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ANNUAL REPORT

2008-2009

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

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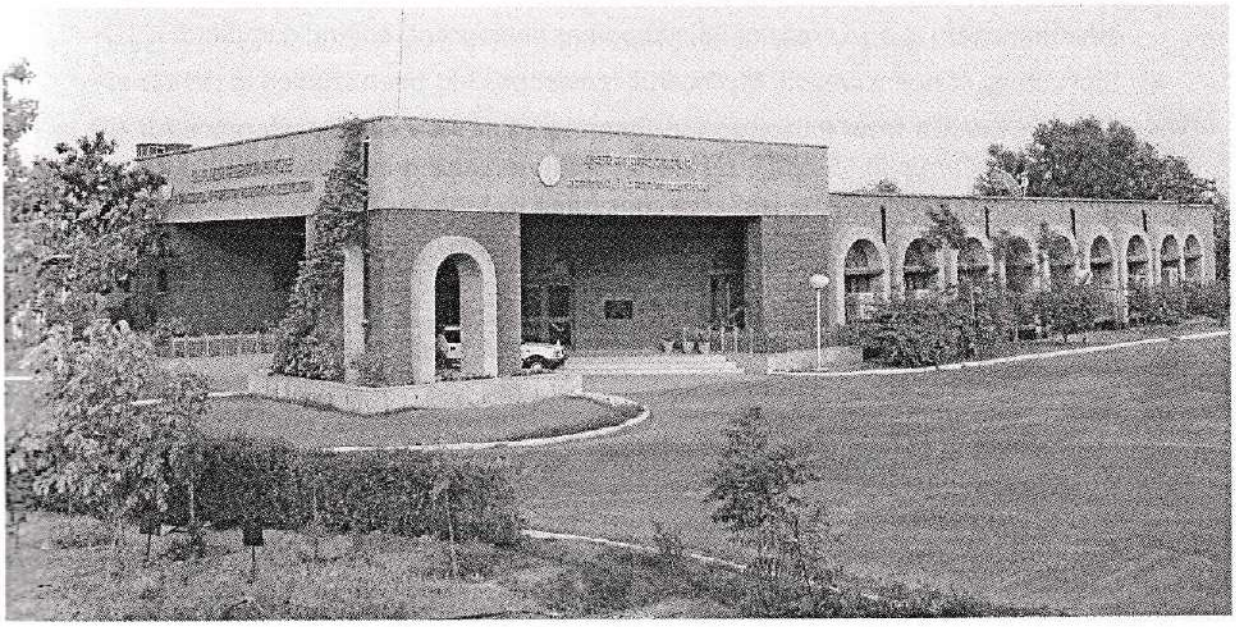
Institute – At a Glance

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

The main thrust areas of the institute are soil, water & nutrient management, technologies for afforestation of stress sites, management of plantations, growth and yield modeling, planting stock improvement, bio-fertilizers and bio-pesticides, Agroforestry, JFM & extension, phytochemistry & non-timber forest products, integrated pest & disease management and forestry education. During 2008-09, thirty three projects were executed including thirteen externally funded projects from Rajasthan Forest Department, Gujarat Forest Department, Deptt. of Bio-technology, Govt. of India, New Delhi; National Medicinal Plant Board, N. Delhi and CSIR, N.Delhi.



Significant achievements

Insect pests and disease problems of Medicinal plants:

- Severe infestation of a semilooper, *Achaea janata* (noctuidae) has been noticed on all mehndi (*Lawsonia inermis*) growing areas at Sojat road (Pali).
- 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
- Foliar spray of 0.02% of Monocrotophos in combination with Bavistin 0.1% was proved to be the most effective in controlling the problem.
- Isabgol (*Plantago ovata*) crop was found severely attacked by downy mildew disease (*Peronospora* sp.).
- The major insect pest attacking Isobgol is an aphid species (*Aphis gossypii*).
- Soil treatment (Trichoderma + Vermicompost + Phorate) was found the best amongst other three treatments wherein Mehandi yield was increased from 1.5 to 2.1 Kg per meter sq in treated plots.

Insect Pest spectrum of neem:

- A check list of 20 species of insects, 2 species of mollusk and 5 species of Mites of infesting neem in arid areas of Rajasthan has been prepared and compiled.
- Bioecology of neem weevil, *Myllocerus tenuicornis* has been studied in detail.
- The provenance from Palanpur and Jhansi exhibited the least preference for the larvae of *M. tenuicornis* (0.65 and 0.69 cm sq.) whereas the provenance from Mulag was the most favoured host as the leaf area consumed by larvae was 3.11 cm sq.
- Efficacy of Botanical pesticides has been studied against neem weevil, *Myllocerus tenuicornis*.

Khejri mortality management:

- Field experiments were conducted Nagaur (Jhareli) and Sikar (Triloki) with the following treatments viz., **T1**: RT Bavistin+*Chloropyrifos* +Agromin)+ST(AFRI Paste)+ 2/3 rd lopping; **T2:** RT (NIPROT+ Phorate + Vipul) +ST(AFRI Paste)+2/3rd Lopping; **T3:** RT (Ratan+ endosulfan) + ST (AFRI paste) +2/3rd lopping; **T4:** RT(Dithane M-45+ Chloryngrifore)+ST (AFRI paste)+2/3rd lopping; T5: Control without any treatment and no lopping.

- T-1 i.e. Root treatment (Bavistin 0.1% + Chloropyriphos 0.05 %+ Powermin @2ml/lt) with shoot treatment with AFRI paste + 2/3 tree lopped was found to be best in both the districts.
- After one year root infection reduced from 60.9 to 57.4 % whereas borer attack reduced from 57.2 to 54%.
- The average long production has been increased from 15.6 to 18.3 kg per tree after treatment on dry weight basis at Jhareli.

Mycorrhizal association in Mehndi and Ashwagandha:

- 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
- Both the species Mehndi and Ashwagandha were found highly mycorrhizal in nature.
- Raised performance trial from 24 elite accessions, Native trials from 160 accessions and spacing and pollarding trials of Jatropha curcas
- Established performance trial and agri-trial of guggal
- Established clonal trials and seedling seed orchard of *Jatropha curcas*
- Established progeny trial of 30 CPTs of *J. curcas* selected from Rajasthan and Gujarat
- Developed preliminary seed yield equation for *J. curcas* relating seed yield with crown diameter
- Seed germination studies were conducted on seeds of Acacia nilotica and A. catechu collected from various seed sources of Gujarat.

PROJECTS COMPLETED DURING 2008-2009 (PLAN)

Project 1: Assessment of International Neem Provenance Trial (AFRI-78/FGTB/ 2006-2009)

Principal investigator: Shri N. Ravi

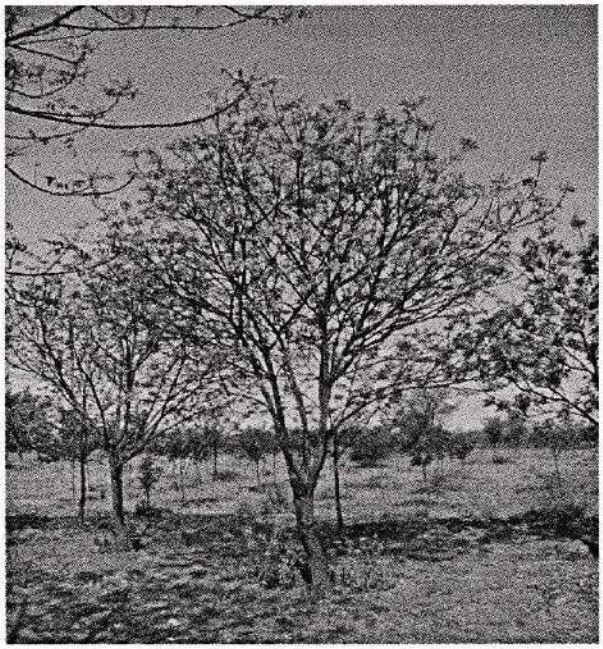
Findings:

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

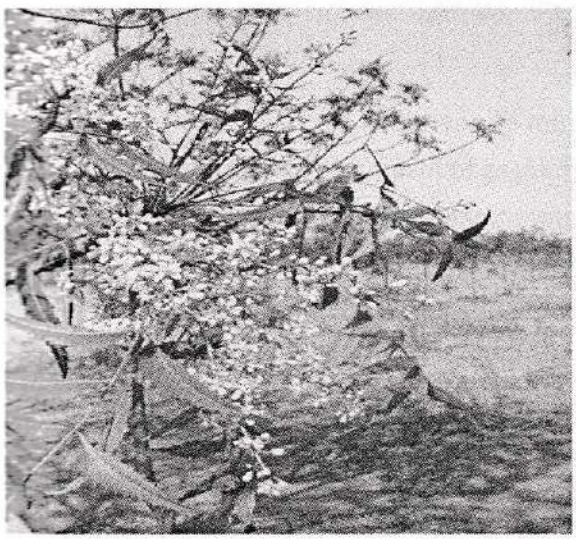
of initiation of the project, only 12 provenances were present and the other provenances were succumbed to extreme biotic factors like frost and heat. 3 of the 12 provenances are from Yezin(Myanmar), Geta, Dhangadhai(Nepal) and Chamnion (Tanzania), and the rest of the 9 provenances are from India. These provenances were assessed for their flowering behaviour, since flowering in provenances makes way for further genetic improvement programme. Growth performances of these provenances were also assessed during this project period. 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 year 2007. The mean growth of this Nepal provenance (5.37 m) was the best among all other provenancs. 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.

The introduced provenances produced flower buds alongwith the Indian provenances during the second week of March. The peak flowering was found in the month of April and May in all the provenances. There is sufficient synchronization in flowering of both 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).

The introduced provenances from different parts of India and other countries had synchronization in flowering. The variation in growth performance was due to the biotic factors. Any improvement programme in tree species can be best achieved only when the introduced provenances showed good adaptability, which results in flowering and seed production. In the present study, all the introduced provenances had synchronization in flowering and produced seeds. Hence, these provenances can be further 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)

Principal investigator: Dr. S.I.Ahmed

Findings:

Though the neem tree is endowed with spectacular pesticidal properties but it is itself infested by a number of insects and non insect pests at different stages of its growth. With the perusal and screening of the literature, it is obvious that a very few detailed account are available on the insect fauna attacking this medicinally and economically important tree species but the incidence of damage caused by insects and non insects pests and the possibilities of their management have not been known in detail. Since the host plant resistance is the result of interaction between the plant and insects. It is, therefore, assumed that optimum conditions, under which a plant species is grown, are also favorable enough for the growth and development of the insects so that the plant species is accepted by them. The concept of host plant resistance is, therefore, developed by comparing the performance of a variety under optimum conditions for the growth and development of the plant in the absence of insect population which is capable of causing maximum loss. In view of severe infestation of neem raised under provenance trial at Arid Forest Research Institute, Jodhpur, it is essential to study the insect pest spectrum and population dynamics of important insect species in detail. The project was initiated with the following objectives during July 2006.

- Survey, evaluation and identification of pest spectrum and mites and their natural enemies in neem provenance trials at AFRI.
- Population dynamics of key insect pests.
- Preparation of a check -list of pest spectrum of neem.
- Evaluation of most resistant neem provenances to insect pests and mites.
- Development of an effective bio management agency against potential insect pests and mites.

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.)
- The provenance from Mulag was found to be the most favoured or susceptible host as the leaf area consumed by larvae was 3.11 cm sq.
-

Microbial control agent of neem weevil:

- Infection of an entomopathogenic fungus, *Beauveria bassiana* has been observed in the adult population of neem weevil, *M. Tenuicorins*.

- Efforts are being made to isolate and propagate the fungus for further lab study.
- Efficacy of this entomopathogenic fungus has been studied.
- The weevil have been exposed with entomofungus in the outdoor cages of insectary

Bioecology of neem defoliator:

- A complete life cycle under different generations took an average period of 39.75 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 was is in progress. Periodical data are being collected and being analyzed.
- Seasonal variation of economic important insect pest i.e. sap suckers and defoliators has been studied
- The mortality data on pest incidence have been recorded.
- Final report is being prepared

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

Principal investigator: Smt. Seema Kumar

Findings:

Biological Diversity Day on 22nd May 2008, World Environment Day on 5th June, 2008, World Day to Combat Desertification and Drought on 17th June, 2008 and 59th Van Mahotsava on 5th July, 2008 were celebrated as day of National Importance. 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 for the endusers visiting these sites. Seeds of teak, etc. tree species growing at AFRI were collected for strengthening the seed display of interpretation centre. 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. Various schools, colleges and university students & teachers, SFS trainees and QRT members visited interpretation center. Lecture as resource persons were delivered in

various trainings for farmers and forest Field functionaries viz, 12-16th Nov., 2008 at Rajpipla, 26th to 28th February, 2009 at Rajkot, Gujarat and 16th to 18th March, 2009 Bikaner, Rajasthan . The proceedings of the workshop on Forestry Research Extension: Challenges & Strategies got published by Scientific Publishers, Jodhpur.

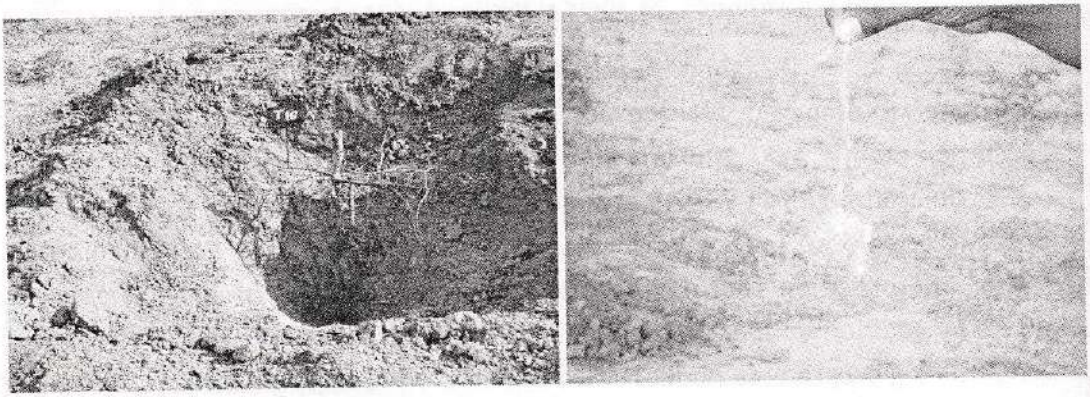
Project 4: Screening of Exotic and indigenous plant species for their performance potential on arid salt affected soils with different level of management. (AFRI-49/NWFP/1997-09).

Principal investigator: Dr. Ranjana Arya

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) *C. mopane* registered 92.0 % survival on CDM and 86.5 % in control after five year 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 Factor 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 meter.



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%).

Effect of fertilizer application on growth and yield of *Salvadora persica* and *Acacia ampliceps* plantations under silvipastoral system on arid salt affected soil.

Initial growth data recorded, seed yield recorded for *A.ampliceps*. Un-favorable weather conditions (high temp, strong winds and untimely rain almost destroyed the fruit/seed seed yield in *S. persica*. For *S. Persica* the treatment wise 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 % SOC was determined. % 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, 0.18 - 0.25 % in inter row spaces in *S. persica*. % 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, 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.

Thirteen treatments viz 1.Control; 2. FYM (10 Kg/plant); 3.FYM + Urea (500 g N) 4.FYM + $ZnSO_4$ (25 kg/ha) 5.FYM + K_2SO_4(50 g K_2O) 6.FYM + SSP (500 g P) 7.FYM + Urea + $ZnSO_4$, 8. FYM + Urea + K_2SO_4 9.FYM + Urea + SSP, 10. FYM + $ZnSO_4$ + K_2SO_4 11. FYM + $ZnSO_4$ + SSP, 12.FYM + K_2SO_4 + SSP 13. FYM + K_2SO_4 + SSP + Urea + $ZnSO_4$ were applied to *S. persica*, while ten treatments 1.Control; 2. FYM (10 Kg/plant); 3. Urea (500 g N) 4 .SSP (500 g P) 5. ZnSO4 (25kg/ha); 6. K_2SO4 (50 g K_2O) 7. FYM + Urea 8. FYM + $ZnSO_4$ 9. FYM + K_2SO_4 10. FYM + SSP were applied to *A. ampliceps* in Jan 09 with irrigation. .

Flowering was initiated in December 08. Treatment wise phenological observations were recorded fortnightly from January 09. Fruit setting has been initiated in all the treatments in *S. persica*, maximum mean fruit yield/tree (132 g) was obtained in T_7 closely followed by T_8 (urea + K_2SO_4) 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 09.

DROPPED PROJECTS

Project 1: Development of suitable models for Eco-restoration of Degraded community Lands in Thar Desert. (AFRI-74/Silvi/ 2006-10).

Principal Investigator: Pravin H. Chawhann

Status:

Project was initiated at village Ostra, district Jodhpur over community land in 2007 but due to resistance of local people, work was stopped. Efforts were made to locate alternate site at village Salawas, Jodhpur district and Gram Panchayat was requested for granting no objection but nothing could be sorted out.

The RPC 2009 dropped this Project.

Project 2: Field efficacy of control measures for the management of khejri mortality in North-Western Districts of Rajasthan. (Approved, RAG- 2006/ Submitted RPC-2007) (AFRI-8/FPD/2006-09)

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

Status:

Pests and diseases are causing large-scale damage in natural and traditional agro forestry plantations of *Prosopis cineraria.* Systematic work was undertaken on this aspect during 2006 in AFRI. However, field efficacy of recommended chemicals is yet to be tested. Severe mortality of khejri trees has been recorded in north-western districts of Rajasthan. Heavy infestations of four species of insect borers *viz., Derolus iranensis, Aeolesthes holoserecea, Acanthophorus serraticornis* and *Hypoeschrus indicus* (Coleoptera: Cerambycidae), and five highly infective species of *Fungi imperfacti viz., Alternaria alternata, Colletotrichum sp., Ganoderma lucidum, Phoma* sp., *Botryodiplodia* sp., cause the die-back diseases in mature trees as a result of which the infected trees start drying from the top.

These biotic factors contribute as one of the potential causes for the large scale drying and mortality of Khejri trees Rajasthan. Recommendations for control measure based on the results obtained out of a field trial on this problem have been communicated to all the concerned agencies and state government. The extensive surveys on the Khejri mortality have been conducted in four north- western districts of Rajasthan and the observations on various biotic and abiotic aspects have been collected. Data on the biotic and abiotic have been analyzed in

order of evolving possibilities of finding out the responsible causes for the mass scale mortality of *Prosopis cineraria*. The objectives of the project are:

- To work out the field efficacy of prior tested chemical combinations to check the Khejri mortality.
- To develop effective strategies for large scale Khejri mortality.
- To asses the production before and after the treatments to obtain maximum production/ yield from Khejri trees.
- To disseminate the knowledge to the end users.

Findings:

A collaborative field experiment on management of khejri mortality was laid out at Jhareli (Nagaur). The experiment was laid at in Randomized Block Design (RBD) with five treatments viz., T1: RT (Bavistin+Chloropyriphos+Agromin)+ST(AFRI paste)+2/3 rd lopping;T2: RT (NIPROT+ Phorate + Vipul) +ST(AFRI Paste)+2/3 rd Lopping; T3: RT (Ratan+ endosulfan) + ST (AFRI paste) +2/3rd lopping;T4: RT(Dithane M-45+ Chloryngrifore)+ST (AFRI paste)+2/3rd lopping; T5: Control without any treatment and no lopping. The result showed that ,T-1 i.e. Root treatment (Bavistin 0.1% + Chloropyriphos 0.05 %+ Powermin @2ml/lt) with shoot treatment with AFRI paste + ½ tree lopped was found as compare to other treatments. After one year root infection reduced from 60.9 to 57.4 % whereas borer attack reduced from 37.05 to 12.22 percent. The average loong production has been increased from 11.08 to 13.32 kg on dry weight basis.The treated tree showed remarkable improvement in growth after treatment. No new tree mortality has been recorded.

- The fruiting bodies of *Ganoderma* were noticed in infected khejri trees. Heart rot disease in khejri (*P. cineraria*) was recorded Triloki - Sikar road. The Fruiting bodies of *Fomes* were collected for identification.

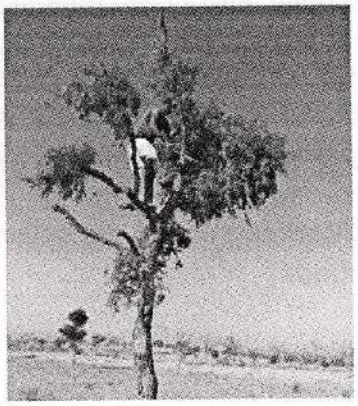
Table-1: Effect of treatment on loong weight, % of infestation of pest & disease and defoliation (Before and after treatment) after one year

S.No	Treatments	Before Treatment				After Treatment			
		Loong wt (in Kg)	% infestation (Pest)	% infestation (defoliation)	% infestation (disease)	Loong wt. (in Kg)	% infestation (Pest)	% infestation (Defoliation)	% infestat (Disea
1.	T1:RT Bavistin+Chloropyripho s +Agromin)+ST(AFRI P	11.08	38.22	31.85	37.05	13.32	11.03	10.74	12.2
2.	T2: RT (NIPROT+ Phorate+Vipul) ST(AFRI Paste)+2/3rd Lopping.	11.37	30.11	23.81	27.62	11.42	20.09	23.18	23.5

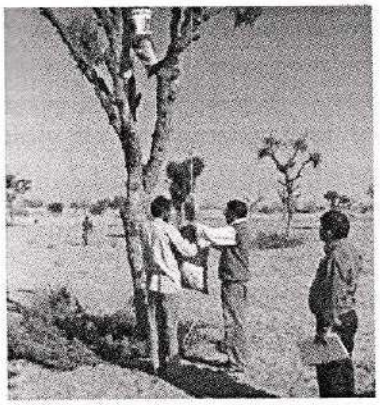
Treatments	Before Treatment				After Treatment			
	Loong wt (in Kg)	% infestation (Pest)	% infestation (defoliation)	% infestation (disease)	Loong wt. (in Kg)	% infestation (Pest)	% infestation (Defoliation)	% infestation (Disease)
T3: RT (Ratan+ endosulfan) + ST (AFRI paste) +2/3rd lopping;	10.72	32.29	31.37	32.81	12.68	29.48	27.11	28.92
T4: RT(Dithane M-45+ Chloryngrifore)+ST (AFRI paste)+2/3rd lopping	11.52	35.96	32.55	36.70	12.80	28.00	27.70	28.44
T5: Control without any treatment and no lopping	10.56	36.77	37.00	39.07	10.58	34.70	32.03	33.33

Experimental trial laid out in Jhareli, in Nagaur District to test the field efficacy of chemicals against the insect pests and diseases

Shoot Treatment with AFRI paste at Jhareli



Harvesting of Loong of Khejri



Loong weight of Khejri

Treated Shoot of the tree

PROJECTS CONTINUED DURING 2008-2009 (PLAN)

Project 1:Development of economically viable and integrated Agroforestry models for arid region (AFRI-55/Silvi/2003-09)

Principal Investigator: Dr. Bilas Singh

Status:

Agroforestry model being maintained at farmer's field at village Harsh, Bilara. Survival, growth and crop production data were recorded and compiled. Performance of *Ziziphus mauritiana* (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)

Principal Investigator: Dr. V.P. Tewari

Status:

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

Project 3: Survey, selection, performance trial and estimation of yield potential of *Jatropha curcas* in Rajasthan and Gujarat. (AFRI/JU/SILV/2006-07 RPC 25-26th Feb. 2007, 2007-12)

Principal Investigators: Dr. V.P. Tewari & Dr. D.K. Mishra

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 5.7cm to 13.2cm, respectively. Observation on the seed yield was also taken

which varied from 4.6gm to 189gm. 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 and 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 was 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 taken and analyzed. Initial plant mean height (28-70.60cm), mean number of branches (1.0-2.40) and collar diameter (0.80-2.20cm) were observed at AFRI, Jodhpur and 37-52.3cm, 1.0-1.20 and 1.30-1.76cm 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/SILV/2006-07 RPC 25-26th Feb. 2007).

Principal Investigator: Dr. D.K. Mishra

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 collected in previous quarter 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 30% 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. Report prepared and submitted.

Project 5: Characterization and classification of forest soils of Rajasthan. (AFRI-85/FED/2007-2012)

Principal Investigatosr: N. Bala

Status:

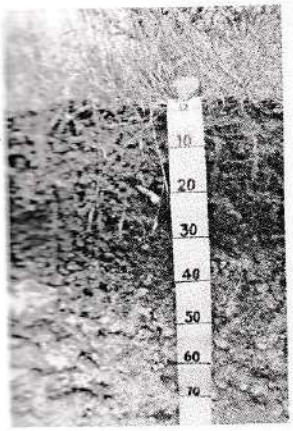
The project has been initiated in September 2007 with the objective to characterize and classify the forest soils of Rajasthan following the USDA classification system. Soil profiles have been studied at 55 places in Jodhpur, Banswara, Pratapgarh, Dungarpur and Pali districts covering 25 vegetation/forest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

Physico-chemical characterization of the soils has been done in the field as well as in laboratory. Soil structure, consistency, colour, pH, electrical conductivity, organic carbon, NO^-_3 N and NH_4–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.

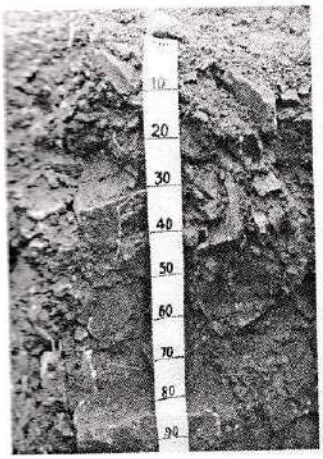
In general forest soils are found to be very shallow to shallow as most of the forests are located on hilly terrain. Presence of calcium carbonate layer at shallow depth was observed in grassland soils. Deep soils are present along narrow strip of valley.

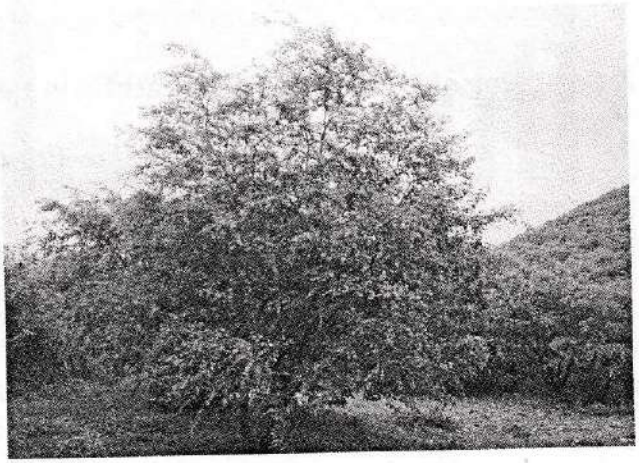
Soils on the hilly area of Banswara, Pali, Dungarpur and Pratapgarh are neutral to acidic in nature with low electrical conductivity whereas, on grasslands in Pali and Jodhpur district they are basic with high electrical conductivity.

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

Project 6: Genetic Improvement of Tecomella undulata. (AFRI-33/FGTB-7/(2002- 2009)

Principal investigator: CJSK Emmanuel

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-8/2002-2009)

Principal investigator: CJSK Emmanuel

Status:

The progeny trial of neem established in Govinpura, 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.

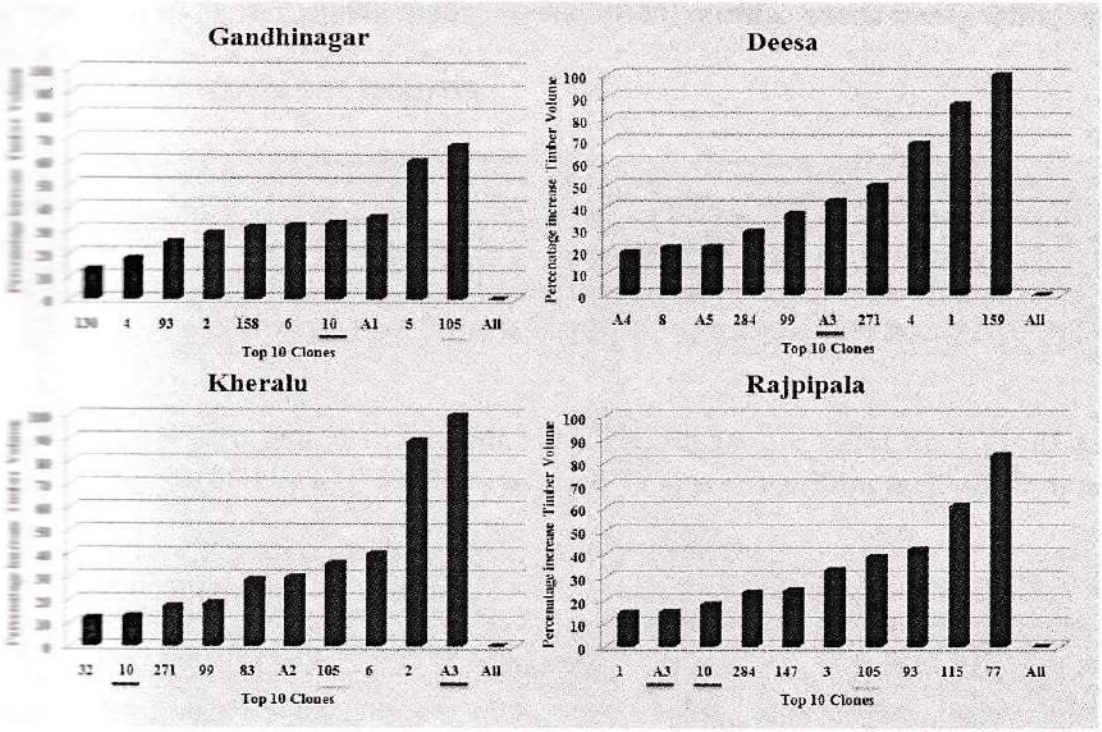
Project 8: Multilocational trial of *E. camaldulensis and D.Sissoo* clones in Gujarat state. (AFRI-41/FGTB/2002-09)

Principal investigator: Dr. U.K.Tomer

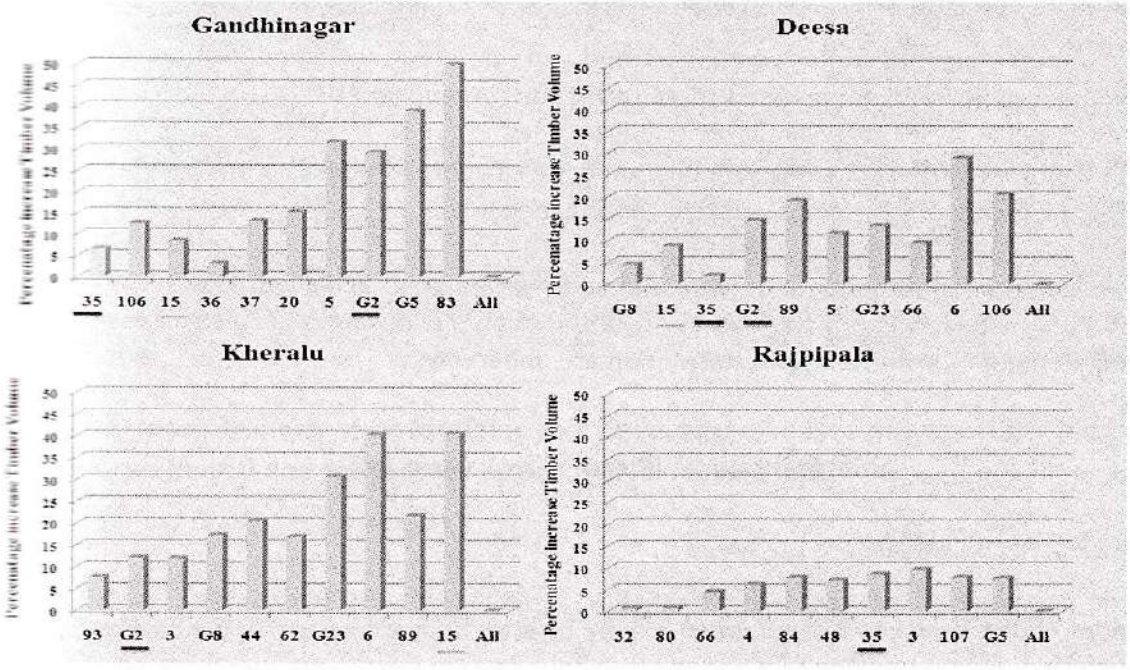
Status:

Analysis of variance reveled 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 *Eucalaptus 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 *Eucalaptus 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 (Plate 1). Similarly *D. sisso* clone Nos. A3, 10 and 105 were found suitable in all the four test sites (Plate 2).

Graph 1: Top ten clones showing higher percentage of increase over average of all *E. camaldulensis* clones



Graph 2: Top ten clones showing higher percentage of increase over average of all *D. sissoo* clones



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

Principal investigator: Dr. U.K.Tomer

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/2007-2010)

Principal Investigator: Dr. Tarun Kant

Status:

Embryogenic callus cultures have been obtained. Embryogenic callus cultures were multiplied further by repeated subculturings. Part of the embryogenic callus cultures with somatic embryo formation zones was diverted to SE germination medium where somatic embryo germination has been achieved.

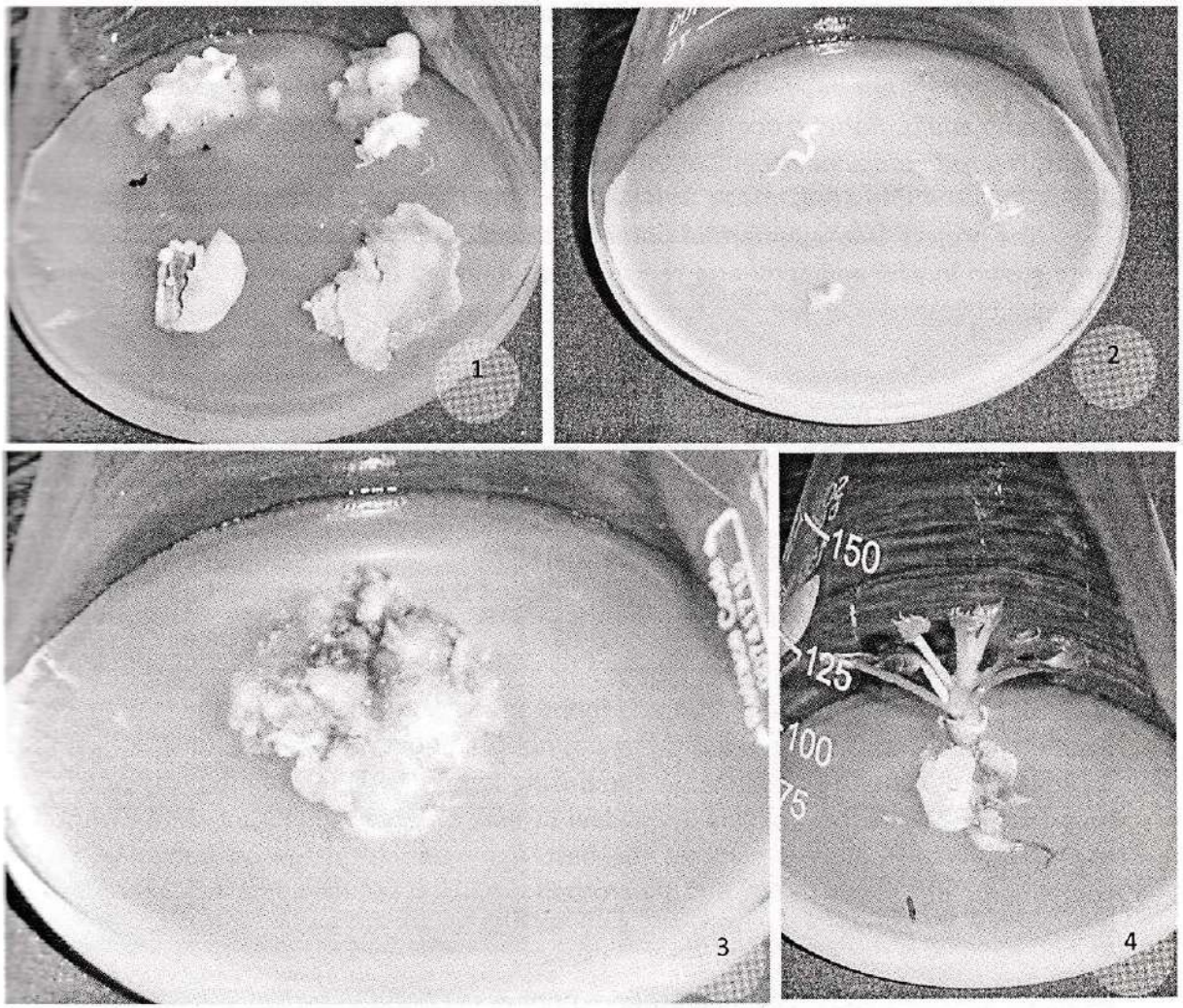
Apical bud explants when cultured on different combination of BAP & IAA supplemented MS medium resulted shoot formation (organogenesis)

Cultures with bud break response and shoot morphohenesis were further multiplied and the microshoots were transferred to rooting media.

Rooting experiments underway and rooting has been achieved. However problem of callus along with rooting at the basal end of the shoots is posing a problem. Experiments on rooting without intermittent callus formation are underway.

Photoplate: (Please refer to next page)

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



Project 11: Management of potential insect pests and diseases of important medicinal plants grown in arid and semi-arid regions. (AFRI-72/FPD/2006-09)

Principal investigator: Dr. S.I.Ahmed

Status:

Pests and diseases cause moderate to severe losses in cultivation of some important medicinal plant species. No systematic account of work done on this aspect has been cited in the literature. However, some scattered information is available on this aspect from India and

abroad. The output of the proposed studies will provide guidelines to medicinal plant growers and other user agencies

In spite of adverse climatic conditions and high biotic pressure, the Indian arid region supports a large number of plant species including medicinal and aromatic of which a few are endemic, threatened and rare in the arid desert (Singh, 1985; Bhandari and Shringhi, 1987; Mertia, 1990). Indiscriminate use of natural resources for various developmental activities in the desert ecosystem has led to the loss of many endemic plants like *Commiphora wightii, Carallumma edulis, Barleria acnthoides, Tephrosis falciformis, Dipcadi reythraeum, Glossonema varians, Neurada procumbens* etc. of this region.

The project "Management of potential insect pests and diseases of important medicinal plants grown in arid and semi-arid regions" was initiated during July 2006 with the following major objectives:

- Collection, preservation and identification of insect pests and diseases and their natural enemies.
- Preparation of a check-list of pest and disease spectrum and natural enemies.
- To work out the field efficacy of natural enemies, biopesticides and conventional insecticides, fungicides against potential insect pest and diseases.

Findings:

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 *Peronospora* sp. The treatment-8 comprising Ratan (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 30% to 3.5% after the treatment.

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

- The life cycle of *Achaea janata,* defoliator of mehndi crop has been completed.
- In Mehandi crop incidence of a 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.

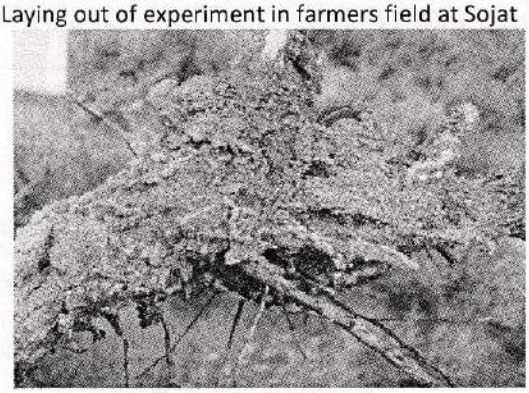
A field experiment was laid out on Mehndi for the managment of economic important pest (semi-looper larvae) and charcoal root rot /leaf spot/blight disease. The experiment was laid out in randomized Block Design and four treatments by using biopesticides viz., T-1: Soil treatment (Trichoderma + Vermicompost + 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 meter sq in treated plots.

Plate –II: Field experimental site at Sehwaj (Sojat) against protection of Mehndi defoliator, leaf spot & root rot disease infestation (August, 2008)

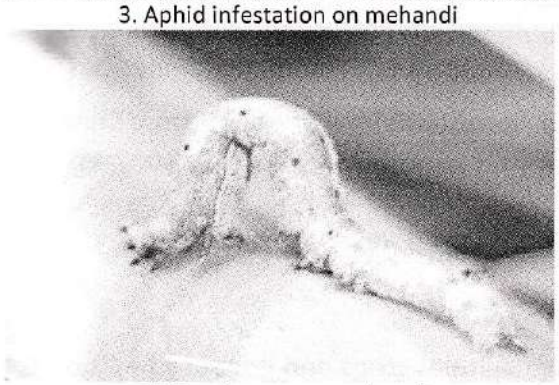
1. Laying out of experiment in farmers field at Sojat

2. Laying out of experiment in farmers field at Sojat

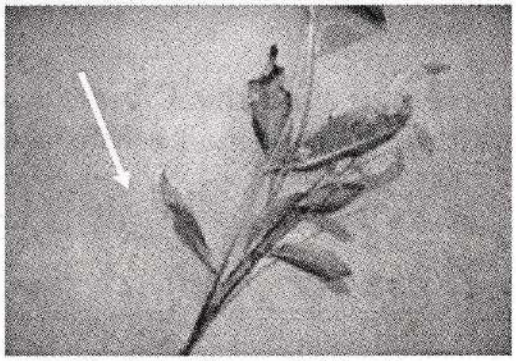
3. Aphid infestation on mehandi



4. Root rot of Mehandi



5. Semilooper on mehandi



6. Leaf spot disease of Mehandi (C.O. *Alternaria sps.)*

Table 2: Effect of treatment on yield of Mehndi crop (Dry weight and cost after treatment)

Replication Treatment	R-I		R-II		R-III		Mean	
	Dry wt. (Kg)	Cost (Rs.)	Dry wt. (Kg)	Cost (Rs.)	Dry wt. (Kg)	Cost (Rs.)	Dry wt. (Kg)	Cost (Rs.)
T-1	2.5	62	2.6	65	2.8.	70	**2.63**	**65.6**
T-2	2.0	50	2.2	55	2.1	52.5	**2.1**	**52.5**
T-3	2.2	55	2.4	60	2.2	55	**2.27**	**56.6**
T-4 (control)	2.0	50	1.9	47.5	2.0	50	**1.97**	**49.17**

Table 3: Dry weight and cost of Mehndi leaves after treatment)

Treatments (Mean)	Dry wt.	Cost
Treated	**2.33**	**59.9**
Untreated	**1.97**	**49.17**

Project 12: Mycorrhizal Dependency and productivity of economic important medicinal plants (Mehndi & Ashwagandha) of arid zones. (AFRI-84/FP/2007-2010)

Principal investigator: Dr. K.K.Srivastava

Status:

VAM occurs in all types of horticultural, agricultural crops and grasses in nature. Lot of research work has been carried out in India and abroad. Gupta *et al.* (2001) studied the effect

eatment)

	Cost (Rs.)
	65.6
	52.5
	56.6
	49.17

mic important
2007-2010)

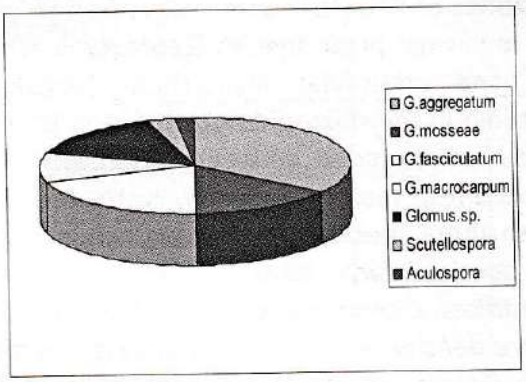
K.K.Srivastava

in nature. Lot of
tudied the effect

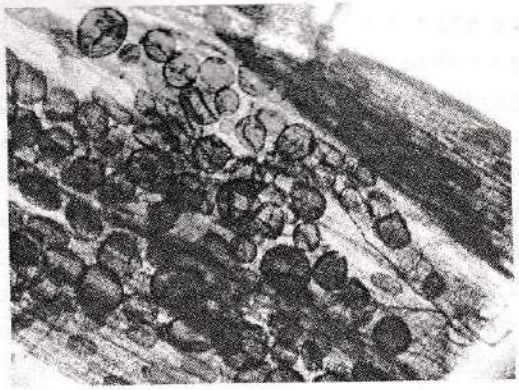
of the vesicular–arbuscular mycorrhizal (VAM) fungus *Glomus fasciculatum* on the essential oil yield related characters and nutrient acquisition in the crops of different cultivars of menthol mint (*Mentha arvensis)* under field conditions. Panwar and Tarafdar (2006) has been conducted a field study of 12 districts of arid zones of Rajasthan was undertaken to evaluate the occurrence of three selected endangered medicinal plant species (*Leptadenia reticulata, Mitragyna parvifolia, Withania coagulans*), and arbuscular mycorrhizal fungal (AMF) associations with them. Five genera were identified in the rhizosphere of these selected plant species. A high diversity of AMF was observed which varied between different host plant species. Among the five genera, *Glomus* occurred most frequently, with ten species, *Acaulospora* and *Scutellospora* were found with three species, respectively, while *Gigaspora* and *Paraglomus* were detected with one species each. *Glomus constrictum, Glomus fasciculatum, Glomus geosporum, Glomus intraradices, Glomus mosseae* and *Glomus rubiforme* were the most dominant species. The AMF spore density was not clearly affected by the host plant suggesting that biotic factors may be relatively less important than abiotic/edaphic factors for establishing population pattern. The spore density of AMF had a strong positive correlation with soil pH and organic carbon content and a negative correlation with Olsen's P content of the soil. The association with AMF of these plant species native to the harsh environmental conditions of the Indian Thar Desert may play a significant role in the re-establishment and conservation of these multipurpose medicinal plants species like, Mehndi and Ashwagandha. In view of these facts, A research project entitled "**Mycorrhizal Dependency & Productivity Of Economic Important Medicinal Plants (Mehndi & Ashwagandha) Of Arid Zones."** has been Approved, RAG- 2007/ and RPC-2008 at ICFRE for a period of three years (2007-2010) with a total outlay of Rs. 2.00 Lacs. As per the memorandum of understanding the project has been initiated with the following objectives:

- Isolation & Identification of AM fungi associated with Mehndi and Ashwagandha
- Maintenance of pure cultures of indigenous and non-indigenous strains of Biofertilizers
- Mass production of AM fungi/other biofertilizers
- Inoculation in nursery
- Demonstration trials of medicinal plants on VAM / Other Biofertilizer
- Interaction studies of AM fungi with (phosphorus solubilizing bacteria) PSBs in nursery and evaluation for best performance
- Estimation of nutrient uptake
- Mass production of fortified seedlings for planting in different areas
- Nursery and Field experiments
- Training to SFDs, NGOs & progressive farmers

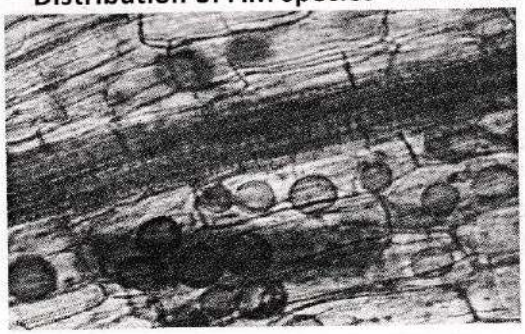
Plate- III: Distribution and root infection of VAM fungi



Distribution of AM species in Mehndi

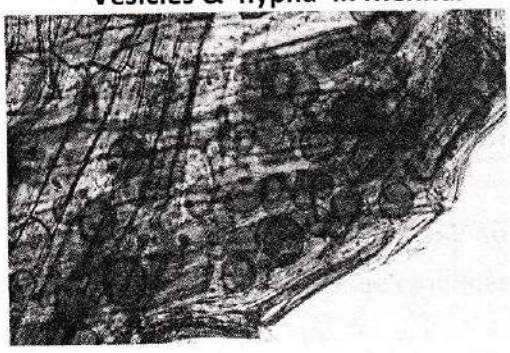


Vesicles and intercellular hypha (Mehndi)



Vesicles & hypha in Mehndi

Extrametrical hypha with mature spore



Vesicles in Ashwagandha

VAM inoculation expt. in Mehndi

Findings:

- 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 percent. Initial observations have been taken.

Project 13: Development of web portal for forestry research extension. (AFRI-II.2/ITCELL/2007-2011)

Principal Investigator: Sh.A.K.Sinha

Status:

Project Activities

The project activities of the project during the year 2008-2009 comprised of the following activities

- Purchase of softwares.
- Training in web database development and web designing.
- Selection of fields of the database and creation of the database after normalization.
- Collection of information and entry into the database.
- Initiation of Development of the website.
- Scripting for the integration of website with the database.

Significant Achievements:

In the follow-up action of the Activity No. 1, 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.

ha (Mehndi)

nature spore

in Mehndi

d Seven species
acrocarpum G.
ied.

In follow-up of the Activity No. 2 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.

According to the Activity No. 3, 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 the 50 important Tree Species has been started according to the fields finalized and fed into the excel sheet for further entry into the database.
Activity No. 5 and 6 can only be started once the training on "Web Programming gets completed" which is undergoing.

Extension Activities

Establishment of Van Vigyan Kendra

Extension Officer- Sh. M. R. Baloch, CF & HOD, AFED

IC (I) Smt Bhawana Sharma, Scientist- B, for VVK Rajasthan

(II) Dr. Bilas Singh, RO, for VVK Gujarat and Dadra & Nagar Haveli

MOU signed AFRI and RFD on 18 March 2009 at VVK, Bichhwal, Bikaner, Rajasthan. Training – 3 days training organized for farmers and field functionaries under VVK from16-18 March 2009 at Bikaner and 42 farmers and forest field functionaries participated in the training. Extension/Display Material like photographs, display boards, printed material in Hindi & English displayed at VVK Bikaner. The Progeny trial of *T. undulata* (2.3 hec, 1440 nos of seedlings) has been planted at the site for demonstration. MOU signed by AFRI and GFD on 26 Feb. 2009. at VVK, Chhipardi Beedi, Rajkot, Gujarat. Traning -3 days training organized for farmers and field functionaries under VVK from 26-28 Feb.2009 at Rajkot and 36 farmers and forest field functionaries participated in the training. Extension/Display Material like photographs, display boards, printed material in Gujarati/English displayed at VVK Rajkot. SFD, Dadra & Nagar Haveli 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 Haveli.

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

PI-Sh. P. H. Chawhaan, Sc-E & Dr. Bilas Singh, RO

Two demo village plantation sites on farmer's field namely Mrs. Sita Chaudhary, Bijwadia and Mr. Rajendra Singh Chaudhary, Harsh were maintained. Mortality replaced. Growth data recorded six monthly. Crop production estimated on both site. *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).

NEW PROJECTS INITIATED DURING 2008-2009

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).

Principal Investigator: Dr. G. Singh

Status:

Experiment was started in July 2005 by financial assistance of 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. Plant growth, soil nutrients, soil water content and vegetation diversity and productivity were recorded in 2008.

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 *Dendrcalamus strictus* and *Acacia catechu* showed lowest growth in 10-20% slope area. Growth of *Dendocalamus strictus*, *Azadirachta indica* and *Zizyphus 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, Syzigium comini, Zizyphus mauritiana*. In some of the cases the difference is about 2-fold.

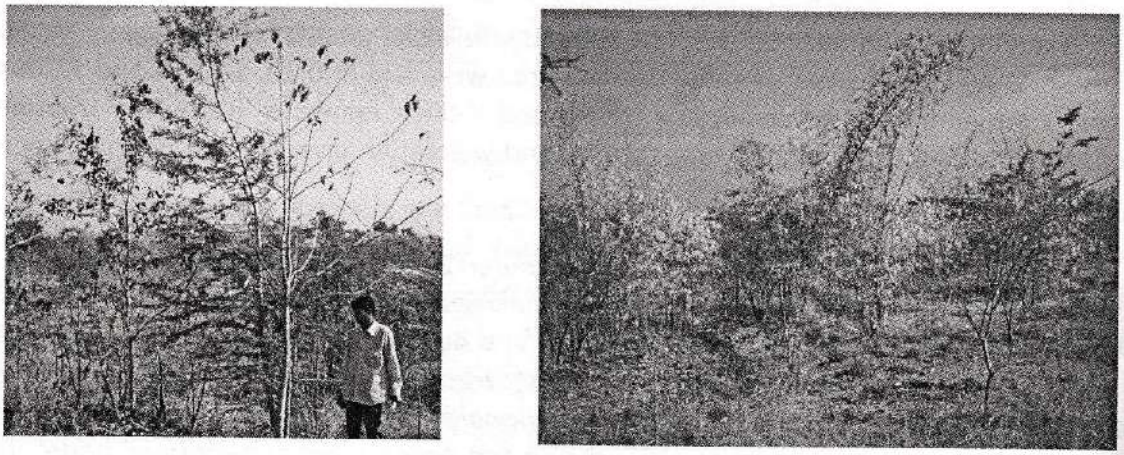
Soil water content increased downward but soil organic carbon (SOC), NH_4-N and NO_3-N were highest at mid position in a plot. Soil water content and soil organic carbon were highest in <10%, whereas NO_3-N and NH_4-N concentrations were highest in >20% slopes. In RWH treated area, SOC and PO_4-P were highest in CT plots; SWC and NO_3-N were highest in G plots,

whereas NH_4-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 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 478.5g m^{-2} in 10-20% to 439.2 g m^{-2} in <10% slope. Among the treatment, dry mater 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 gm^{-2}) area of the site.



Plant growth at Banswara site. *A. catechu* in fruiting, *A. leucophloea* and *G. arborea* (left) and *D. strictus* & *E. officinalis* (right photo)

Quinquintial Review team on inspection of experimental area, Gauapada, Banswara.

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

Principal Investigator: Dr. G. Singh

Status:

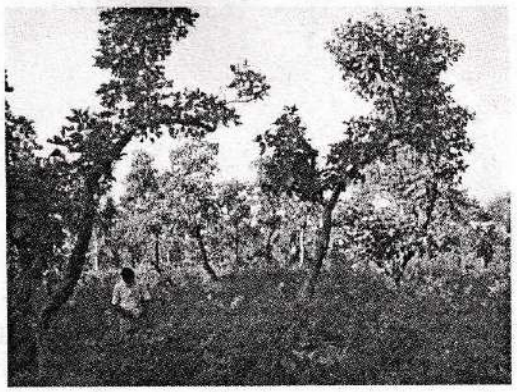
Project was started after approval from the RPC in April 2008. The objective of the project were (i) to estimate carbon stock in forest soils, (ii) to estimate carbon stock in forest litters, and to estimate carbon stock in aboveground and below ground biomass; with broader objective 'to provide an estimate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

In the project 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.

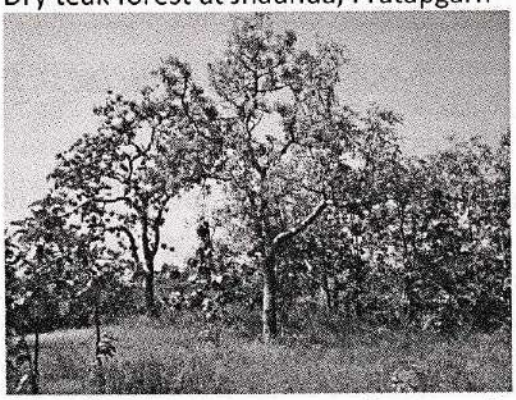
Studies at five different forest blocks of Pratapgarh with *Dendrocalamus strictus* as one species showed a total number of 35 trees/shrub species. In this population of trees/shrubs varied from 770 at Arampura to 3280 plants per ha at Jhaunda. Numbers of species were highest in Arampura, whereas it 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 1 ha area in respective aspect.

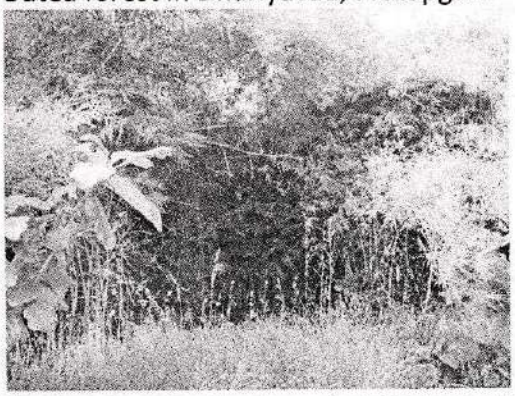
Dry teak forest at Jhaunda, Pratapgarh



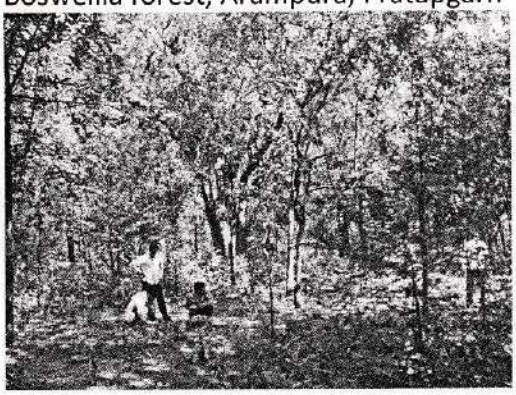
Butea forest in Dhariyavad, Pratapgarh



Boswellia forest, Arampura, Pratapgarh



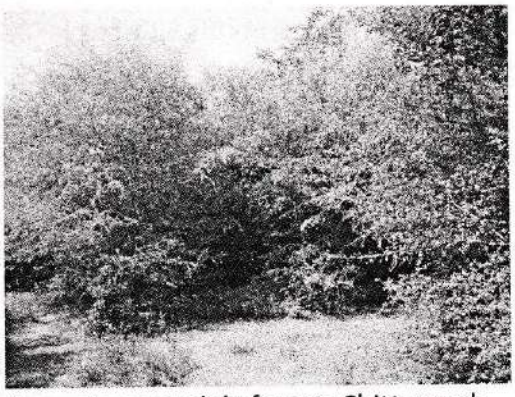
Dry bamboo brake, Umarkot, Pratapgarh



Madhuca forest, Siyakhedi, Pratapgarh

Aegle forest, Samlipathar, Chittorgarh

Phoenix savanna, Karaundia, Chittorgarh



Anogeisus pendula forest, Chittorgarh

Technology developed

Technology developed for reclamation/rehabilitation of waterlogged soil in canal command area of IGNP using principle of bio-drainage. 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 waterlogged (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 year.

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

Principal Investigator: Dr. R.Arya

Initial growth data recorded, seed yield recorded for *A.ampliceps*. Un-favorable weather conditions (high temp, strong winds and untimely rain almost destroyed the fruit/seed seed yield in *S. persica*. For *S. Persica* the treatment wise 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 % SOC was determined. % 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, 0.18 - 0.25 % in inter row spaces in *S. persica*. % 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, 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.

Thirteen treatments viz 1.Control; 2. FYM (10 Kg/plant); 3.FYM + Urea (500 g N) 4.FYM + $ZnSO_4$ (25 kg/ha) 5.FYM + K_2SO_4(50 g K_2O) 6.FYM + SSP (500 g P) 7.FYM + Urea + $ZnSO_4$, 8. FYM + Urea + K_2SO_4 9.FYM + Urea + SSP, 10. FYM + $ZnSO_4$ + K_2SO_4 11. FYM + $ZnSO_4$ + SSP, 12.FYM + K_2SO_4 + SSP 13. FYM + K_2SO_4 + SSP + Urea + $ZnSO_4$ were applied to *S. persica*, while ten treatments 1.Control; 2. FYM (10 Kg/plant); 3. Urea (500 g N) 4 .SSP (500 g P) 5. ZnSO4 (25kg/ha); 6. K_2SO4 (50 g K_2O) 7. FYM + Urea 8. FYM + $ZnSO_4$ 9. FYM + K_2SO_4 10. FYM + SSP were applied to *A. ampliceps* in Jan 09 with irrigation. .

Flowering was initiated in December 08. Treatment wise phenological observations were recorded fortnightly from January 09. Fruit setting has been initiated in all the treatments in *S. persica*, maximum mean fruit yield/tree (132 g) was obtained in T_7 closely followed by T_8 (urea + K_2SO_4) 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 09.

PORJECTS COMPLETED DURING 2008-2009

(Externally Aided)

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/2006-2009)

Principal Investigator: Dr. R.L.Srivastava
CO PI.: Dr. Sunil Kumar

Findings:

Plants of some species like *A. indica* (neem)*Cordia myxa* (gunda), *Ziziphus jujuba* (ber), *P. cineraria* (khejeri), *T. undulata* (rohida) *Moringa oleifera* (sahjan), *Caraissa carandas* (karoda), *Commiphora wightii* (guggal) were raised at AFRI Nursery.

Plants of some medicinal plant species like Aloe vera, Brahmi, Ashwagandha etc were procured from outside sources

- *Aloe vera* – S. K. N college, Rajasthan Agriculture University, Jobner (87000 nos)
- Ashwa gandha *(Withania somnifera)* seeds – 16 kg Rajasthan Agro Forestry corporation, Jodhpur.
- Brahmi *(Bacopa monnieri)* – CIMAP, Lucknow (2500 Nos)
- *Osimum sanactum*- CIMAP, Lucknow (100 grm)

- *Osimum barcilicum* - CIMAP, Lucknow (100 grm)

Two sites at Tibna and Jadan of Jodhpur and Pali districts respectively were planted & maintained by convincing and motivating farmers by timely irrigation for the enhancement of productivity . 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 myxa* (gunda), *Zizyphus jujuba* (ber), *P. cineraria* (khejeri), *T. undulata* (rohida) *Moringa oleifera* (sahjan), *Carissa carandas* (karoda), *Commiphora wightii* (guggal) were maintained at farmers fields.

Some of the farmers shown their interest to plant Aloe vera (guwarpatha), and Withania somnifera (ashwagantha). Total area planted is 5.75 ha. at village Tibna At Jadan, species *T. undulata* (rohida), *P. cineraria* (khejeri), *Cordia myxa* (gunda), *Zizyphus jujuba* (ber) , *Emblica officinalis* (aonla)*Commiphora wightii* (guggal) and Citrus (nimbu) were maintained over 1.25 ha. The mortality replacement was done at both the sites The survival percentage in the field of Sh Roop Singh was 90 % and in the field of others was 70 %. At Jadan, species T. *undulata* (rohida), *P.cineraria* (khejeri), *Cordia myxa* (gunda), *Zizyphus jujuba* (ber) , *Emblica officinalis* (aonla) *Commiphora wightii* (guggal) and Citrus (nimbu) were maintained.

At AFRI nursery, Jodhpur 420000 nos. of *Aloe vera* plants transplanted in thirty five numbers of 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 45000 seedlings. About 40,000 numbers of seedlings are being maintained in it.

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 speices Nimbu and Guggal and tree species Gunda and Khejri in Randomized Block Design. The treatment combination were

1. Nimbu 2. Guggal 3. Nimbu & Guggal 4. Gunda 5. Khejri 6. Gunda & Khejri 7. Nimbu & Gunda 8. Nimbu & Khejri 9. Guggal & Gunda 10. Guggal & Khejri.

The number of replication was three and number of trees per block was sixty. The total number of trees were 180. The plot area was 18x12m.

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/2007-2009)

Principal Investigator: Dr. V.P. Tewai

Findings:

Data regarding forestry statistics collected from Rajasthan, Gujarat and Dadra & Nagar Haveli compiled on 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 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)

Principal Investigator: Dr. G. Singh

Findings:

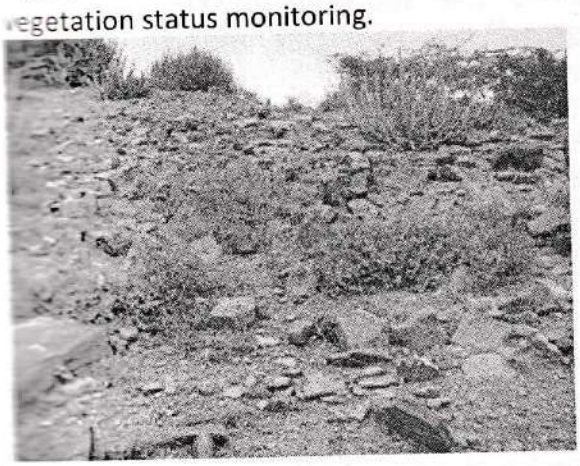
For the Second National Communication (NATCOM II) the component relating to inventory estimation of **Soil carbon from Indian Forests** has been assigned to ICFRE for (i) estimation of soil organic carbon stock in forest soil of India; and (ii) assessment of soil carbon dynamics due to land use change from forest to non-forest and *vice versa*. Arid Forest Research Institute, Jodhpur is working in Rajasthan and Gujarat with assigned task of 18 sub group types of forests. 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 sub group types identified covering 6 districts of Gujarat and 16 districts of Rajasthan. Field observations were rock outcrop, erosion status, soil depth, topography, aspect, per cent gravel area and vegetation growth. Soil samples were analyzed for soil per cent (<2 mm size), soil organic carbon and bulk density and soil carbon density calculated.

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.

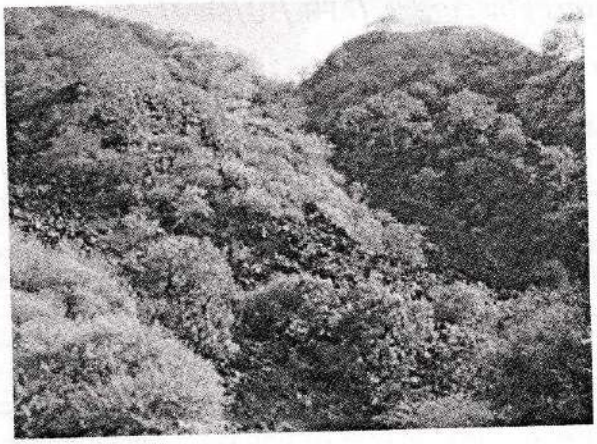
Carbon density was relatively greater in Rajasthan than in Gujarat forests. Lesser carbon density in most of the forest types than in the agriculture land indicates varying degree of degradation resulting in less carbon storage. However, **Dry tropical riverain forest**, **Dry Teak Forest**, **Northern 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.

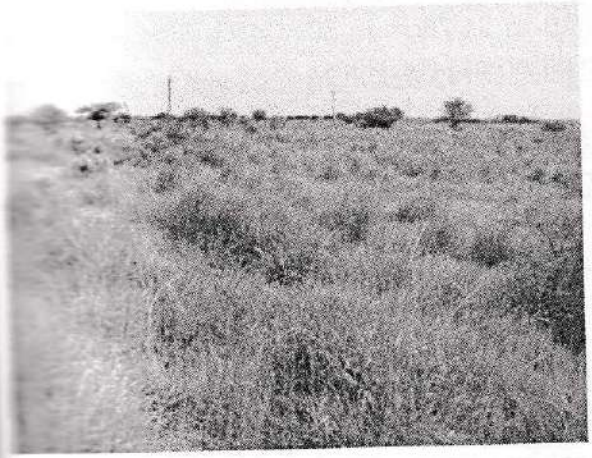
Figure 1. Some forest types in Rajasthan and Gujarat, surveyed during soil sampling and vegetation status monitoring.



Salvadora oleoides scrub at Kaladungar, Kutchh



S. urense + *M. oleifera* at Dhiondharhill, Kutchh



S. nervosum + *D. annulatum* grass, Hirasar, Rajkot

Euphorbia caducifolia scrubland at Mandor, Jodhpur

PROJECTS CONTINUED DURING 2008-2009
(Externally Aided)

Project 1: Establishment of multilocational clonal trial and seedling seed orchard of *Jatropha curcas.* (AFRI/JU/SILV/2006-07 RPC 25-26th Feb. 2007/DBT/2007-10)

Principal Investigator – Dr. D.K. Mishra

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. Table-3 showed plant survival, mean above-ground plant height, mean number of branches and mean collar diameter of accessions planted in December 2007 in the field. 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.

Table 1: Plant survival and growth parameters in accession supplied for multilocational clonal trial-I. Growth was measured in the month of December 2008

Accession No.	*IC Number*	*Percent survival*	*Mean Plant Height (cm)*	*Mean Number of Branches*	*Mean Collar Dia (cm)*
TERI/DBT-Jat/06/05-06/12	IC 551379	90	39.00	1.07	1.68
TERI/DBT-Jat/06/05-06/1	IC 555380	91	41.26	1.03	1.63
TERI/DBT-Jat/06/05-06/27	IC 555381	99	43.69	1.08	1.86
TERI/DBT-Jat/06/10	IC 555382	92	37.75	1.02	1.53
TERI/DBT-Jat/06/16	IC 555383	87	41.14	1.18	1.67
TERI/DBT/Jat/04-05	IC 468910	94	47.49	1.08	1.94
BTP-K	IC 553591	93	46.18	1.03	1.59
PDKV-DBT-3	IC 558210	95	43.45	1.04	1.71
PDKV-DBT-12	IC 558217	100	48.85	1.05	1.73
SDHQ4N1	IC 550461	98	51.78	1.12	1.89
SDHQ4N2	IC 550462	100	44.72	1.08	1.23
SDHQ4N4	IC 550463	100	51.10	1.29	1.32
CD at 5%			8.84	0.10	0.50

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 (Table 2).

Table 2: Plant survival and growth parameters in accession supplied for multi-locational clonal trial-II. Growth was measured after 3-months of planting in the field.

Accession No.	IC Number	Percent survival	Mean Plant Height (cm)	Mean Number of Branches	Mean Collar Dia (cm)
NBR-JA-9	IC- 565027	86.10	32.31	1.00	1.14
NBR-JA-126	IC- 565029	91.70	25.97	1.06	1.12
NBR-JA-139	IC- 565028	94.40	35.46	1.00	1.17
Biotech Park	IC-553591	55.50	17.38	1.12	0.98
J-C, Hisar		83.30	18.05	1.00	1.13
J-41	IC-550431	83.30	21.20	1.00	1.20
J-42	IC-550447	97.20	16.37	1.03	1.21
J-44	IC-550448	86.10	18.19	1.07	1.24
CD at 5%			7.67	0.1	0.2

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) was in TERI/DBT/JATROPHA/01/12 at Udaipur (Table 2).

Table 3: Minimum and maximum range of initial plant growth parameters of the accessions (CPTs) established in seedling seed orchard of Jatropha curcas at AFRI, Jodhpur and Haldughati, Udaipur. Growth data is after 3-months of planting in the field

Institute	No of CPTs supplied	AFRI, Jodhpur			Haldughati, Udaipur		
		Range of Mean Height (cm)	Range of Mean No. of Branches	Range of Mean Collar dia (cm)	Range of Mean Height (cm)	Range of Mean No. of Branches	Range of Mean Collar dia (cm)
CIMAP/TC, CSSRI, Hisar	4	41.0-60.0	1.2-2.20	1.39-1.83	43.33-57.7	1-1.13	1.57-2.07
IIVR, Madurai	21	32.0-59.0	1.0-1.60	1.14-1.86	34.7-44.3	1-1.07	1.4-1.91
NBRI, Lucknow	18	23.0-48.0	1.0-1.40	1.03-1.63	32.67-46.3	1-1.20	1.32-1.89

PDKV, Akola	22	23.0-59.0	1.0-1.60	1.02-2.04	32.7-47.67	1.0-1.27	1.42-1.76
FRI, DehraDun	6	40.0-58.0	1.0-1.80	1.61-2.15	31.3-45.36	1.0-1.07	1.28-1.71
Garwal University	45	33.0-58.0	1.0-2.0	1.21-2.16	33.7-45.7	1.0-1.13	1.23-1.72
Total	116						

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)

Principal Investigator: Dr. D.K. Mishra

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 (Table 1). The maximum mean height (177.0cm) was of CRIDA-JJ-06, mean number of branches (4.44) of CSMCRI-GUJ-Banas-1205-C1.

Table 1: Performance of accessions received at AFRI in 2005 and 2006 and planted in the field.

Sl. No.	*Name of the Accession*	*Mean Height (cm)*	*Mean No. Branch*	*Total Fruits (g)*	*Total Seeds (g)*	*Seeds/ Plant (g)*
1	CRIDA-JL-06	148.0	3.50	26.94	11.94	3.98
2	CRIDA-JJ-06	177.0	3.63	45.83	20.83	5.21
3	CRIDA-JR-06	162.0	3.67	220.51	110.51	27.63
4	CSMCRI-GUJ-Banas-1205-C1	146.0	4.44	16.24	6.24	6.24
5	CSMCRI-GUJ-Banas-1205-C2	143.0	3.75	19.72	9.72	4.86
6	CSMCRI-GUJ-Panch-0106-C3	157.0	3.63	163.58	93.58	18.72
7	CSMCRI-OR-Ganj-1205-C4	85.8	1.89			
8	CSMCRI-OR-Ganj-1205-C5	166.0	4.06	45.53	22.52	5.63
9	EXCEL-GUJ-BHV-0105-C-1	150.0	3.25	42.6	17.6	8.8
10	FRI-UA-Teh-1005-DD-EL-1	85.8	1.83			
11	FRI-UA-Teh-1005-DD-EL-2	134.0	3.25			
12	FRI-UA-Deh-0705-DD-EL-3	128.0	3.50			
13	FRI-UA-Deh-0805-DD-EL-4	119.0	1.75			
14	FRI-UA-Har-0805-DD-EL-5	150.0	3.54			
15	NBPGR-HAR-HAU-0306-Hisar Local	105.0	2.50			
16	NBPGR-GUJ-SKN-0605-SKNJ-2	97.8	3.15			
17	NBPGR-GUJ-SKN-0605-Hansraj	125.0	1.90	24.68	9.68	9.68
18	NBPGR-GUJ-SKN-0605-Chhatrapati	116.0	2.56	8.61	3.61	1.81
19	NBPGR-GUJ-SKN-0605-Urlikanchan	92.8	1.33			
20	NBRI - J-05	142.0	2.63	70	35	17.5

21	NBRI - J-18	155.0	2.71	17.19	7.19	3.6
22	NBPGR-GUJ-SKN-0605-SKN-Big	70.0	2.00			
23	PAPL -JPH009	159.0	3.69	155	85	28.33
24	PAPL -JPH108	93.6	2.25			

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. Table 2 showed range of percent survival, height, branches and seeds/plant in native accessions planted at AFRI, Jodhpur

Table 2: Percent survival of native accessions of *Jatropha curcas* collected from various partners Institutes and their status in the field after 24-months of planting

Partner Institutes	*Accessions Provided*	*Survival (%)*				*Height Range (cm)*	*Mean Number of Branches Range*	*Seeds/Plant (g) Range*
		Dead	33	66	100			
AFRI, Jodhpur	22	-	-	4	18	153-230	1.33-3.0	15-650.0
CSMCRI, Bhav Nagar	17	-	-	-	17	58.3-213	1.33-2.67	9.61-305.0
CRIDA, Hyderabad	20	-	-	1	19	107-208	1.33-3.0	30-310.0
FRI, Dehra Dun	35	-	-	3	32	55-230	1-3.33	17.5-310
NBPGR, New Delhi	53	-	-	7	46	50-208	1-3.33	10-550.0
NEIST, Jorhat	14	-	-	1	13	95-218	1-3.50	27-200.0
Total	161			16	145			

*123 accessions have seeding

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. The spacing was 2 x 2m, 2.5 x 2.5m, 3 x 3m and 4 x 4m. Observations on above ground height, mean number of branches and collar diameter were recorded after 18-months of planting. The mean plant height varied from 141±19.2 to 167±19.1cm, mean number of branches 3.1±0.86 to 3.7±0.62 and collar diameter from 5.32±0.23 to 6.35±0.98 after 18-months of planting in the field. 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 (I_0 = Life saving irrigation 60 days or as required, I_1 = 15 days, I_2 = 30 days, and I_3 = 45 days) and five levels of fertilizer treatments (F_0 =

no organic manure i.e. FYM, F_1 = 2 kg/pit FYM, F_2 = 5 kg/pit FYM, F_3 = Nitrogen 10g+ P 20g, K, 10g per pit, F4 = 2 kg FYM, Nitrogen 10g+ P 20g, K, 10g per pit). 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. Average height was 193.44±17.87in control and varied upto 220.21±16.49 in I_1F_0. 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±28.68cm, 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)

Principal Investigator: Dr. D.K. Mishra
Dr. Ranjana Arya,
Dr. Tarun Kant

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 08. Growth data (Height, crown diameter) was recorded in September 08. 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 (207-226cm), FI_0 (172-226 cm) and FI_2 (183-210 cm).

All the trees, where tapping was under taken in February, 08 were healthy up to August 08, even those branches did not dry where cuts were given. Gum exudation completed till 15 April 08. Casualties started in September end and total nine trees out of total 48 trees died till December 08, after ten months of gum extraction. Protection measures (application of termiticide and fungicide) were applied in January 09 and no further casualty observed after that. Casualties

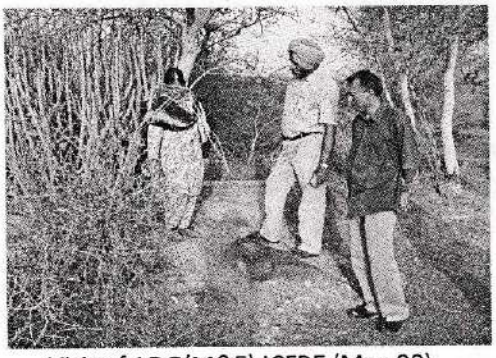
were maximum (77.78%) in C_3 (450 mg ethephone) followed by in C_2 (22.22%) treatment with or without irrigation. There was no casualty in C_1 dose (150 mg of ethephone) and control.

Phenological observations were recorded on monthly basis. Leafing occurs in 70-80 % plants in April –May due to rain but plants were completely leafless in June 08. Plants were lush green after rains in monsoon (July to September 08). Association of *Asparagus racemosus* was with all the plants. Leaf started yellowing in late October and all the plants were completely leafless in November 08. Flowering was noticed in January 09 in all the plants with leaf initiation in some plants of I_1 treatment. Fruit setting was observed in February 09.

Twigs (Pre & post ethephone treatment in 07-08) 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'08 in experimental trees as per the treatment. Treatment wise irrigation schedule (at an interval of 20 & 30 days) was imposed from November 08 to January 09. Tapping experiments were initiated, in third week of March 09. 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. Gum was collected after six days; yield is low probably due to tapping in March end. So far all the trees are healthy.

ADG, M & E, (May 08) Dr. Maiti, Dir NRC M &A plants, Anand (June 08) and DG ICFRE (July 08) visited the experimental site.



Visit of ADG(M&E),ICFRE (May 08)

Visit of DG, ICFRE (July 08)

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

Principal Investigator- N. Bala, Scientists D

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 x 2 x 2 m^3) at Jodhpur.

Among the tree species (*Eucalyptus camaldulensis*, *E. fastigata*, *E. rudis*, and *C. tessellaris*) tried in the field performance of *E. rudis* 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.

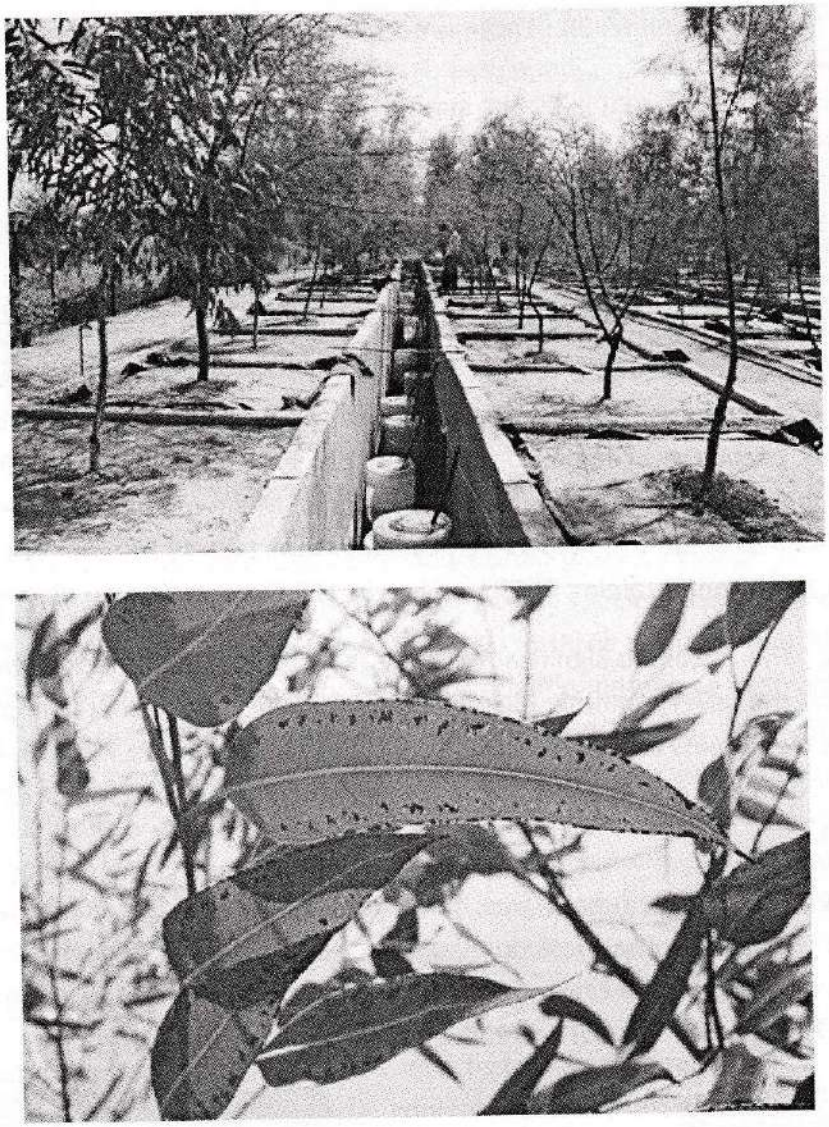
Ground water table has receded from 25 cm to 145 cm depth as recorded in the observation pit resulted by transpiration pull (biodraining) of the growing vegetation.

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-.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 l day^{-1} $tree^{-1}$ in the month of October and November however it was on a par with *A. nolotica* (29 l day^{-1} $tree^{-1}$) and *T. aphylla* (28 l day^{-1} $tree^{-1}$).



Layout and plantation of different species in lysimeter experiment (top), 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)

Principal Investigator: Dr. Ranjana Ary

Status:

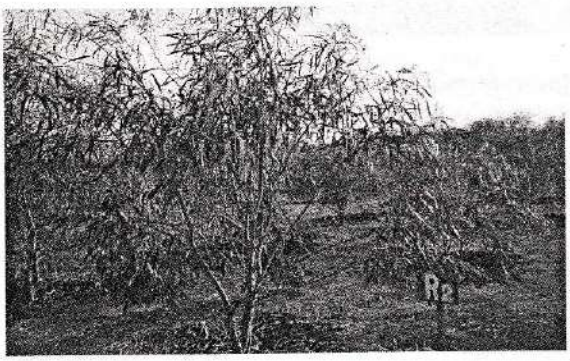
The experimental area is located in Kordha, Sami Range in Patan (23.83° N latitude 72.12°E longitude) of Gujarat, India. After 20 months, *Acacia bivenosa and A. ampliceps* recorded 86.0 and 72.6 % as mean survival and there is almost negligible change in mean

survival from Aug 08 to March 09. 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 09.

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).

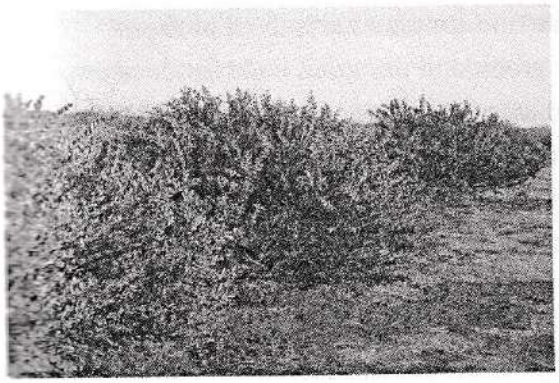
Soil properties: There was no significant change in pH values recorded between winter and summer months, however, summer EC values are significantly higher compared to winter values in all the treatments in 0-25 and 25-50 cm soil layer in plant pit for both *A. bivenosa* and *A. ampliceps.* EC values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

Weed Biomass: Green weed-mass was dominated by halophytes and other salt tolerant species. *Chloris virgata* was the most dominant species followed by *Sueada fruticosa*. Overall 431gm^2 yield was recorded however, species wise variation was observed and it was 693.0 gm^2 (*A. bivenosa*), 375.5 gm^2 (*S. persica*) and 224.1 gm^2 (*A. ampliceps*).

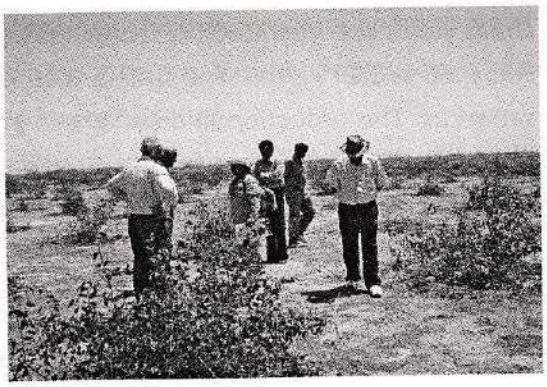


Acacia ampliceps

Pod setting



Acacia bivenosa



Salvadora persica

Eighteen months old plantation

Sub **project B**: Trials with four tree species namely *Cordia gharaf, Prosopis cineraria, Zizyphus. mauritiana* and *Colophospermum mopane* and three grass species, namely, *Cenchus ciliaris, C. Setigerus* and *Dicanthium annulatum* were laid in RBD in three replication at Mochirai, Bhuj in July 06. Experiment one with *D. annulatum* grass is abandoned due to destruction of one and half replication due to passing of Narmada pipeline in June 08. **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 *Zizyphus 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* (Table 2). Within species, height difference was highly significant (p-0.00), due to less height growth of *P. cineraria* compared to *C. 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 ka 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. ciliris*, 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.

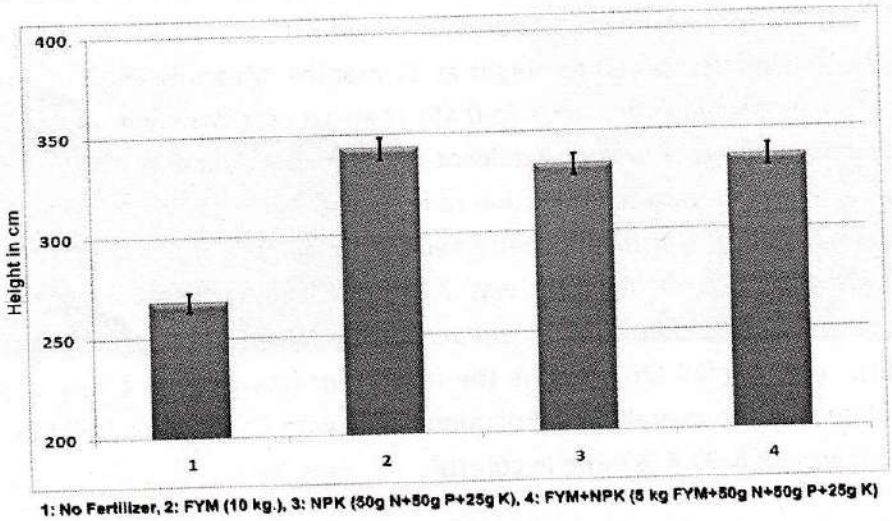
Project 6:Multiplication and field trial of bamboos through tissue culture in Rajasthan & Gujrat. (AFRI-68/FGTB/DBT/2005-09)

Principal investigator: Dr. U.K.Tomer
Principal Investigator: Dr. R.L.Srivastava
CO PI.: Shri C.S. Dange

Status:

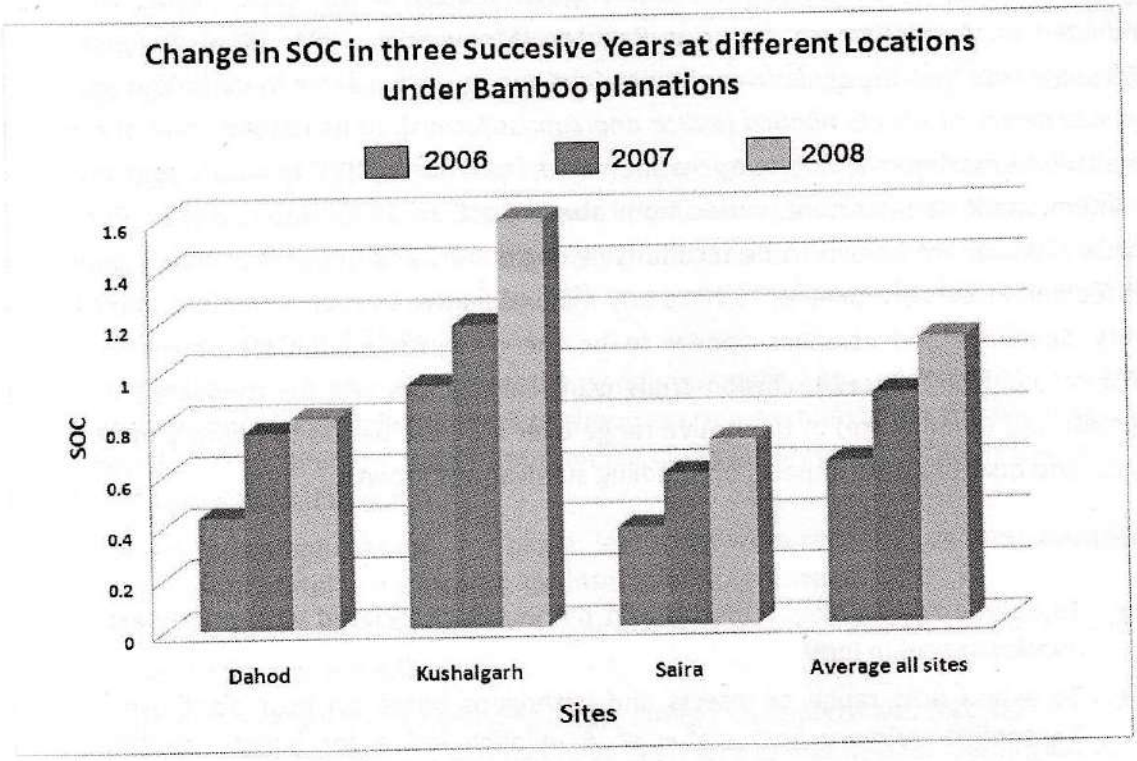
Experiment conducted with four fertilizer treatments namely, T1 – No Fertilizer, T2 – FYM (10kg), T3 – NPK (50g N + 50g P + 25g K) and T4 – FYM + NPK (5kg FYM + 50g N + 50g P + 25g K). Effect of fertilizer treatment on height is clearly visible irrespective of the site. At Kushalgarh, Banswara *D. strictus* 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 Chakhalia, but here average height was more in all the treatments as compare 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 Chakhalia. Data was also analyzed with number of culm per clump and clump girth. Effect of fertilizer treatment on *Bambusa bambos* is shown in following graph.

Effect of fertilizer treatment on Height of *Bambusa bambos* TC Plants at Dahod Site



1: No Fertilizer, 2: FYM (10 kg.), 3: NPK (50g N+50g P+25g K), 4: FYM+NPK (5 kg FYM+50g N+50g P+25g K)

Three years studies on soil carbon revealed a gradual increase in two successive years at all three demonstration sites as shown in Figure A. The present experiments successfully demonstrate the performance of tissue culture plants in degraded sites.



Externally aided project (ongoing)

(International)

Project 7: New Biocontrol opportunities for prickly acacia: exploration in India (AFRI/FPD/2008-2011)

Name of the PI: Dr. S.I.Ahmed

Status:

Acacia nilotica was introduced into Queensland from India in the late 1890s as an ornamental tree (Bolton, 1989). It is commonly known as Babul. *Acacia nilotica* subsp. cupriciformis is described as Ramkanta Babul which occurs mostly in Uttar Pradesh, Punjab, and Rajasthan in Agricultural lands (Troup, 1921; Joshi, 1944: Vahed, 1944). These Acacia spp. Grow naturally in most parts of arid and semiarid regions, including Maharashtra, Madhya Pradesh, Andra Pradesh, Haryana, Punjab and Bihar. *Acacia nilotica* and its sub spp. is a tree 5-20 meters high with a dense spheria crown, stems and branches usually dark to black coloured, fissured bark, grey-pinkish slash, exuding a reddish low quality gum. The tree has thin, straight, light, grey spines in axillary pairs, usually in 3 to 12 pairs, 5 to 7.5 cm long in young trees, mature

trees commonly without thorns. *Acacia nilotica* is now considered as weed of national significance in Australia.

Biological control of *A. nilotica* was initiated in the early 1980s, with surveys conducted on *A. nilotica* ssp. *indica* in Pakistan (Mohyuddin, 1981, 1986). Dhileepan *et. al.*, 2006 suggested that the climatic conditions (hot and dry) have same in Rajasthan and India for two subspecies of *Acacia nilotica* (*indica and cuprissiformis*). In its natural zone of occurrence, the absolute maximum shade temperature varies from about 40°C to 47.5°C and the absolute minimum shade temperature, varies from about 1.1°C to 15°C (Anon., 1983). Prickly acacia (*Acacia nilotica*) are known to be facultatively deciduous, and hence it is widely believed that leaf-feeding insects are unlikely to have any major negative impact on mature and established plants. Seedlings and juveniles appear to be the most susceptible life stages to target for biological control. Hence, exclusion trials using insecticides will be conducted at two sites (Jodhpur and Coimbatore) in the native range over a 3-year period to identify most damaging insects and quantify their impacts on seedling survival and growth.

Objectives:

- To Survey and catalogue insects and pathogens associated with prickly acacia (*Acacia nilotica indica*) in India
- To assess host range of insects and pathogens based on host plant use in the field To confirm primary host status of *A. nilotica indica* for agents identified through preliminary host-range testing
- To prioritize potential biocontrol agents on the basis of likely impacts on the weed To seek and obtain approval from Government of India through its National Biodiversity Authority (NBA) to export prioritized agents to Australia for further host-specificity tests
- Evaluate the effectiveness of already established biocontrol agents in the field in Australia

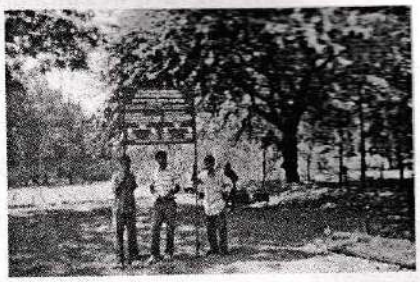
Achievements:

- 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
- Parameters *i.e.,* age of seedling, shoot length, number of leaves, root length, and total wet weight randomly from the 2 main treatments (exposed to biocontrol agents and excluded from biocontrol agents)

- 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)
- 20 to 25% 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 bag-worm, *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, *Fusariam* 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.
- First Report on the work done during April to December 2008 has been prepared and submitted to AFRS, Australia.
- Seedlings are maintained and regularly surveyed for pest and disease infestations in the AFRI nursery.

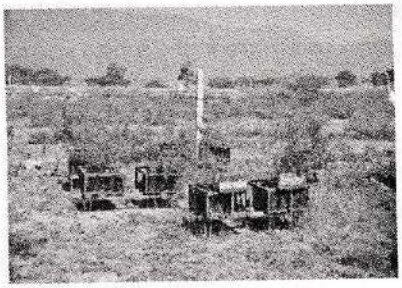
Plate IV: Exclusion Trial and diseases and insect pests of *Acacia nilotica*

Exclusion trial at Hanumangarh

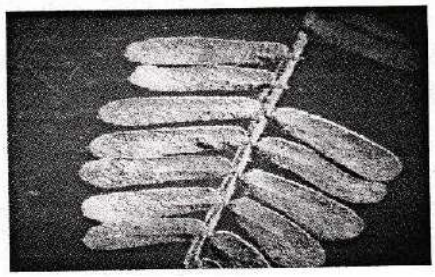


Exclusion trial at Junagarh

Exclusion trial: Under Canopy

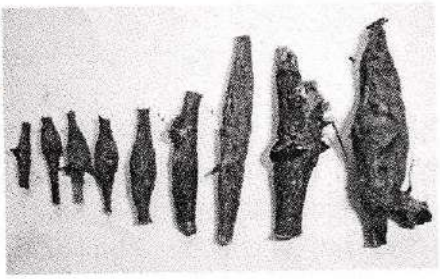


Exclusion trial: Exposed to sun

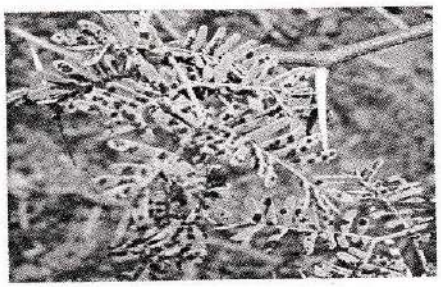


Powdery mildew in Acacia in nursery

Leaf blight of Acacia (C.O. *Alternaria sps.)*



Gall on Acacia



Rust on Acacia

Table 4: Twenty four week old seedlings: 1. Proportion of seedlings with combined herbivores attack, 2.Number of insect herbivores per seedlings, 3. Proportion shoot and leaf area damaged. (Exclusion trial at Rajasthan)

SITE	MEASURMENT	TR/UC	TR/US	UTR/UC	UTR/US
JODHPUR	Proportion of seedlings with combined herbivores attack	72:28	79:21	29:71	34:66
		R=2.6:1	R=3.8:1	R=0.4:1	R=0.5:1
	No of insect herbivores per seedlings	2 (*,#)	2 (*,#)	3 (*,#,@)	3 (*,#,@)
	Proportion shoot and leaf area damaged	Shoot: Nil Leaf: 10%	Shoot: Nil Leaf: 07%	Shoot: Nil Leaf: 23%	Shoot: Nil Leaf: 16%
PALI	Proportion of seedlings with combined herbivores attack	74:26	73:27	31:69	30:70
		R=2.8:1	R=2.7:1	R=0.4:1	R=0.4:1
	No of insect herbivores per seedlings	2 (*,#)	2 (*,#)	4 (*,#,$,@)	3 (*,#,@)
	Proportion shoot and leaf area damaged	Shoot: Nil Leaf: 09%	Shoot: Nil Leaf: 08%	Shoot: Nil Leaf: 21%	Shoot: Nil Leaf: 15%
BHARATPUR	Proportion of seedlings with combined herbivores attack	79:21	75:25	28:72	31:69
		R=3.8:1	R=3:1	R=0.4:1	R=0.4:1
	No of insect herbivores per seedlings	2 (*,#)	2 (*,#)	4 (*,#,$,@)	3 (*,#,@)
	Proportion shoot and leaf area damaged	Shoot: Nil	Shoot: Nil	Shoot: Nil	Shoot: Nil

SITE	MEASURMENT	TR/UC	TR/US	UTR/UC	UTR/US
		Leaf: 11%	Leaf: 08%	Leaf: 25%	Leaf: 18%
HANUMANGARH	Proportion of seedlings with combined herbivores attack	73:27	81:19	35:65	41:59
		R=2.7:1	R=4.3:1	R=0.5:1	R=0.7:1
	No of insect herbivores per seedlings	2 (*,#)	1 (*)	4 (*,#,$,@)	4 (*,#,@,$)
	Proportion shoot and leaf area damaged	Shoot: Nil Leaf: 12%	Shoot: Nil Leaf: 10%	Shoot: Nil Leaf: 20%	Shoot: Nil Leaf: 19%

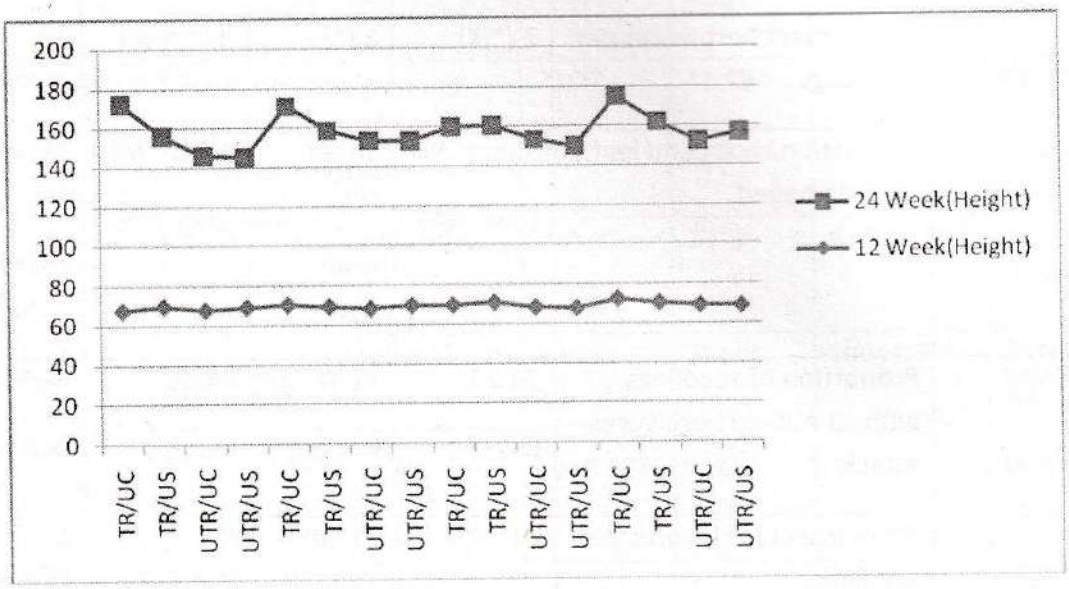
Table 5: Twenty four week old seedlings: 1. Proportion of seedlings with combined herbivores attack, 2.Number of insect herbivores per seedlings, 3. Proportion shoot and leaf area damaged. (Exclusion trial at Gujarat)

SITE	MEASURMENT	TR/UC	TR/US	UTR/UC	UTR/US
GANDHINAGAR	Proportion of seedlings with combined herbivores attack	82:18	78:22	48:52	39:61
		R=4.5:1	R=3.5:1	R=0.9:1	R=0.6:1
	No of insect herbivores per seedlings	2 (*,#)	2 (*,#)	4 (*,#,$,@)	3 (*,#,$)
	Proportion shoot and leaf area damaged	Shoot: Nil Leaf: 12%	Shoot: Nil Leaf: 09%	Shoot: Nil Leaf: 23%	Shoot: Nil Leaf: 17%
NADIAD	Proportion of seedlings with combined herbivores	78:22	84:16	29:71	25:75
		R=3.5:1	R=5.2:1	R=0.4:1	R=0.3:1

SITE	MEASURMENT	TR/UC	TR/US	UTR/UC	UTR/US
	attack				
	No of insect herbivores per seedlings	2 (*,#)	1 (*)	3 (*,#,@)	3 (*,#,@)
	Proportion shoot and leaf area damaged	Shoot: Nil Leaf: 10%	Shoot: Nil Leaf: 06%	Shoot: Nil Leaf: 26%	Shoot: Nil Leaf: 21%
JUNAGARH	Proportion of seedlings with combined herbivores attack	73:27	82:18	34:66	48:52
		R=2.7:1	R=4.5:1	R=0.5:1	R=0.9:1
	No of insect herbivores per seedlings	2 (*,#)	2 (*,#)	4 (*,#,$,@)	3 (*,#,@)
	Proportion shoot and leaf area damaged	Shoot: Nil Leaf: 09%	Shoot: Nil Leaf: 07%	Shoot: Nil Leaf: 22%	Shoot: Nil Leaf: 19%
BHUJ	Proportion of seedlings with combined herbivores attack	89:11	84:16	43:57	61:39
		R=8.1:1	R=5.2:1	R=0.7:1	R=1.6:1
	No of insect herbivores per seedlings	2 (*,#)	1 (*)	4 (*,#,$,@)	3 (*,#,$)
	Proportion shoot and leaf area damaged	Shoot: Nil Leaf: 10%	Shoot: Nil Leaf: 07%	Shoot: Nil Leaf: 21%	Shoot: Nil Leaf: 19%

R= **Ratio {*: Whitefly, #: Myllocerus, @: Membraciad, $: Others}**

Fig1: Height of 12 and 24 weeks old seedlings in Gujarat



Dr. K. Dhileepan, Scientist, Alen Fetcher Research Station, Univ. of Queensland, Australia, PI and Dr, A. Balu, Scientist E, IFGTB, Coimbatore have visited AFRI, Jodhpur (India) from 14-9-08 to 21-9-08 to discuss the project with AFRI scientists and finalization of sites.

NEW PROJECTS INTIATED DURING 2008-2009
(Externally Aided)
Nil

STATEWISE PROJECTS ALLOCATION (under Institutes jurisdiction)

Name of State	No. of projects completed in 2008-2009	No. of ongoing projects in 2008-2009	No. of projects initiated in 2008-2009
Rajasthan	06	15	03
Gujarat	00	02	00
Raj.&Guj.	01	06	00
Raj., Gujarat , Dadar &Nagar Haveli	01	00	00

Abstract: Number of Projects

	No. of projects completed in 2008-2009	No. of ongoing projects in 2008-2009	No. of projects initiated in 2008-2009
Plan Projects	05	16	03
External Projects	03	07	00
Total	08	23	03

TECHNOLOGY ASSESSED AND TRANSFERRED

Nil

EDUCATION AND TRAINING

- Dr. S. I. Ahmed attended and delivered a lecture on बॉस की पौधशालाओं एवं वृक्षारोपण एवं अन्य महत्वपूर्ण वृक्ष प्रजातियों के हानिकारक कीट एवं उनका समेकित कीट प्रबंधन in the farmers training program at Udaipur (Rajasthan) from 3rd to 6th October and Rajpipla (Gujarat) from 12th to 15th October, 2008.

- Dr. K.K.Srivastava, Scientist-E and Dr. Meeta Sharma, Research Officer attended ten days training programme on "Pest Management" at National Centre for Integrated Pest Management (ICAR) New Delhi from 10th to 19th feb. 2009 in pursuance of HRD plan.

LINKAGED AND COLLABORATION

National:

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

- Rajasthan Forest Department
- Gujarat Forest Department.

PUBLICATIONS

Book/Chapters in Books:

1. S.I. Ahmed, Shivesh Kumar, Meeta Sharma, Sahadev Chouhan, S.D. Paunikar & A.U. Khan. (2008). "Integrated Management of Insect Pests and Mites associated with important Arid and Semi-Arid Tree species in India" in Pests of Forest Importance and their Management by Dr. B.K. Tyagi, Dr. Vijay Veer and Dr. Shri Prakash. Scientific Publishers
2. Growth and Biomass production of fodder species in agroforestry systems under arid conditions (2008) Ranjana Arya, G. R. Kachhwaha, K.R. Chaudhary and R.R. Lohara in Diversification of Arid Farming Systems(Eds. Pratap Narain, M. P. Singh, Amal Kar, S. Kathju and Praveen Kumar) pub. Arid Zone Research Association of India and Scientific Publishers(India) Jodhpur, pp124-131
3. Changing role of forestry in sustaining livelihoods and environment, and utilization of ITK in forest management, V.P. Tewari, 2008. pp. 176-178. In: John A. Parrotta, Liu Jinlong, Sim Heok-Choh (eds.) Sustainable Forest Management and Poverty Alleviation: Roles of Traditional Forest-related Knowledge. IUFRO World Series Vol. 21. IUFRO, Vienna, 223 p.

A. Research Papers in Scientific Journals:

1. Ranjana Arya and R. R. Lohara, (2008) Performance of halophytes and glycophytes on various types of mounds on arid salt affected soil in hot arid region. Current Agriculture: 32, 91-97.
2. Neelam Verma; Tarafdar, J.C.; Srivastava, K.K. and Jitendra Panwar (2008). Arbuscular Mycorrhizal (AM) diversity in *Prosopis Cineraria* (L.) Druce under arid agroecosystems. *Agricultural Sciences in China* Vol.7,No.6,754-761.
3. Effect of seed orientation and sowing depth on germination and seedling performance of Neem (*Azadirachta indica* A. Juss.) seeds. Kumar, Devendra and Mishra, D.K., *Annals of Forestry* 15 (2), 2007, 311-321.
4. Effect of age classes on physical indices of maturity in neem (*Azadirachta indica* A. Juss.) Devendra Kumar and D.K. Mishra., *My Forest* 43(3), 2007, 403-416.

5. Enhancement of germination and seedling parameters by hydration pretreatment of stored seeds of *Azadirachta indica* (A.Juss.). Devendra Kumar, D.K. Mishra, C.J.S.K. Emmanuel, Sunil Kumar, S.K. Sharma and Ranbir Singh, *My Forest* 43(4), 2007, 477-484.

6. Effect of methods of seed collection on seed qualities and storability of *Azadirachta indica* A. Juss. (Neem) seed. Kumar, Devendra and Mishra, D. K., *Journal of Non Timber Forest Products* 14(4), 2007, 271-276.

7. Studies on seed germination in *Capparis decidua* (Forsk.) Edgew: A tree of hot desert. Devendra Kumar and D.K. Mishra., *The Indian Forester* 134(4), 2008, 500-504.

8. Effect of methods of drying on viability, storability and seedling performance of Neem (*Azadirachta indica* A. Juss.) seeds. Kumar, Devendra, Mishra, D. K., Singh, Balbir and Singh, Ved Pal, *The Indian Forester* 134 (8), 2008, 991-1002.

9. Site index model for *Tecomella undulata* plantations in a hot arid region of India. V.P. Tewari and Bilas Singh, *Journal of Arid Environments* 73(4-5), 2009, 590-593.

10. Predicting potential density and basal area development in social forestry plantations of *Acacia nilotica* in Gujarat state of India. V.P. Tewari, *Journal of Sustainable Forestry* 26(4), 2008, 284-300.

11. WTA Vs WTA for assessing the recreational benefits of urban forests: a case from a modern and planned city of a developing country. P. Chaudhry, V.P. Tewari and B. Singh, *Forests, Trees and Livelihoods* 18(3), 2008, 215-231.

12. Modelling potential density limiting survival, stand density and basal area growth for pure even-aged *Dalbergia sissoo* stands in a hot arid region of India. V.P. Tewari and K.v. Gadow, *Forests, Trees and Livelihoods* 18(2), 2008, 133-150.

13. Tourism recreational value of Rock Garden Chandigarh, India. P. Chaudhry and V.P. Tewari, *e-Review of Tourism Research* 6(2), 2008, 36-44.

14. Potential density and basal area prediction equations for unthinned *Eucalyptus* hybrid plantations in the Gujarat state of India. V.P. Tewari and Bilas Singh, *Bioresource Technology* 99(6), 2008, 1442-1449.

B. Research Papers Presented in Seminars/Symposiums/Workshops:

1. Jatropha plantation-Prospects and problems. N.K. Bohra, J.K. Shukla and D.K. Mishra. Paper presented in the National Conference on Biofuels: Potential and Challenges held at TFRI, Jabalpur during 25-26 Feb., 2009.

2. Jatropha an environment friendly fuel and an opportunity for employment generation in rural and urban India. R.L. Srivastava, N.K. Bohra and D.K. Mishra. Paper presented in the National Conference on Biofuels: Potential and Challenges held at TFRI, Jabalpur during 25-26 Feb., 2009.

3. Bamboo types and uses with reference to Rajasthan and Gujarat. D.K. Mishra and N.K. Bohra. Paper presented in the National seminar on Bamboo "Plantation management and its utilization" held at AFRI, Jodhpur during 17-19 March 2009.

4. Sustaining urban parks & gardens: a case study of Chandigarh city of India. P. Chaudhry and V.P. Tewari. Paper presented in the 3rd annual International Conference on 'Public Policy and Management' organised by the Centre for Public Policy, IIM, Bangalore during 3-6 Aug. 2008.

5. Trees Outside Forests: its Assessment and Significance in Arid and Urban Environment. V.P. Tewari. Paper presented in the Indo-German Symposium on 'Education and Research for Sustainability' organised by the DAAD Regional Office India at IIT, Chennai during 8-9 Sept. 2008.

6. Improving the productivity of degraded arid salt affected soil through halophytic shrub-*Atriplex lentiformis* (quail saltbush). R. Arya and V.P. Tewari. Paper presented at the National Symposium on 'Forage Symposium-2009: Emerging Trends in Forage Research and Livestock Production' organised by The Indian Society of Forage Research, CCS HAU, Hisar & CAZRI, Jodhpur at CAZRI, RRS, Jaisalmer during 16-17 Feb. 2009.

7. Current approaches in modelling growth and yield in forestry plantations. V.P. Tewari. Lecture delivered during One-week Compulsory Training Course for IFS Officers on 'Integrated Approach for Sustainable Development of Fragile Desert Eco-system' organised at AFRI, Jodhpur during 9-13 Feb. 2009.

8. Sangeeta Singh, S.I. Ahmed, K.K. Srivastava, Neelam Verma and B. Sharma (2009). Some important diseases, their causal organism and insect pests of bamboo. Abstract published in Proceeding on "National Seminar on Bamboo-Plantation, Management and Its Utilization" from 17 - 19 March, 2009, AFRI, Jodhpur.

9. Dr. S. I. Ahmed, Scientist-F & Head, FPD, Dr. K.K. Srivastava, Scientist-E, Dr. S. Singh and Dr. Neelam Verma, Research Officer, Dr. Sahadev Chouhan, RA-I and Shri Shiv Lal Chouhan RA-I participated in "National Seminar on Bamboo-Plantation, Management and Its Utilization" from 17 - 19 March, 2009, AFRI, Jodhpur.

10. Dr. S.I Ahmed, Dr. K.K. Srivastava, Dr. Neelam Verma , Dr. Sahadev Chouhan, Ms. Neelam Mewari, Ms. Anamika Sharma and Shri Mahadeo Gorain attended two day Hindi workshop from 23 -24 March, 09 at AFRI, Jodhpur.

11. Sharma Meeta, Ahmed S.I. and Ashok Kumar (2009). Impact of Phyto-Pesticides against *Patialus tecomella* (Coleoptera : curculionidae), a serious pest of Marwar Teak in Western Rajasthan. Submitted in the national conference on applied entomology- Impact of Global warming on the incidence and management of insect pests in Agriculture- held at M.P.University of Agriculture & Technology, Udaipur- 313 001 on 5-7 March 2009.

C. Research Papers Communicated/Accepted/in Press:

1. Approaches to modelling growth and yield of forestry tree species, **V.P. Tewari,** *My Forest* (communicated).
2. **G. Singh** and M. Bahti (2008). Changing effluent chemistry affect survival, growth and physiological functions of *Acacia nilotica* seedlings in north-western region of India. *The Environmentalist*, 28: 175-184.
3. **G. Singh**, T.R. Rathod, Bilas Singh and Manoj Chouhan (2008). Component interactions and productivity in *Emblica officinalis* based agri-horticulture system in Indian Desert. *Biological Agriculture & Horticulture*, 25: 253-268.

National

4. N. Bala, G. Singh, N.K. Bohra, K.R. Choudhary and R.K. Gupta (2008). Growth and biomass accumulation in *Eucalyptus camaldulensis* irrigated at different water regimes in an arid sandy plain of India. *Indian Forester*, 134(5): 611-621.
5. G. Singh, Sahadeo Chouhan and T.R. Rathod (2008). Vegetation diversity and socioeconomic profile relations in some selected villages of Indian desert. *Indian Forester*, 134(6): 744-756.
6. G. Singh, T.R. Rathod, S. Mutha, S. Upadhyaya and N. Bala (2008). Impact of different tree species canopy on diversity and productivity of under canopy vegetation in Indian desert. *Tropical Ecology* 49(1): 13-23.
7. G. Singh, T.R. Rathod, S.R. Baloch and C.S. Purohit (2008). A note on addition to the flora of Banswara district, Rajasthan. *Indian Forester*, 134 (8): 1087-1099.

8. G. Singh (2008). Gaining momentum: Growing *Jatropha curcus* with rainwater harvesting in degraded hillocks of Aravalli. *Wasteland News*, 23(1): 17-19.

D. Research Papers Communicated/Accepted/in Press:

1. G. Singh (2008). Soil water dynamics, growth of *Dendrocalamus strictus* and herbage productivity influenced by rainwater harvesting in Aravalli hills of Rajasthan. Forest Ecology and Management, (Submitted).

2. G. Singh, T.R. Rathod, S. S. Komara and N.K. Limba (2009). Microsite differentiation, herbage production and biomass partitioning influenced by resource availability through rainwater harvesting in hillslopes of Aravalli in India. *Land Degradation and Development* (submitted).

3. G. Singh, Abha Rani, N. Bala, S. Upadhyaya, S.R. Baloch and N.K. Limba (2009). Resource availability through rainwater harvesting influenced vegetation diversity and herbage yield in hillslope of Aravalli in India. *Ecohydrology* (Under revision).

4. G. Singh, N. Bala, G.R. Choudhary, Bagaram and N.K. Limba (2009). Herbage diversity and productivity influenced by rainwater harvesting in degraded Aravalli hills in western India. *Biodiversity & Conservation* (Submitted).

5. Neelam Verma; Tarafdar, J.C. and K.K. Srivastava (2008). Standardization of Inoculum Dose of AM fungi in *Prosopis Cineraria* seedlings. *Indian Journal Of Forestry* (accepted)

6. Neelam Verma, J.C. Tarafdar and K.K. Srivastava (2009). Soil depth distribution of arbuscular mycorrhizal fungi associated with *Prosopis cineraria* (L.) Druce. Send for Publication in "Tropical Ecology".

7. Neelam Verma, J.C. Tarafdar and K.K. Srivastava (2009). Role of am strains on biomass production and p, cu, zn uptake of *Prosopis cineraria*. Send for Publication in "The Indian Forester"

8. Neelam Verma, J.C. Tarafdar and K.K. Srivastava (2009). Effect of seasonal variation and site factors on am population associated with *Prosopis cineraria* (l.) Druce. Send for Publication in "Journal of Tropical Forestry"

E. Scientific Reports Prepared and Submitted:

1. Annual report of the project New Biocontrol opportunities for prickly acacia: exploration in India (AFRI/FPD/2008-2011) 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 semi-arid regions submitted to Dr. Allah Noor.
3. Evaluation report of Combating Desertification Project (2002-03 to 2006-2007) phase VII Jhunjhunu Division Rajasthan has been prepared by Dr. Sangeeta Singh.

F. Technical Bulletin: NIL

G. Scientific Brochures: NIL

H: Scientific Films/Documentary: NIL

AFRI Darpan

1. **Sharma Meeta,** Ahmed S.I. (2008). Shusk aur Ardh sushk shetro mein kamjor peristhithikiya tantra ko shati phuchana vale keet avum unka niyantran. AFRI Darpan (Hindi), April-June. 6(2).
2. डॉ. नीलम वर्मा, गंगाराम चौधरी, डॉ. के.के. श्रीवास्तव एवं डॉ. यू.के.तोमर (2008). नीम का रोना–एक वैज्ञानिक अध्ययन "आफरी दर्पण" July-September , Year 6, N0.3..

Radio Talk

नीलम वर्मा (2009) ऑवलों के बगीचे में सामयिक कार्य, *कृषि जगत* में भेंटवार्ता, जोधपुर

CONSULTANCY

The Final Report of consultancy project entitled *"Identification of mycorrhizal and rhizobial association, establishing gene bank and technology transfer to farmers in field"* funded by Gujarat State Biotechnology Mission are being prepared.

PATENTS OBTAINED/FILED

Nil

Commercialisation of Technology

Nil

CONFERENCE / MEETING / WORKSHOPS / SYMPOSIA / EXHIBITIONS

1. Seasonal variation of secondary metabolites in medicinal plant *Calotropis procera,* Rathore Mala, Rani Abha, Meena Rajendra and Sharma Hemant, NIM 2008-09.

2. Medicinal applications of bamboos, Mala Rathore and Abha Rani. In National Seminar on Bamboo, 17-19 Mar'09, AFRI Jodhpur.

3. Uses of Bamboo as food and Feed, Abha Rani, Mala Rathore and P.H. Chawhaan. In National Seminar on Bamboo, 17-19 Mar'09, AFRI Jodhpur.

4. Establishment of silvi-pastoral systems to enhance the productivity of highly degraded aridisol in Bhuj, Kachchh district in Gujarat- Ranjana Arya, Hemant Kumar, R.R. Lohara and R.L. Meena In National Symposium on Agroforestry Knowledge for Sustanability, Climate moderation and challenges ahead at NRC Jhansi from 15-17 Dec 08 (Abstract no 120)

5. Improving the productivity of degraded arid salt affected soil through halophytic shrub - *Atriplex lentiformis (quail saltbush)* Ranjana Arya and V.P. Tewari in the Forage symposium'09- "Emerging Trends in Forage Research and Livestock Product" held at CAZRI, RSS Jaisalmer from February 16-17, 2009

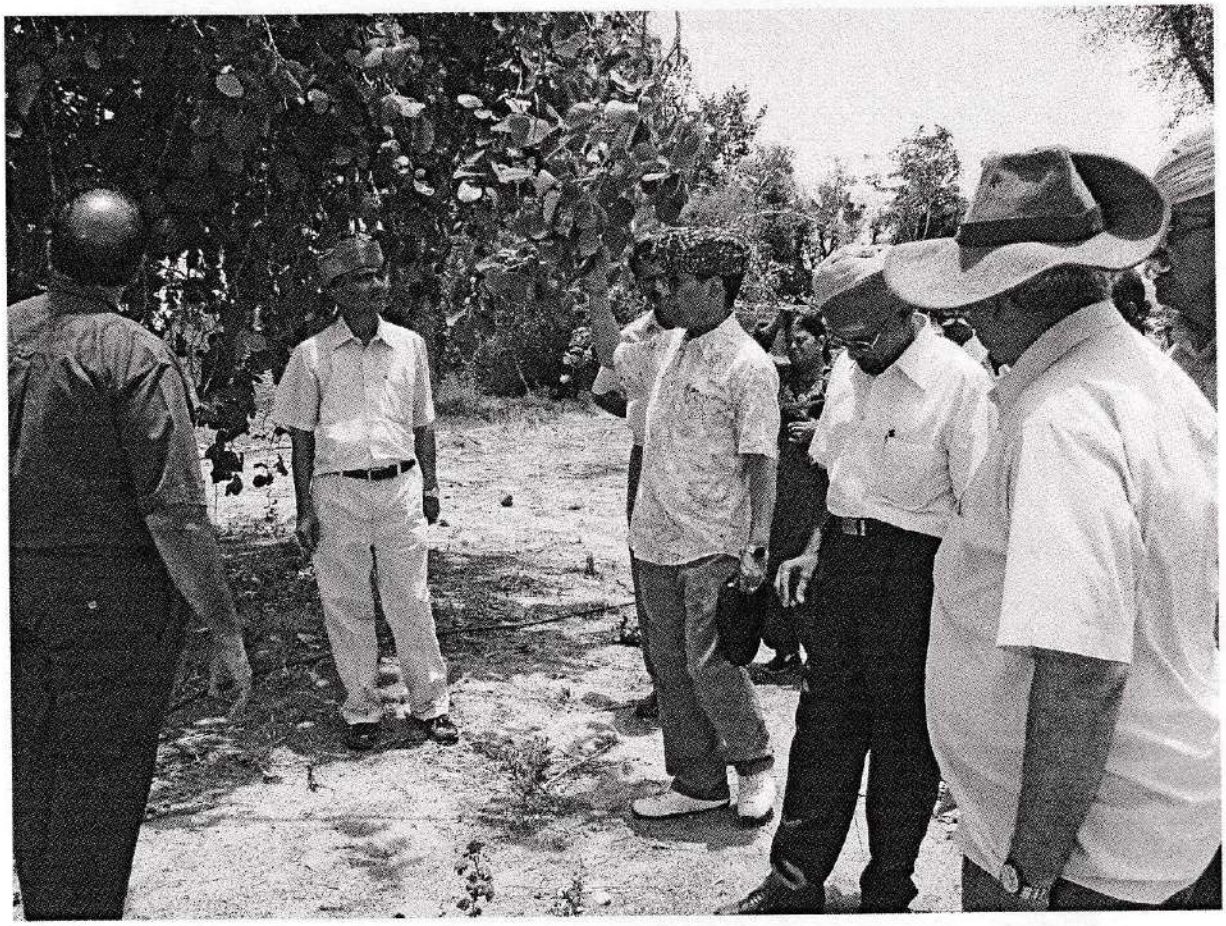
6. Role of women in NTFP Collection, in Thar Desert of Rajasthan' Ranjana Arya, Sangeeta Tripathi & Uma Lohra in Int. Seminar on "Role of Plant Taxonomy in Biodiversity Management and human Welfare" organized at Forest Research Institute, Dehradun from December 1-3, 2008.(Abstracts: Page No.74)

7. Role of NTFP in Sustainable Management of Biodiversity in Thar Desert of Rajasthan' in International Seminar on "Role of Plant Taxonomy in Biodiversity Management and human Welfare", Sangeeta Tripathi, Ranjana Arya & R.K. Gupta, organized at Forest Research Institute, Dehradun from December 1-3, 2008.(Abstracts: Page No.76)

Awards

Consolation Prize awarded for poster presentation to Dr. S.Singh, Dr. S.I. Ahmed, Dr. K.K. Srivastava, Dr. Neelam Verma and Ms. B. Sharma (2009). Some important diseases, their causal organism and insect pests of bamboo. in "National Seminar on Bamboo-Plantation, Management and Its Utilization" held on March 17 - 19, 2009 at AFRI, Jodhpur.

Distinguished Visitors



Director General ICFRE, Dehradun, Shri Jagdish Kishwan visited AFRI from 2nd to 5th July 2008. He visited the experimental areas of AFRI at 1357 RD in IGNP area, Mohangarh (Jaisalmer), Kumathia enclosure at Kailana and Tibna, Jodhpur district.

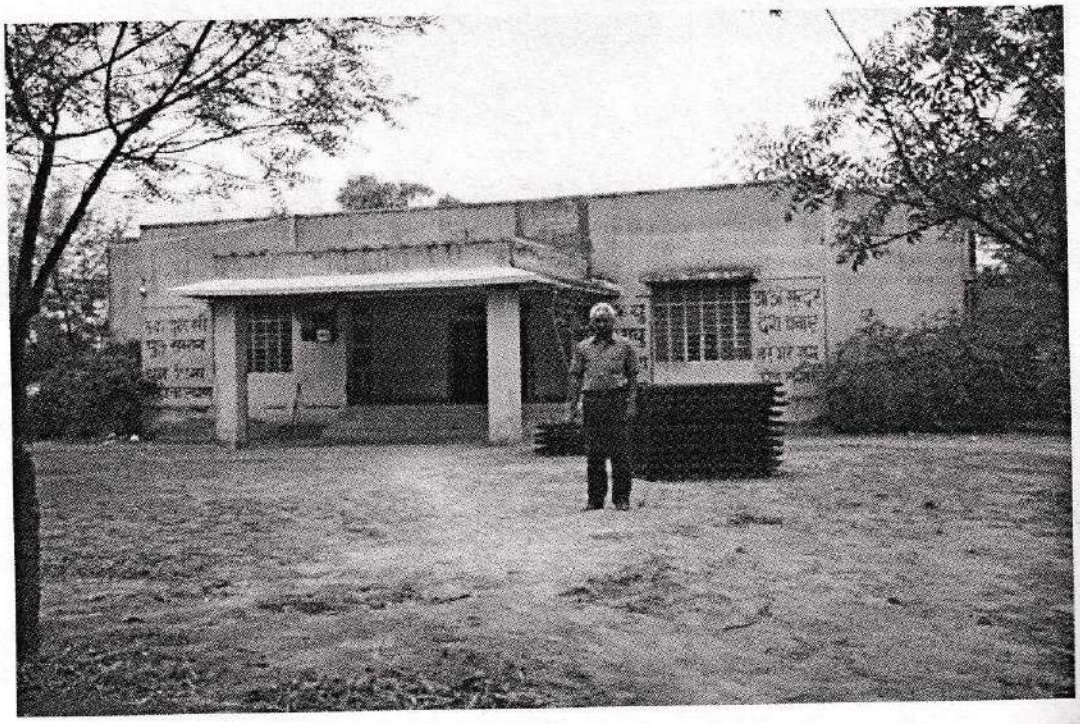
Miscellaneous

- 59th Van Mahotsav was celebrated on 5th July 2008 in the Institute. Plantation of ornamental tree species was undertaken in a Bhanwari Devi school near Shastri Nagar Jodhpur. Honorable DG, ICFRE, Dehradun was the chief guest on the occasion.
- A stakeholders meet of AFRI, Jodhpur was organized in Seminar Hall of AFRI, Jodhpur under Chairmanship of PCCF (TREE) Rajasthan on 8th & 9th July 2008.
- A brain storming session was held on 5th sept.2008 at AFRI seminar hall for all India Co-ordinated Project on Jatropha. The scientists from various institutes i.e., IFP-RANCHI,

RFRI-Jorhat, HFRI-Shimla ,IFGTB –Coimbatore & AFRI-Jodhpur participated in the session.

- Dr. K. Dhileepan, Scientist, Alen Fletcher Research Station, Univ. of Queensland, Australia, PI of the research project **"New bio-control opportunities for prickly acacia: exploration in India"** visited India from 14-9-08 to 20-9-08 to discuss the project with AFRI scientists and for finalization of sites at Desuri and Sadri for the experiments to be carried out under the project. The field visits of Gandhinagar, Surat, Junagarh & Bhuj (Gujarat) were conducted from 18th to 27th September, 08 along with Dr, A Balu, Scientist E, IFGTB, Coimbatore.
- Research Advisory Group (RAG) meeting was held in AFRI from 29th Sept. to 30th September 2008, which was chaired by Dr. M.L. Sharma, PCCF, Gujarat and co-chaired by Shri U.M. Sahai, CCF (TREE)-Training Research, Education & Extension, Rajasthan. Shri Sudhanshu Gupta, ADG (R&P) from ICFRE and other fourteen distinguished members attended RAG meeting of AFRI.

Initiatives for Van Vigyan Kendra



Proposed site for VVK at Bichhwal (Bikaner) Rajasthan (FRH building of Forest Deptt.)

Proposed model nursery site of VVK at Bikaner, Rajasthan

State wise locations of proposed VVKs

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

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 (*Tecomella 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 Nov.-Dec 2008 The DFO Bikaner has been made the Nodal Officer, RFD for VVK.

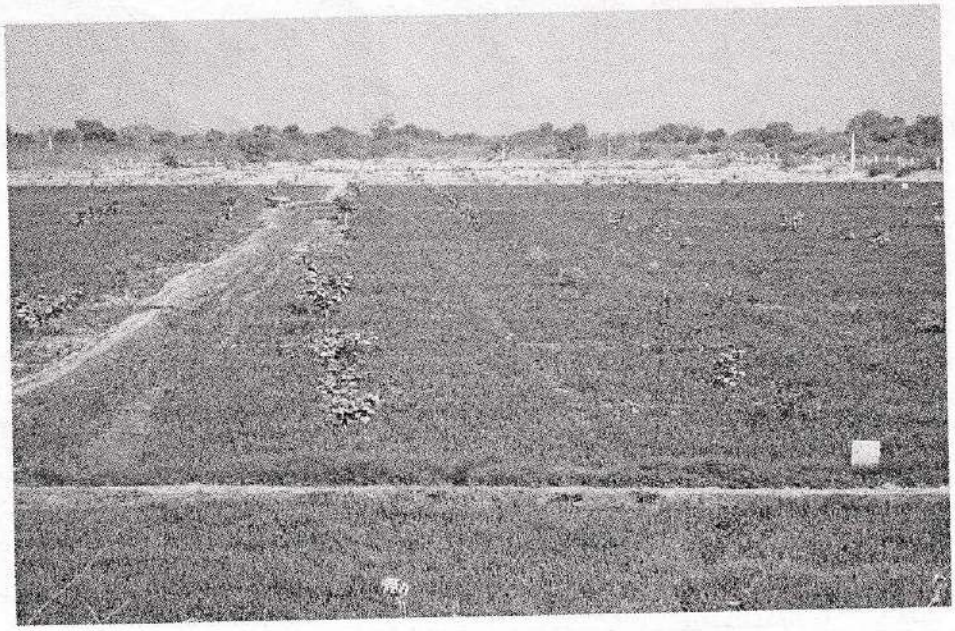
(B) Rajkot (Gujarat)

Forest Department, Gujarat has agreed for proposed VVK at Rajkot. The MOU will be finalised soon.and there after other activities will be taken up.

(C) Khanwel (Dadra &Nagar Haveli)

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

Initiatives for Model Village



A panoramic view of Agro forestry trial on the farmer's field at village Harsh

- The Model village has been established at Harsh (Bilara) in Jodhpur District. Agro forestry trial has been laid down on the farmer's field
- One week compulsary IFS training was organized in the Institute on "Integrated approach for sustainable development of fragile desert ecosystem" from 9-13, 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 Feb.

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, Kachchh welcome the delegates and Dr. Ranjana Arya, Organizing Secretary presented the vote of thanks. Total 58 delegates participated the workshop including Sh. U.D.Singh, CF, Mehsana; Dr. Pradeep Choudhary, CF (Admin.), AFRI; Prof M.V. Patel, Sardarkrushinagar Agricultural University, Dantiwada; Dr. Shreyas Bhatt, Patan University; ACFs, RFOs, Foresters and delegates from AFRI. Four presentations were made by resourse persons and then visited experimental site at Kordha. Feedback and suggestions taken from delegates.

- "National Seminar on Bamboo – Plantation, Management and Its Utilization" was conducted by Arid Forest Research Institute, Jodhpur during 17 – 19th March, 17-19, 2009. Sh. S.K.Pandey, IFS, (Retd.) Former Director General, MoEF & Special secretary to Govt. of India was the Chief Guest of this seminar and the inauguration was presided by Prof. Lokesh Kumar Shekhawat, Vice-Chancellor, J.N.V.University, Jodhpur. The technical session programme was started after the speeches of Guest of Honour, Dr. K.P.R. Vittal, Director, CAZRI, Jodhpur, Dr. Narendra Kumar, Director, Defence Lab, Jodhpur, Prof. N.S.Shekhawat, Head, Department of Botany, J.N.V.U. Jodhpur and by the Director, Dr. R.L.Srivastava, Director, AFRI, Jodhpur. During the seminar four main themes viz. 1. Nursery techniques and conventional propagation of bamboos; 2. Biotechnological interventions; 3. Management of Bamboo stands and conservation strategies; 4. Bamboo utilization and value addition were covered by presenting 84 abstracts in the form of paper presentation and posters. Deliberations were made with respect to plantation techniques, where Tissue-Culture had showed its potentials for rapid and mass multiplication of different bamboos and increasing planting stock material. In general it was felt that bamboo plantation work may be taken up in Rajasthan area seriously.

- IFRIS roll out started in the Arid Forest research Institute, Jodhpur from 2nd March upto 10th March 2009 with a lot of enthusiasm and anticipation. The consultant from SRIT, Shri Sudhir Pandey, Shri Manish Darjee & Tijo Thomas demonstrated the application to the various user groups and introduced them to the various modules of Indian Forestry Research Information system. Shri Pandey explained how to use the RIMS, FEMS module. Shri Manish Darjee demonstrated the Finance, Payroll and Personnel Information System Module and Shri Tijo Thomas demonstrated the Procurrement and Inventory Module of IFRIS to the user groups of AFRI. Hands-on practise was also provided by the consultants. E-champions of the institute Sh. A.K. Sinha and Dr. Tarun

Kant made the necessary arrangements and liasoning with consultants and AFRI personnels. All IFS Officers, Scientists, RO, RAs and TAs of the Institute attended this IFRIS rollout-cum-training programme, gave their feedbacks and discussed their views and doubts with the consultant. The rollout was a grand success at AFRI

- Three days training programme for farmers and field functionaries under Van Vigyan Kendra, organized by Arid Forest Research Institute Jodhpur, with the help of Rajasthan Forest Department on16-18 March 2009 at Kisan Ghar, Bikaner. Total 45 participants were included in this training programme. Both classroom lecturers and field visit were included in this training programme.

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