost and other climatic factors. The trials were maintained and the periodical flowering observations taken. The observations in the month of March 2009 showed flower bud initiations in most of the progenies of the selected CPTs.

Project 8: Multilocational trial of *E. camaldulensis* and *D. sissoo* clones in Gujarat state [AFRI-41/FGTB/2002-09]

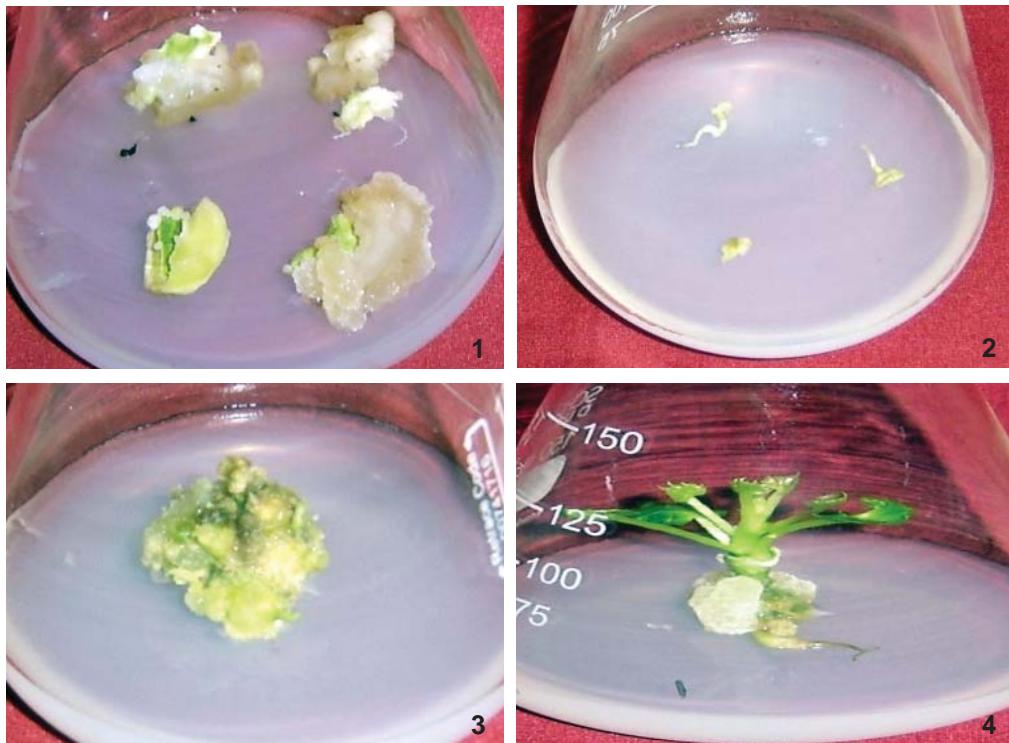
Status: Analysis of variance revealed significant to very highly significant variation between the clones of both the species for most of the traits across the locations. Estimation of genetic parameters showed that the growth traits of *Eucalyptus camaldulensis* are strongly inherited and under the influence of both additive and non additive gene action. Detailed genetic analysis of *D. sissoo* trials is being carried out. As far as the performance of the clones at different sites is concerned, ranking of the clones varies in different sites, however, few *Eucalyptus camaldulensis* clones like G2 and clone No. 15 and 35 showed stable performance across the sites as demonstrated by their better growth. These clones were amongst the top 10 clones in all the sites. Similarly *D. sissoo* clone Nos. A3, 10 and 105 were found suitable in all the four test sites.

Project 9: Demonstration trial of male and female *Ailanthus excelsa* plants raised through grafting and tissue culture [AFRI-79/FGTB/2006-09]

Status: Demonstration trial is established with grafted seedlings raised through male and female scions collected from marked trees. Trail is laid in Randomized Block Design in July 2008 in AFRI experimental area. Trial is irrigated and is being maintained well. Survival percentage is about 85%. Data have been recorded on growth parameters as per schedule.

Project 10: *In-vitro* mass propagation of *Jatropha curcas* L. and optimization of low cost options for Economizing the technology [AFRI-83/FGTB/2007-10]

Status: Embryogenic callus cultures have been obtained. Embryogenic callus cultures were multiplied further by repeated subculturings. Part of the embryogenic callus cultures with somatic embryoformation zones was diverted to South-East germination medium where somatic embryo germination has been achieved.



Photoplate: *Jatropha curcas*: 1. Somatic embryo (SE) formation from callus; 2. Germination of SE; 3. Callus showing formation of multiple shoot buds and 4. Multiple shoot formation

Apical bud explants when cultured on different combination of BAP & IAA supplemented MS medium resulted shoot formation (organogenesis). Cultures with bud break response and shoot morphogenesis were further multiplied and the microshoots were transferred to rooting media.

Project 11: Management of potential insect pests and diseases of important medicinal plants grown in arid and semiarid regions [AFRI-72/FPD/2006-09]

Status: Isabgol (*Plantago ovata*) crop was found severely attacked by downy mildew disease at Sojat (Pali). The incidence of the disease was noticed about 35-40%. The fungus was identified as *Peranospora* sp. The treatment 8 comprising Rattan (1.5%)+Monocrotophos (0.05%) was

found very effective against downy mildew disease, whereas, treatment 7 Bavistin (1.5%) + Monocrotophos (0.05%) was found the best against aphid attack on Isabgol at Sojat. The combination of Bavistin (1.5%) + Monocrotophos (0.05%) reduced pest incidence from 3.0% to 3.5% after the treatment.

Combination of Rattan (1.15%) and Monocrotophos (0.05%) reduced disease incidence from 43 to 13% after the treatment.

- The lifecycle of *Achaea janata*, defoliator of Mehndi crop has been completed.
- In Mehndi crop, incidence of one species of semilooper, one species of whitefly, mite and blister beetles were recorded. Termite damage caused maximum injury to the plants. A few other symptoms like yellowing and shedding of leaves were also recorded but were due to early sprouting of lower leaves which can be explained as physiological disorder.
- An Aphid species (*Aphis gossypii*) is the major insect pests attacking Isabgol.

A field experiment was laid out on Mehndi for the management of economic important pest (semilooper larvae) and charcoal root rot/leaf spot/blight disease. The experiment was laid out in randomized block design and four treatments by using biopesticides viz., T-1: Soil treatment (Trichoderma + Vermicompost + Phorate) foliar spray Pratirodh; T-2: Neem ban+ Bavistin + Wonderlife; T-3: Terminator + Wonderlife; T-4: Control (untreated). The replication were three with the block size of 5mx5m soil treatment (Trichoderma + Vermicompost + Phorate) was found the best amongst other three treatments, wherein, Mehndi yield was increased from 1.5 to 2.1 kg per sq metre in treated plots.

Project 12: Mycorrhizal dependency and productivity of economically important medicinal plants (Mehndi & Ashwagandha) of arid zones [AFRI-84/FP/2007-10]

Status:

- AMF genera like Glomus, Scutellospora, Sclerocystis and Acaulospora and Seven species of Glomus viz., *G. fasciculatum*, *G. aggregatum*, *G. mosseae*, *G. macrocarpum*, *G. intraradices*, *G. reticulatum* and *G. constrictum* were isolated and identified.
- The distribution of different VAM species viz., *Glomus aggregatum* (35%); *G. mosseae* (15%); *Glomus fasciculatum* (20%); *G. macrocarpum* (10%); *Glomus* sp. (15%); Scutellospora (3%) and Acaulospora (2%) were recorded.
- The AM spore population of Rhizosphere soil collected from Ashwagandha plants under the *Albizia lebbeck* and Khejri trees from Nagour and Jharali The spore population was recorded 320 spores per 100 gm of soil from Nagour and 270 spores per 100 gm of soil from Jharali.
- Both the species Mehndi and Ashwagandha were found highly mycorrhizal in nature. The root infection was found in the form of intercellular, intracellular hyphae, vesicles and arbuscular structures in the roots.
- A field experiment on Mehndi & Ashwagandha was laid down in Randomised Block Design (RBD) with six treatments including control. The treatments were, T-1= *G. intraradices*, T-2 = *G. reticulata*, T-3 = *G. fasciculatum*, T-4 = *G. mosseae*, T-5 = *G. constrictum*, T-6= Control (untreated). About 90 percent survival percentage was recorded in Mehndi, whereas, in Ashwagandha it was only 35%. Initial observations have been taken.



Project 13: Development of web portal for forestry research extension [AFRI-82/ITCELL/2007-11]

All the required softwares namely MS-Visual Studio 2008 and MS-SQL Server 2008 have been procured during this year. The first activity of the purchase of the software has been completed.

Out of the three scheduled trainings, two trainings on "Web Designing" and "Programming in C Language" has been completed and the third and final training is undergoing and likely to be completed soon.

The selection of the fields for the database has been finalized and the structure of the underlying database has been finalized. The Database could not be created physically as the MS-SQL Server 2008 software has been supplied during March 2009.

The collection of data for 50 important tree species has been started according to the fields finalized and fed into the excel sheet for further entry into the database.

EXTENSION ACTIVITIES

Establishment of Van Vigyan Kendra

MOU was signed between by AFRI and RFD on 18th March 2009 at VVK, Bichhwal, Bikaner, Rajasthan. Training programme was organized for farmers and field functionaries under VVK from 16-18 March 2009 at Bikaner. Extension/display material like photographs, display boards, printed material in Hindi & English were displayed at VVK Bikaner. A progeny trial of *T. undulata* (2.3 hec, 1440 nos of seedlings) has been planted at the site for demonstration.

MOU was signed by AFRI and GFD on 26th February 2009 at VVK, Chhipardi Beedi, Rajkot, Gujarat. Training was organized for farmers and field functionaries under VVK from 26th to 28th February 2009 at Rajkot. Extension/display material like photographs, display boards, printed material in Gujarati and English were displayed at VVK Rajkot.

SFD, Dadra & Nagar Havelli FD has provided the VVK site at Rudana Nursery, Khanwel. The site had been visited by the DCF/ Director & staff. Director AFRI recently has discussed MOU with FD of Dadra & Nagar Havelli.

Development of Agro-hort-silvi demonstration Models in Demo village, Bilara

Two Demo village plantation sites on farmer's field namely Mrs. Sita Chaudhary, Bijuwadia and Mr. Rajendra Singh Chaudhary, Harsh were maintained. Mortality replaced. Growth data recorded six monthly. Crop production estimated on both the sites. *Cordia mixa* attained maximum height (102 cm) followed by *Zizyphus mauritina* and *Prosopis cineraria*. Survival of *Prosopis cineraria* is the highest (68% and 71%, respectively, Mr. Rajendra Singh Chaudhary and Mrs. Sita Chaudhary).

EXTERNALLY AIDED PROJECTS

Project 1: Establishment of multilocational clonal trial and seedling seed orchard of *Jatropha curcas* [AFRI/JU/Silvi/2006-07/RPC 25th-26th February 2007/DBT/2007-10]

Status: Two multilocational clonal field trials have been established at Haldughati, Udaipur. The first trial was established in the month of November 2007 with 12 accessions and the second



clonal trial was established with 8 accessions in the month of September 2008 in RBD with four replications.

The initial growth parameters were recorded for both the trials. Percent survival varied from 87% in TERI/DBT-Jat/06/16 to 100 percent in PDKV-DBT-12 in clonal trial-I. Mean above ground plant height varied from 37.75cm in TERI/DBT-Jat/06/10 to 51.78cm in SDHQ4N1. Similarly, Mean number of branches and collar diameter varied in different accessions.

In clonal trial-II, percent survival varied from 55.50 to 97.20, plant height from 16.37cm to 35.46cm, mean number of branches from 1.0-1.12 and collar diameter from 0.98 to 1.24cm.

For raising seedling seed orchard of *Jatropha curcas*, seeds from 116 CPTs selected earlier by various micro-mission linked partner Institutes have been received and their percent oil content on seed basis as tested by TERI, New Delhi. Percent oil varied from 33.07 to 42.08 in all collected accessions.

Randomized Block Design (RBD) with 5 replications at Arid Forest Research Institute, Jodhpur and 15 replications at Haldughati, Udaipur was used for plantation. Trial was established in July 2008 from 116 CPTs having single plant per replication at a distance of 3x3m.

Whereas maximum mean height of 60.0cm in J-83 of Hisar was observed initially, mean number of branches was maximum in J-80 and maximum collar diameter of 2.20cm was of TERI/DBT-JATROPHA/05/06 planted at AFRI, Jodhpur. However, J-127 showed initial maximum plant growth of 57.67cm and collar diameter of 2.07cm. Mean number of branches was highest (1.27) in TERI/DBT/JATROPHA/01/12 at Udaipur.

Project 2: Genetic improvement of *Jatropha curcas* for adaptability and oil yield [AFRI/JU/Silvi/No.5/258/39/2004/CSIR, New Delhi/2005-10]

Status: Performance Trial of *Jatropha* Accessions: A total of 185 accessions (24 elite and 161 native) were collected/exchanged with participating Institutes and planted in September 2005 and 2006 showed variation in plant mean height, mean collar diameter and mean number of branches. The maximum mean height (177.0cm) was of CRIDA-JJ-06, mean number of branches (4.44) of CSMCRI-GUJ-Banas-1205-C1.

A total of 161 native accessions (now accessions) have been exchanged. All accessions have been planted in August 2006 in RBD design with three replications having single plant per replication at 2.5 x 2.5m spacing. Causalities were replaced in July 2007. At present, 161 accessions were surviving. Percent survival varied from 66 to 100.

Spacing Trial: Spacing trial was initiated from the seedlings raised from seeds received from Bhav Nagar. Plants were planted in RBD design with 16 plants per treatment and in five replications in July 2007. Except height, none of the parameters were affected by spacing.

Irrigation and Fertilizer Trial: The experiment was laid out in split plot design with four replications at four levels of irrigation treatments and five levels of fertilizer treatments. Plants were spaced at a square spacing of 2.5 x 2.5 m.

Observations have been recorded on above ground height, number of branches and collar diameter after 18 months of planting. The irrigation treatments were imposed in February 2008. Initially, application of fertilizer has no significant effect on plant growth. Number of branches and collar diameter was also unaffected by the treatments at present. However, Irrigation at 15 days interval has significantly affected height and collar diameter of the plants.



Pollarding trial: Trial was established in July 2007 in RBD design with five replications and four treatments (T_0 : No Pruning; T_1 : Pruning Height 30cm; T_2 : Pruning Height 45cm and T_3 : Pruning Height 60cm. The number of plants per treatment was 10.

The treatments were imposed in February 2008. The initial survival is 100 percent and average height in T_0 was 167.1 ± 28.68 cm, mean number of branches 7.82 ± 1.62 and collar diameter 5.862 ± 0.95 . Analysis of variance suggested that there is insignificant effect of pruning on average plant height. However, T_0 and T_2 varied significantly for mean number of branches only. Collar diameter was unaffected by the treatments.

Project 3: Source variation, extraction and cultivation practices for *Commiphora wightii* Arn. Bhandari [AFRI-76/Silvi/NMPB/2006-09]

Status: Trial was maintained in Kumatia enclosure, Kailana Forest Area, Jodhpur. Percent moisture in thinner branches was ranging from 36.6-39.4% in various treatments in the month of April 2008. Growth data (Height, crown diameter) was recorded in September 2008. Height increment was maximum (4 - 32 cm) in trees treated with FYM and I_1 (irrigation after 20 days) and minimum in trees with no FYM and no irrigation (2-15 cm). Crown diameter was maximum in FI_1 (207-287cm) while all other treatments were in similar range F_0I_0 (207-226 cm), FI_0 (172-226 cm) and FI_2 (183-210 cm).

All the trees, where tapping was undertaken in February 2008 were healthy up to August 2008, even those branches did not dry where cuts were given. Gum exudation completed till 15th April 2008. Casualties started in September end and total nine trees out of total 48 trees died till December 2008, after ten months of gum extraction. Protection measures were applied in January 2009 and no further casualty observed after that. Casualties were maximum (77.78%) in C_3 (450 mg ethephone) followed by in C_2 (22.22%) treatment with or without irrigation. There was no casualty in C_1 dose (150 mg of ethephone) and control.

Leafing occurs in 70-80 % plants in April -May due to rain but plants were completely leafless in June 2008. Plants were lush green after rains in monsoon (July to September 2008). Association of *Asparagus racemosus* was with all the plants. Leaf started yellowing in late October and all the plants were completely leafless in November 2008. Flowering was noticed in January 2009 in all the plants with leaf initiation in some plants of I_1 treatment. Fruit setting was observed in February 2009.

Twigs (Pre & post ethephone treatment in 2007-08) were pulverized and soxhlet extracted with petroleum ether and ethyl acetate. The petroleum ether contents was 1.7 to 1.9 % in the pre ethephone treated plants. It was ranging from 2.12 to 2.78 % in various treatments in post ethephone treated trees.

Organic manure (2 kg/plant) was applied in September 2008 in experimental trees as per the treatment. Treatment wise irrigation schedule (at an interval of 20 & 30 days) was imposed from November 2008 to January 2009. Tapping experiments were initiated in third week of March 2009. Ethephone doses were modified (0, 100, 200 & 300 mg in place of 0, 150, 300 and 450 mg) and injected at two to three places in a tree and cuts were given simultaneously.



Visit of DG, ICFRE

Gum was collected after six days; yield is low probably due to tapping in March end. So far, all the trees are healthy.

DG, ICFRE visited the experimental site in July 2008.

Project 4: Study of Characteristic Features Pertaining to Bio-drainage Potential of Some Selected Tree Species [AFRI-38/FED/MOWR/2004-09]

Status: This project is funded by the Ministry of Water Resources (MoWR), New Delhi. It was initiated in 2004 with two field experiments in Indira Gandhi Nahar Pariyojana (IGNP) and one in in-filled non-weighing type of lysimeters ($2 \times 2 \times 2 \text{ m}^3$) at Jodhpur.

Among the tree species (*Eucalyptus camaldulensis*, *E. fastigata*, *E. rufa*, and *C. tessellaris*) tried in the field, performance of *E. rufa* has been found to be the best with respect to growth, biomass, transpiration rate and overall bio-drainage potential. Soil working at the site resulted in heavy regeneration of *Eucalyptus camaldulensis*. The regenerated plants were mostly concentrated between 6 and 10 m from the tree trunk of the mother trees situated at the edge of the experimental site. Number of seedlings varied between 13 and 36 per m^2 area.

Ground water table has receded from 25 cm to 145 cm depth as recorded in the observation pit resulted by transpiration pull (bio-draining) of the growing vegetation. Apart from the planted ones, some species like *P. juliflora*, *Tamarix dioca*, *Saccharum munja* and *Arundo donax* also have come up in the area. The number of *A. donax* has reduced gradually with recession of ground water table in the experimental plot. With the lowering of ground water level, other species started growing in the area as natural succession. Population of *S. munja* was highest followed by *P. juliflora* and *Tamarix dioca*. Total biomass per tree in *P. juliflora* was recorded as 110 kg. Contribution of root to the total biomass was 25%. *S. munja* and *T. dioca* accumulated total biomass of 76.5 and 73.25 kg per tree.

In lysimeter experiment, water use by *E. camaldulensis*, *Acacia nilotica* and *Tamarix aphylla* and their growth has been affected by water logging and salinity treatments. Height and collar girth was highest in *E. camaldulensis* whereas, crown growth was highest in *A. nilotica*.

Tree growth has been highest in waterlogged treatments than the control where surface irrigation was done. Trees were taller water logging ranged between 1-1.25 m soil depth in comparison to 0.5-0.75 cm. Water logging at shallow depth may have restricted root growth resulting in less growth.

Water use per day per tree was significantly affected by salinity level and depth of water logging. Water use of *E. camaldulensis* was 32 ltr. day^{-1} tree^{-1} in the month of October and November, however, it was at par with *A. nilotica* (29 ltr. day^{-1} tree^{-1}) and *T. aphylla* (28 ltr. day^{-1} tree^{-1}).



Layout and plantation of different species in lysimeter experiment (left), mineral deficiency in *E. camaldulensis* leaf due to salinity and water-logging stresses

Project 5: Enhancing productivity of saline wastelands in Kachchh, through improved tree planting techniques (Patan) and silvipastoral study (Bhuj) [AFRI-77/NWFP/SFD/2006-09]

Status: The experimental area is located in Kordha, Sami Range in Patan (23.83° N latitude 72.12°E longitude) of Gujarat, India. After 20 months, *Acacia bivenosa* and *A. ampliceps* recorded 86.0 and 72.6 % as mean survival and there is almost negligible change in mean survival from August 2008 to March 2009. There is no effect of treatments on percent survival for *A. bivenosa*, however, in case of *A. ampliceps*, treatments influenced the survival and T_2 and T_3 treatments recorded significantly higher survival compared to other treatments. Survival of *Atriplex* spp. was poor as they were planted on very shallow and waterlogged soil. Maximum survival was for *A. amnicola* (39.5 %) followed by *A. lentiformis* (18%) in March 2009.

At 18 months of age mean height of *A. ampliceps* is 161.3 cm (55.5% more) and crown diameter 169.5 cm (38.9% more). While, in case of *A. bivenosa*, the mean height is 97.9 (60.7% more) and crown diameter 182.2 (65.3% more). T_2 (FYM) and T_3 (Wheat husk) treatments recorded significant higher growth compared to other treatments for both the plant species. Overall *S. persica* recorded maximum mean percent survival (92.8) at 18 months. Plants record appreciably high growth between 12-18 months. Mean increment in height and crown diameter was (40.4%) & (38.6%) respectively ranging from 26.2-49.5% and 26.2 – 51.5%. So far T_5 was the best treatment attaining maximum height 112.6 cm and crown diameter (154.1 cm).

Soil Properties: There was no significant change in pH values recorded between winter and summer months. However, summer EC values are significantly higher compared to winter values in all the treatments in 0-25 and 25-50 cm soil layer in plant pit for both *A. bivenosa* and *A. ampliceps*. EC values of interrow spaces were generally higher compared to plant pit in summer season.

Weed Biomass: Green weedmass was dominated by halophytes and other salt tolerant species. *Chloris virgata* was the most dominant species followed by *Sueada fruticosa*. Overall 431 gm² yield was recorded, however, species wise variation was observed and it was 693.0 gm² (*A. bivenosa*), 375.5 gm² (*S. persica*) and 224.1 gm² (*A. ampliceps*).

Sub project B: Trials with four tree species namely *Cordia gharaf*, *Prosopis cineraria*, *Ziziphus mauritiana* and *Colophospermum mopane* and three grass species, namely, *Cenchrus ciliaris*, *C. setigerus* and *Dicanthium annulatum* were laid in RBD in three replication at Mochirai, Bhuj in July 2006. Experiment one with *D. annulatum* grass is abandoned due to destruction of one and half replication due to passing of Narmada pipeline in June 2008.

Survival: Plant species maintained more than 90% survival in both the experiments. Overall periodic percent survival recorded after 30 months of age was in similar range, *Cenchrus setigerus* 95.6%, and *Cenchrus ciliaris* 95.4% (almost no change between 24-30 months growth period). However, survival with grass was higher in case of *C. ciliaris* (98.1%) compared to *C. setigerus* (92.0%). Species wise maximum survival was with *Prosopis cineraria* 94.9%, *Cordia gharaf* 99.5%, and *Ziziphus mauritiana* 93.5%.

Height & Crown Diameter: At the age of 26 months, tree species recorded 15.2 to 17.5 % and 12.2 to 28.7% mean height increment under control and with grass treatment for *C. ciliaris* and *C. setigerus*, respectively compared to height at 14 months. Mean height and crown diameter of control trees was significantly more (p-0.45) than trees grown with grass in case of *C. setigerus*. However, difference was insignificant for *C. ciliaris*. Within species, height



difference was highly significant ($p=0.00$), due to less height growth of *P. cineraria* compared to *Z. mauritiana* and *C. gharaf* which almost attained similar height with *C. setigerus* and *C. ciliaris*. Incremental growth for crown diameter was 7.7 to 5.7 and 11.9 to 25.7 % respectively for various tree species with *C. ciliaris* and *C. setigerus*, respectively, between the growth periods (14-26 months). Low rainfall (287 mm) is the reason for less growth. Effect of grass growth significantly influenced the overall crown diameter only with *C. setigerus* ($p=0.00$) at 14 and 26 months where it was 39 & 37.4 % more in control.

Grass yield: The year 2008 received very scarce rain and yield was one third of the year 2007. It was 0.66 & 0.17 kg ha⁻¹ and 0.47 & 0.16 kg ha⁻¹ as green and dry grass yield for *C. ciliaris* and *C. setigerus*. The reduction in mean green grass yield was 2.9 fold for *C. ciliaris* and 3.2 fold for *C. setigerus*. Conclusions so far are *C. ciliaris* is the best grass species very closely followed by *C. setigerus*. Establishment of *D. annulatum* was poor. *Cordia gharaf* maintained nearly 100 % survival and appreciable growth followed by *Z. mauritiana* with all the grass species.

Project 6: Multiplication and field trial of bamboos through tissue culture in Rajasthan & Gujarat [AFRI-68/FGTB/DBT/2005-09]

Status: Experiment conducted with four fertilizer treatments namely, T1 – No Fertilizer, T2 – FYM (10kg), T3 – NPK (50g N + 50g P + 25g K) and T4 – FYM + NPK (5kg FYM + 50g N + 50g P + 25g K). Effect of fertilizer treatment on height is clearly visible irrespective of the site. At Kushalgarh, Banswara *D. strictus* average height in control was 3.36 m. and it was more than 4.1 m in all other three fertilizer treatments. Similar trends were recorded at Chakkhalia, but here average height was more in all the treatments as compared to Kushalgarh. In case of *B. bambos*, average height was 1.59 m in control and in treatments average height was more than 2.0 m at Kushalgarh. In this species also trend in fertilizer experiment was same but the performance was better at Chakkhalia. Data were also analyzed with number of culm per clump and clump girth.

Project 7: New Biocontrol opportunities for prickly Acacia: exploration in India [AFRI/FPD/2008-11]

Status:

- Contract agreement has been signed and sent to AFRS, Australia.
- Selection of 4 experimental locations i.e., Jodhpur Pali (Selibandh Forest Nursery), Bharatpur (Keoladeo National Park) and Hanumangarh (Kohla Forest Nursery) in Rajasthan and Gandhinagar, Junagarh and Bhuj in Gujarat.
- Extensive field survey were made covering Rajasthan State and samples of entomo-herbivores and disease infected plant parts were collected.
- A severe primary attack of *Ganoderma lucidum* was noticed in 2005. *A. nilotica* plantation at Sadri (Desuri) in Pali Forest Division followed by a secondary infestation of a termite species *Odontotermes* sp.
- Heart rot of *Acacia nilotica* tree caused by *Fomes* sp. collected from Keoladeo National Park, Bharatpur.
- Charcoal root rot was recorded in young plantation of *A. nilotica* collected from Desuri (Pali).



- Twenty to Twenty five percent seedlings (12 weeks old) were found attacked by two species of Myllocerus (Curculionidae : Coleoptera) at Sadri - Desuri (Pali) during the month of August 2008.
- Active larvae of one species of bagworm, *Pteroma* sp. nr. *plagiophleps* (Psychidae: Lepidoptera) was noticed on 30 to 40% trees at Sadri Range, having *Acacia nilotica* plantation in an area of 25 ha.
- Plant height was maximum when the seedlings were kept under canopy whether treated or untreated while numbers of shoots were maximum when the seedlings were exposed to sun. Similarly, maximum number of leaves were recorded in the seedlings which were exposed to sun.
- In nursery, Fusarium root rot, leaf blight, leaf spots were recorded on *Acacia* seedlings. Among insects whitefly, myllocerus, lac insects were recorded.
- Among pathogens powdery mildew fungus and rust was found to be very promising and host specific for acacia seedlings.
- The infestation of gall insect belonging to the family Lepidoptera was recorded for the first time in Desa Forest Range. The samples have been sent to Australia for identification.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges [AFRI-39/EED/2005-09]

Status: Experiment was started in July 2005 with the financial assistance from Rajasthan Forest Department. A total 75 plots of about 700 m² area were laid in 0-10, 10-20% and >20% with control, contour trench, gradonie, Box trench and V-ditch rainwater harvesting treatments.

Growth data recorded in July and December 2008 indicated plants were taller and thicker in <10% slope area and decreased with increase in slope. But *Holoptelia integrifolia* indicated highest, whereas, *Dendrocalamus strictus* and *Acacia catechu* showed lowest growth in 10-20% slope area. Growth of *Dendrocalamus strictus*, *Azadirachta indica* and *Ziziphus mauritiana* was best in V-ditch area. *Embilca officinalis* and *Holoptelia integrifolia* performed best in contour trench areas, whereas, *G. arborea* and *Acacia catechu* performed better in Box trench areas.

Growth data of July 2008 indicated that seed sown seedling of *Acacia catechu* outperformed the planted seedlings of *E. officinalis*, *Syzygium comini* and *Ziziphus mauritiana*. In some of the cases, the difference is about 2 fold.

Soil water content increased downward but Soil Organic Carbon (SOC), NH₄-N and NO₃-N were highest at mid position in a plot. Soil water content and soil organic carbon were highest in <10%, whereas, NO₃-N and NH₄-N concentrations were highest in >20% slopes. In RWH treated area, SOC and PO₄-P were highest in CT plots; SWC and NO₃-N were highest in G plots, whereas NH₄-N concentration was highest in VD plots. Lowest availability of soil nutrients indicated greater diversity.

Species diversity, richness and herbage yield increased downward, but species evenness was highest at mid position in a plot. Among slope species, diversity and species richness were highest in <10%, dry matter yield was highest in 10-20% and species dominance and vegetation height were highest in >20% slopes. In RWH treated area, species diversity and herbage yield

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were highest in CT plots; whereas, evenness, richness and vegetation height were highest in VD plots. Lowest availability of soil nutrients indicated greater diversity.

There were 80 numbers of herbs and grass species recorded in October 2008. Number of species increased downward from >20% slope (5.33 m^{-2}) to <10% slope (6.25 m^{-2}). In microsites, number of herbage species was highest down slope and lowest at midslope position. Dry matter production increased downward being highest at down slope position (567.8 g m^{-2}).

Dry matter production was 478.5 g m^{-2} in 10-20% to 439.2 g m^{-2} in <10% slope. Among the treatment, dry matter production was 523.6 g m^{-2} in contour trench plots as compared to 413.5 g m^{-2} in control plots. It was significantly greater (458.8 g m^{-2}) in treated area than untreated (244.9 g m^{-2}) area of the site.

Project 2: Studies on carbon sequestration in different forest types of Rajasthan [AFRI-88/EED/2008-11]

Status: Project was started after approval from the RPC in April 2008. The objectives of the project were (i) to estimate carbon stock in forest soils, (ii) to estimate carbon stock in forest litters and (iii) to estimate carbon stock in aboveground and below ground biomass; with broader objective to provide an estimate of carbon stock of forests in Rajasthan for its utilization in planning and execution of afforestation/ reforestation programme in this region.



Dry Teak Forest at Jhaunda,
Pratapgarh



Butea Forest in Dhariyavad,
Pratapgarh



Boswellia Forest, Arampura,
Pratapgarh



Madhuca Forest, Siyakhedi,
Pratapgarh



Dry Bamboo Brake, Umarkot,
Pratapgarh



Aegle Forest, Samlipathar,
Chittorgarh

In the Inproject vegetation in different forest blocks of Banswara, Chittorgarh, Dungarpur, and Pratapgarh Forest Division were surveyed for estimation of carbon stock in vegetation, forest litter and soil samples up to 90 cm soil depth. Tree and shrubs growth measured and herbage biomass recorded. Litter, plant and soil samples collected from 80 sites. A Carbon

Nitrogen and Sulphur (CNS) analyzer and associated chemical purchased for carbon estimation. *Phoenix savannah* and *Madhuca indica* based forests have been identified as the additional types of forest reported in Rajasthan.

Studies at five different forest blocks of Pratapgarh with *Dendrocalamus strictus* as one species showed a total number of 35 trees/shrub species. In this population of trees/shrubs varied from 770 at Arampura to 3280 plants per ha at Jhaunda. Numbers of species were highest in Arampura, whereas, it was lowest in Janagarh forest blocks. Most common species in these sites were *Tectona grandis* and *Dyospyros melanoxylon*. In these blocks, *T. grandis* showed highest abundance, frequency and density. Observations on growth and productivity of *D. strictus* showed highest productivity with greater availability of soil resources and species diversity.

Studies in *Euphorbia* scrubs type of forest of Jodhpur indicated highest number of vegetation diversity i.e. 13 in north-east aspect, whereas, it was 12 in south-west aspect. Total population of trees and shrubs were 323 and 101 number in 2 ha area in respective aspect.



Phoenix savanna, Karaundia, Chittorgarh



Anogeissus pendula Forest, Chittorgarh

Technology Developed

Technology developed for reclamation/rehabilitation of waterlogged soil in canal command area of IGNP using principle of biodrainage. The technology is raised bund with sand mulching and plantation with species of high transpiration potential. Intervention like protection of the area, soil working and planting of tree species enhanced natural regeneration of tree, shrub and bushes also that transformed a water logged (stagnant water of 20 cm to 1 m) area into productive land. Water logging has receded up to 1.25 cm soil depth within a period of four years.

Project 3: Effect of fertilizer application on growth and yield of ten years old *Salvadora persica* and *Acacia ampliceps* plantation on arid salt affected soil [AFRI-89/NWFPD/2008-11]

Status: Initial growth data and seed yield recorded for *A. ampliceps*. Unfavorable weather conditions (high temp., strong winds and untimely rain) almost destroyed the fruit/seed seed yield in *S. persica*. For *S. persica*, the treatmentwise initial mean height and crown diameter was ranging from 163-194 cm and 173- 203 cm respectively. For *A. ampliceps*, these values were 172-238 cm and 137-223 cm. Rooted slips of Karnal grass were obtained from RRS, (CSSRI, Karnal) Lucknow and Grass slips of Karnal grass and *Sporobolus diander* planted in field with *A. ampliceps*.

Initial soil pH, EC and percent SOC was determined. Percent SOC data ranged from 0.10-0.15, 0.09-0.12 and 0.02-0.12% in 0-25 cm, 25-50 and 50-75 cm soil layer inside the plant pit. While it was 0.18-0.34, 0.14-0.20 and 0.18-0.25% in inter row spaces in *S. persica*. Percent SOC ranged from 0.25-0.42, 0.34-0.46 and 0.24-0.33 in 0-25 cm, 25-50 and 50-75 cm soil layer inside the plant pit and it was 0.24-0.36, 0.29-0.30 and 0.19-0.30 percent in inter row spaces

in *A. ampliceps*. Soil samples for *A. ampliceps* and *S. persica* plants were analysed for micronutrient status.

Treatmentwise phenological observations were recorded fortnightly from January 2009. Fruit setting has been initiated in all the treatments in *S. persica*, maximum mean fruit yield/tree (132 g) was obtained in T₇ closely followed by T₈ (urea + K₂SO₄) treatment. In case of *A. ampliceps* trees were healthy, new leaves initiation was observed, however, flowering has been aborted in most plants in the month of March 2009.

LINKAGED AND COLLABORATION

The linkage and collaboration was established with the following organizations at national level

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

PUBLICATIONS

Scientific Reports Prepared and Submitted:

1. Annual report of the project New Biocontrol opportunities for prickly acacia: exploration in India [AFRI/FPD/2008-11] prepared and submitted to AFRS, Australia.
2. Evaluation report of Management of potential insect pests and diseases of important medicinal plants grown in arid and semiarid regions submitted to Dr. Allah Noor.
3. Evaluation report of Combating Desertification Project (2002-03 to 2006-07) Phase VII Jhunjhunu Division, Rajasthan has been prepared.

CONFERENCES/MEETINGS/WORKSHOPS/SYPOSIA/EXHIBITIONS

Attended

The representatives from Arid Forest Research Institute, Jodhpur (Rajasthan) attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

1. National Seminar on Bamboo, Jodhpur from 17th to 19th March 2009.
2. National Symposium on Agroforestry Knowledge for Sustainability, Climate moderation and challenges ahead at NRC, Jhansi from 15th to 17th December 2008.
3. The Forage symposium 2009- "Emerging Trends in Forage Research and Livestock Product" held at CAZRI, RSS, Jaisalmer on 16th and 17th February 2009.
4. International Seminar on "Role of Plant Taxonomy in Biodiversity Management and human Welfare" organized at Forest Research Institute, Dehradun from 1st to 3rd December 2008.

DISTINGUISHED VISITOR

Director General ICFRE, Dehradun, Shri Jagdish Kishwan visited AFRI from 2nd to 5th July 2008. He visited the



DG, ICFRE at Tibna, Jodhpur



experimental areas of AFRI at 1357 RD in IGNP area, Mohangarh (Jaisalmer), Kumathia enclosure at Kailana and Tibna, Jodhpur district.

INITIATIVES FOR VAN VIGYAN KENDRA

Activities conducted so far

(A) Bikaner (Rajasthan): Area of 25 ha (having old plantation one side fenced with barbed wire) on National Highway-89 has been selected. One FRH, model nursery and one old building for the extension activities are available at the site. Recently, a progeny trial of Rohida (*Tecomela undulata*) over the area 3 ha (spacing 4x4, total plants 1440) has been laid out. Steps have been taken to finalize MoU which will be signed by AFRI and RFD. The farmers training and other activities will be taken up during November-December 2008. The DFO Bikaner has been made the Nodal Officer, RFD for VVK.

(B) Rajkot (Gujarat): Forest Department, Gujarat has agreed for proposed VVK at Rajkot. The MoU will be finalised soon. And thereafter, other activities will be taken up.

(C) Khanwel (Dadra & Nagar Havelli): The Forest Department of Dadara, Nagar Havelli, Daman & Diu have agreed to spare land at Khanwel (Rudana) Nursery for proposed VVK site. Soon MoU and other formalities will be taken up in this regard.

Initiatives for Demo Village

- The Demo village has been established at Harsh (Bilara) in Jodhpur District. Agroforestry trial has been laid down on the farmer's field.
- One week compulsory IFS training was organized in the Institute on "Integrated approach for sustainable development of fragile desert ecosystem" from 9th to 13th February 2009. Twenty seven participants attended the course.
- A one day Regional Workshop on 'Management of Salt Affected Soils through Afforestation' was organized at Van Chetna Kendra, Hariz, Patan, Gujarat on 25th February 2009 to present the outcome & findings of the project on afforestation and planting techniques for arid salt affected soils executed by the AFRI since 1997 in Gangani, Jodhpur which is going to be concluded in March 2009. The workshop was presided by Dr. R.L. Srivastava, Director AFRI, Dr. M.L. Sharma, PCCF, Gujarat was the Chief Guest and Sh. R.N. Tripathi was guest of honour. Sh. R.L. Meena, CF, Kutch welcome the delegates and Dr. Ranjana Arya, Organizing Secretary presented the vote of thanks.
- National Seminar on "Bamboo-Plantation, Management and Its Utilization" was conducted by Arid Forest Research Institute, Jodhpur during 17th to 19th March 2009.

