ARID FOREST RESEARCH INSTITUTE

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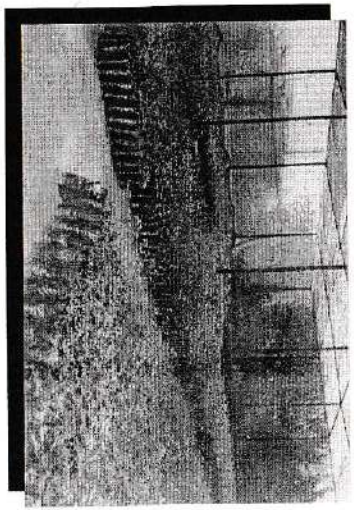
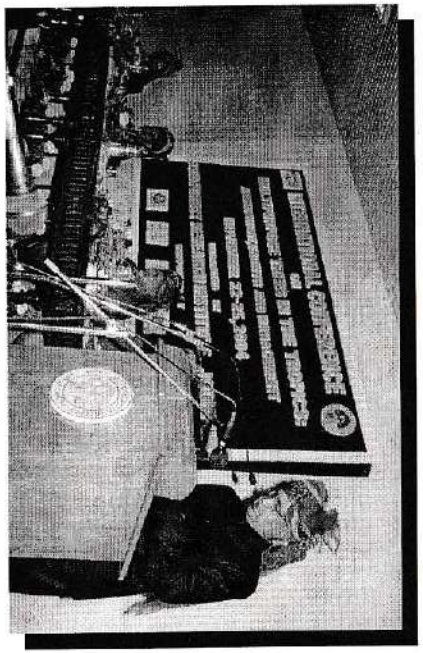
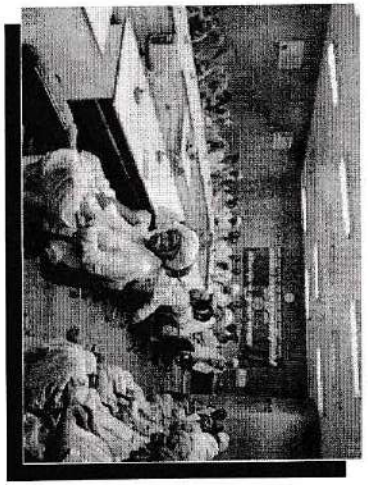
Jodhpur- 342 005 (Rajasthan)







ANNUAL REPORT

2004-2005

(99)

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ARID FOREST RESEARCH INSTITUTE, JODHPUR

A.F.R.I. - *At A Glance:*

Arid Forest Research Institute, Jodhpur (Rajasthan), is one of the eight institutes under the Indian Council of Forestry Research & Education (ICFRE), an autonomous body of the Ministry of Environment & Forests, Govt. of India. The objectives of the Institute are to carry out scientific research in forestry & allied fields to enhance the productivity & vegetative cover, 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 modelling, planting stock improvement, bio-fertilizers and bio-pesticides, Agroforestry, JFM and extension, phytochemistry and non-timber forest products, integrated pest and disease management and forestry education.

During the year 2004-05, thirty-two projects were executed. The institute has taken up three new projects funded by ministry of Water Resources, GOI, New Delhi, Rajasthan Forest Department and Cairn Energy Pvt. Ltd., Chennai.

Encouraging results were achieved in the fields of development of agroforestry models and tree-crop interaction, afforestation of salt affected lands, soil water-plant relations, remedial measures for Khejri mortality, chemistry of forest products, growth & yield studies, management of fodder trees species, seed studies and tree improvement, medicinal plants cultivation etc.

Training programmes on ***"Capacity building and eco-sensitisation of farmers and rural poor for development and sustainable management of life supporting systems"*** for Village Sarpanches, Up-Sarpanches, Panches, BDO's, Gram Sevaks. Gram sabha members, farmers and SFD officials etc. of the 10 Desert districts during Phase I were organized at AFRI to acquaint them with the forestry techniques, development and management of livelihood resources and institute research findings for enhancing rural economy. Also, distributed training materials in local language to them.

PROJECTS COMPLETED DURING 2004-2005

Project 1: Provenance trial on Arid Zone species [AFRI-16/FGTB-3/1992-2005].

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

Findings:

- The Growth data recorded in 2004 shows that Palanpur has the highest growth 6.37 meters followed by Amrawati 5.90 and Raipur 5.90 meters. Data recorded on girth shows that Palanpur is the best with 69.20 cms of collar diameter followed by Kota 55.25 and Indore 52.87 cms.
- On the basis of last five years performance of the provenances Palanpur (Gujarat), Jaiselmer (Rajasthan), Amrawati (Maharashtra), Jhansi (U.P.) and Gandhinagar (Gujarat) have been selected for the provenance proving phase.
- The studies conducted on floral morphology reveals that maximum mean of inflorescence length was recorded in Palanpur provenance with 23.28 cm. and minimum in Kanpur provenance with 11.15 cm. Maximum mean number of flower per inflorescence was found in Palanpur provenances 79.07 and minimum in Kota provenance with 23.28.
- Maximum mean number of fruits per inflorescence was recorded in Palanpur provenances with 9.27 and minimum in Kanpur provenance with 2.93. Studies on floral biology revealed that anthesis starts in the evening from 5.30 pm and continued upto 9.30 pm.
- The maximum percentage of anthesis of flowers occurred between 8.30 to 9.30 pm. The dehiscence of anthers started in closed flowers at 9:30 am and continued upto 3.30 pm. Maximum percent of anther dehiscence occurred from 12.30 to 1.00 pm. Initiation of pollen germination started at 1.15 pm in closed flower.
- Maximum pollen germination takes place from 1.30 - 3.00 pm. Fertilization time was noticed after 36 hours at 2.00 pm in opened flower. Duration of stigma receptivity goes from 1 pm to 2.30 am.
- The data has also been recorded on the oil and azadiractin content of all the provenances. Promising provenances screened for azadiractin are Palanpur 0.93 Shivpuri 0.92, Mulug 92 and lowest Bikaner 0.11 percent.
- The promising provenances for oil are Palanpur 50, Satra 49.4, Shivpuri 49.1 and the lowest from Ranchi 37.07 percent.
- Three enzyme systems were studied; Estrase, Peroxidases and Acid Phosphatase.
- Genetic similarity varies from 90 to 60 %. This shows a very low variation in germ plasm of Neem.

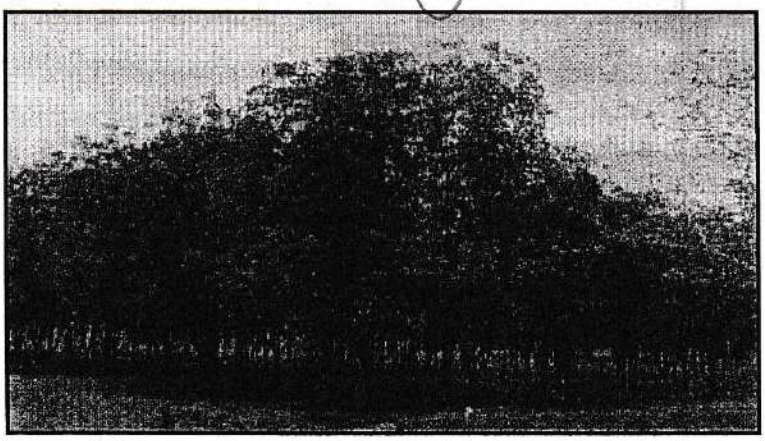


Fig. 1: National Provenance Trial of Neem

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

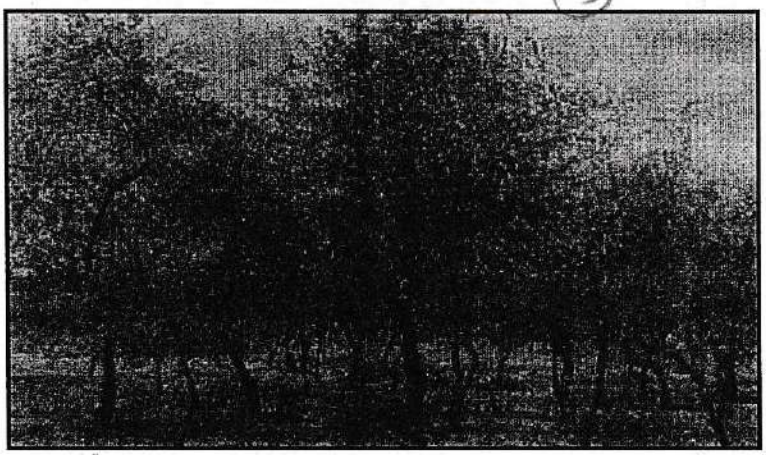


Fig. 2: Provenance Trial of *Tecomella undulata*

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

Project 2: **International Neem Network Provenance trial [AFRI-17/FGTB-2/19 2005].**

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

Findings:

The International provenance trial on neem was initiated by the FAO Neem Network and seeds were exchanged between the participating countries during 1995. The field trials h been laid out during the July - August 1996 at Jodhpur, Jaipur, Palanpur, Jabalpur, Coimbatore, with 18 provenances including control. At present the trial is continuing onl Jodhpur, Jaipur and Coimbatore. The performance of the International Neem Provenance T at Jodhpur is good, though lot of mortality has been observed during this year due to sev drought and low humidity in the atmosphere. The best performing provenances in the trial I height are: Ramanguda (IND) 2.76m followed by Sagar (IND) 2.73m, Jodhpur (Control) 2.4 Yezin (MYN) 2.42m, Geta (NEP) 2.35m and the lowest is Allahabad (IND) 1.56m. The b performing provenances for girth are Sagar (IND) 19.46cms followed by Ramanaguda (I 19.18cms, Jodhpur (Control) 17.67cms, Kulapachra (IND) 16.27cms, Doi Tao(THA) 15.57c and lowest is Ghati Subramanya (IND) 9.35cms. In the Trial II also some of the plants have d due to drought but the general condition is good and the best performing provenances for hei are Sunyani (GHA) 5.26m followed by Myne(MYN) 4.74m, Multan (PAK) 4.58m, Tibbi La (PAK) 4.53m and Chittagon (BAN) 4.74m. The best performing provenances for girth Sunyani (GHA) 41.42cms followed by Myne (MYN) 37.38cms, Multan (PAK) 35.14cms, Ti Laran (PAK) 31.11cms and Chittagon (BAN) 24.25cms.

PROJECTS CONTINUED DURING 2004-2005

Project 1: **Studies on the role of trees in reclamation of waterlogged area and th impact on soil [AFRI-29/FEDD-6/2002-2006].**

Principal Investigator: N. Bala

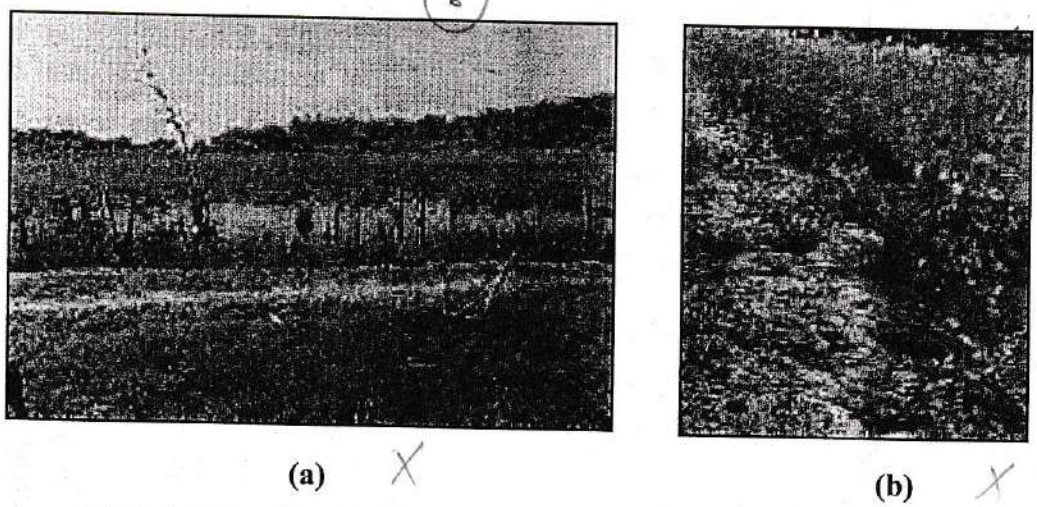
Status:

The experiment was initiated in the year 2002 to screen suitable plants for waterlog area in IGNP. Seedlings of 8 species viz., *Eucalyptus camaldulensis, E. fastigata, E. grandis rudis, E. saligna, Casuarina cunninghamiana, C. glauca* and *Corymbia tesselaris* were plan on raised bunds. Observation on growth and survival recorded periodically. Among the spe planted better growth was recorded in *E. camaldulensis* and *E. rudis.* Though survival was

high in *Casuarina cunninghamiana* and *C. glauca* but because of high biotic pressure and browsing they could not put up best growth.

Table1: Growth of 18 month old Eucalyptus plantations.

Species	Av. Height (cm)	Av. Collar girth (cm)
E. rudis	226	12
Eucalyptus camaldulensis	275	17
E. saligna	175	10
E. fastigata	209	12



(a) **(b)**

Fig 3 : (a) Raised bund and (b) planted seedlings of *Eucalyptus rudis* in a waterlogged area of IGNP

Project 2: Litter dynamics and soil changes during stand development in plantation forest [AFRI-30/FEDD-5/2002-2006].

Principal Investigator: N. Bala

Status

The experiment was initiated in the year 2002 to study litter dynamics and soil changes at various stages of plantation in Indira Gandhi Nahar Pariyojna (IGNP). Four age groups and six species were selected for the study. 76 litter plots of 10 x 10 m^2 area were laid in plantations of *Eucalyptus camaldulensis, Acacia nilotica, Acacia tortilis, Tecomella undulata, Prosopis cineraria* and *Dalbergia sissoo* at Nachna, Sada and Ramgarh area along IGNP. Tree height and girth at breast height (GBH) were recorded for trees inside the plot. Monthly litter collection is being made. Litters are separated into different components and dry weight is recorded. Annual litter production (kg/ha) from different trees in IGNP area indicated highest litter accumulation under *E. Camaldulensis* followed by *D. sissoo.*

Table 2: Annual litter production in plantations of different age.

Species	Litter production (kg ha^{-1})			
	Tree ha^{-1}	12 years old	Tree ha^{-1}	17 years old
E. camaldulensis	1300	4270	1500	3943
D. sissoo	-	-	900	2654
T. undulata	1100	188	1300	1528
P. cineraria	1500	429	100	153
A. tortilis	1300	968	1500	819
A. nilotica	-	-	1100	1528

Soil samples were collected from the plots and were analysed for organic carbon content. Soil organic carbon storage was high in *D. sissoo* followed by *E. camaldulensis, A . nilotica, P. cineraria, A. tortilis, T. undulata.*

Table 3: Soil organic carbon storage in plantations.

Species	Soil organic carbon storage (Mg ha^{-1})	
	0-25 cm	25 – 50 cm
E. camaldulensis	13.08	9.71
D. sissoo	18.37	5.33
T. undulata	1.46	1.01
P. cineraria	4.83	2.35
A. tortilis	2.44	1.46
A. nilotica	6.30	4.84

Litterbags were placed in each plot for decomposition study. After 16 months decomposition was up to 65% in *A. nilotica* and the lowest decomposition was recorded for the litters of *E. camaldulensis.*

Table 4: Litter decomposition in different species.

Species	Percentage reduction in weight at 16 month
E. camaldulensis	14
D. sissoo	54
T. undulata	50
P. cineraria	52
A. tortilis	53
A. nilotica	65

Project 3: Identification And Screening Of Some Suitable Nitrogen Fixing Species of Dry Region For Their Utilization In Improvement Of Soil Fertility And Biomass. [AFRI -41./ FEDD –6 /2003-2007].

Principal Investigator: Dr. S.P. Chaukiyal

Status:

Seeds of *Rhynchosia minima, Clitoria ternatea, Alysicarpus longifolia, Mucuna pruriense, Indogofrea medicagnia, Crotolaria burhia, Indigofera sessliflora, I. urgentia* and *Mimosa hamata* have been collected. Soil samples have been collected from the vicinity and outside of the above mentioned vegetation zone and analyzed for phosphatase, alkaline phosphatase, dehydrogenase activities and soil organic carbon. Acid phosphatase activity was high in *Mucuna pruriense* i.e 5.89 Eu (enzymatic unit) x $10^{-5}g^{-1}s^{-1}$; whereas alkaline phosphatase ans soil organic carbon were higher in *Indigifera linnaei Ali (9.09* Eu $x10^{-5}g^{-1}s^{-1}$ and *0.458%*, respectively*)*. Dehydrogenase activity was highest in *Alysicarpus longifolia* (14.89 pico katal kg^{-1} soil). Buffer and substrate for *Momosa hamata* standardised. The enzyme activity indicated significant role of these vegetation in nutrient enrichment of the soil. Out of 10 species tested *Rhynchosia minima, Momosa hamata, Mucuna pruriense,* and *Crotolaria burhia* species indicated better soil status and therefore selected for multiplication and testing in the field for further multiplication.

Project 4. Screening Different Phenotypes of *Dalbergia sissoo* and *Acacia nilotica* For Their Tolerance To Salinity and Sodicity [AFRI-42/FEDD-7/2003-07].

Principal Investioigator: Dr. Pramod kumar

Status:

Seeds were collected from 14 selected phenotypes of *Acacia nilotica* and *Dalbergia sissoo.* Plantations were raised as per experimental design at *Tharad* range, Palanpur (Gujarat) with the help of State Forest Department. Growth and survival data was recorded six month after planting. Highest survuval (30%) and growth (16.12 cm) of *A. nilotica* was recorded in phenotype collected from *Harethar* and *Lakhani.* The survival and growth of *Dalbergia sissoo* phenotype was very poor because of high salinity level. Salinity of experimental site was in the range of 8.80 – 10.88 dSm^{-1}. Soil pH and organic carbon were 7.66 – 8.86 and 0.23-0.28%, respectively.

Project 5: Provenance trials on *Acacia nilotica* and *Ailanthus excelsa* [AFRI-18/FGTB-3/WB/1995-2005]. *Principal Investigator: C.J.S.K. Emmanuel*

Status:

Acacia nilotica: Provenance trial was laid out in the year 1992 with 28 provenances collected from major states of India. The trial has also been affected due to the prolonged

drought conditions in the state, some mortality has been observed in the trial. The data on growth parameters have been recorded and best performing provenances for height are Shivpuri 3.26m followed by Manikpur 3.20m, Gurgaon 3.17m, Hastinapur 3.13m, Haldwani 3.13m and the lowest height was recorded in Akola 2.57m. The best performing provenances for girth are Makdampur 30.33cms followed by Parlekhmundi 29.42cms, Shivpuri 29.17cms, Gurgaon 29.05cms, Jhabua 28.32cms and the lowest girth was recorded from Manikpur 24.14cms. The studies on fodder value has also been conducted in all the 28 provenances.

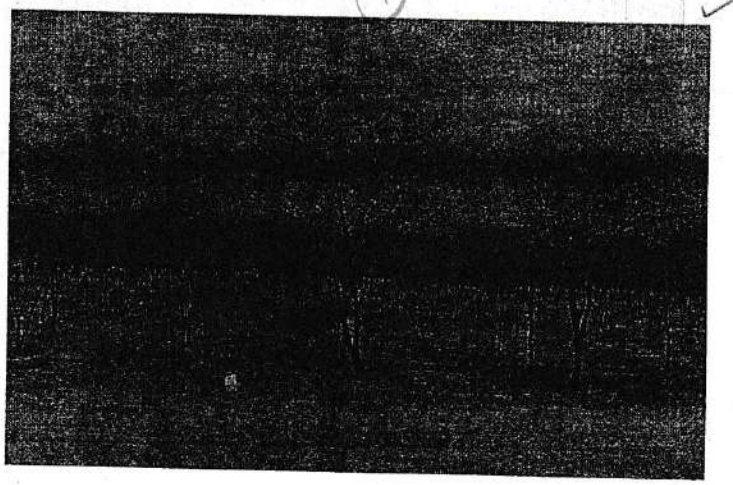


Fig. 4: Provenance trial of *Acacia nilotica*

Ailanthus excelsa: Provenance trial was laid out from the seeds collected from 13 different seed sources were sown in the nursery and transplantable seedlings could be obtained from 8 provenances only. The provenance trial was laid out at two different sites at Jaipur and Jodhpur. This trial has also been affected by the prolonged drought and low humidity conditions prevailing in the state. The data collected during this year shows that the Varanasi (3.95m) was the best followed by Sonbhadra (3.59m), Kazipeth (3.50m), Mirzapur (3.41m) and Pinjore (3.40m), and lowest in height was Jodhpur with 1.84m. The best performing provenances for girth are; Sonbhadra 53.2cms followed by Kazipeth 52.59cms, Mirzapur 47.07cms, Pinjore 46.62cms, Varnasi 44.54cms and lowest in girth is Jodhpur 28.89 cms. The best performing provenances at Jaipur are Bikaner (4.78m), Jaipur (4.75m), Varanasi (4.70m), Pinjore (4.48m) and lowest Kazipeth (3.90m) for height.

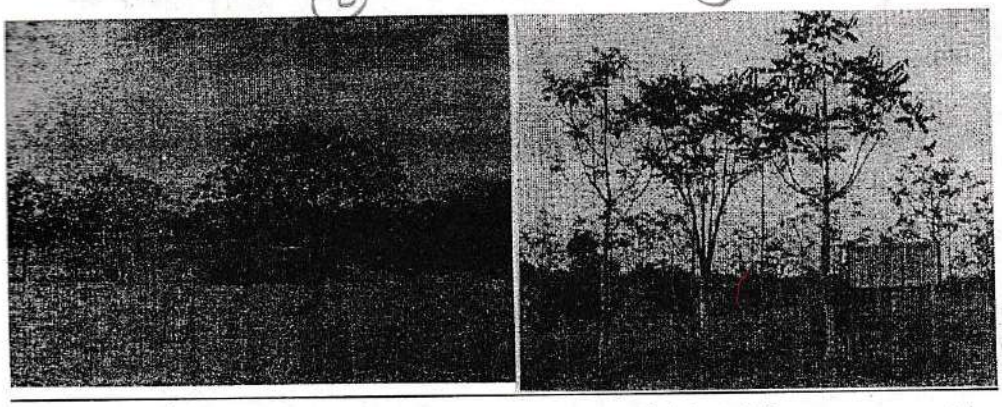


Fig. 5: Trial at Jodhpur Trial at Jaipur

Project 6 : Multilocational trials of *Eucalyptus* and *Dalbergia* clones [AFRI-31/FGTB-7/2002-2006]. *Principal Investigator: Dr. U.K. Tomar*

Status:

A multilocational trial of *E. camaldulensis* and *D. sissoo* clones was established in August, 2003 at four different locations in Gujarat State. The objective of these trials was to evaluate and select superior clones of *D. sissoo* and *E. camldulensis* on the basis of their growth performances.

The locations are:

- Deesa N 24° 17' 39.7" E 72° 12' 17.7"
- Kheralu N 23° 49' 24.2" E 72° 46' 29.1"
- Gandginagar N 23° 11' 56.2" E 72° 40' 53.3"
- Rajpipala N 21° 30' 38.3" E 73° 39' 57.6"

A total of 30 Clones of *D. sissoo* and 35 of *E. camaldulensis* used for establishing multilocational clonal trials at all the four places.

D. sissoo (30 clones)

3	20	48	84	107
4	32	57	93	G1
5	35	62	89	G2
6	36	66	91	G3
15	37	80	103	G4
18	44	83	106	G5

E. camaldulensis (35 clones)

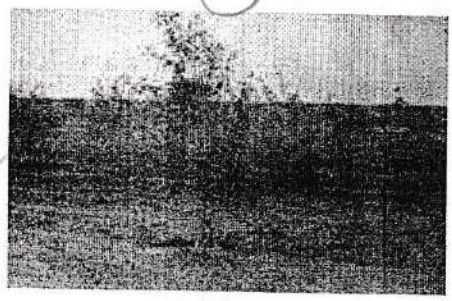
1	10	74	147	A4
2	18	93	158	A5
3	27	99	159	G1
4	32	100	284	G2
5	52	105	A1	G3
6	71	120	A2	G4
8	72	130	A3	G5

At all locations, RBD was used with 3 replications in both species. In case of *E. camaldulensis* 2x3 m spacing was used. It was 4x5 m for *D. sissoo*. Base data was recorded at the time of planting and later on it was recorded annually every year. Therefore, first data recording was carried out in February, 2004 and second was in February, 2005. Initial data were recorded on growth parameters (height and girth in cm).

Best three clones identified after second year's observation are given below:

Rank	*D. sissoo*	*E. camaldulensis*
1st	G5	83
2nd	20	128
3rd	66	99

However, it will take a litter longer time to conclude the final results. In case of *E. camaldulensis,* it can be concluded after three years while for *D. sissoo,* it would take four years.



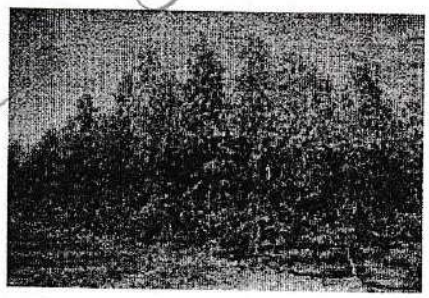


Fig. 6: Dalbergia clones Eucalyptus Clones

Project 7: Micropropagation of an Important Medicinal Plant of the Arid and Semi-arid regions–*Commiphora* [AFRI-32/FGTB-8/2002-2006].

Principal Investigato: Dr. Tarun Kant

Status:

Callus Induction and Multiplication: Leaf from mature plant is selected as best responding explant and used for callus production [Fig. 7a]. Best growth of callus is observed on MS media with NAA and 2,4-D. This callus is continuously growing on different combinations of Auxin and Cytokinin but the callus touching to the media turns brown. Differentiation of any organ from callus has not been observed.

Juvenile hypocotyls [Fig.7b] and cotyledons [Fig.7c] are also selected for callus induction. Callus is growing best on MS media supplemented with lower concentration of 2,4-D. Callus is continuously growing but turns brown as in case of callus derived from mature leaves. Growth rate of callus is good as compare to mature leaf callus and it is also showing development of chlorophyll in callus. This green callus [Fig.7d] grows fast on MS media supplemented by NAA and Kn. But organogenesis is yet not observed.

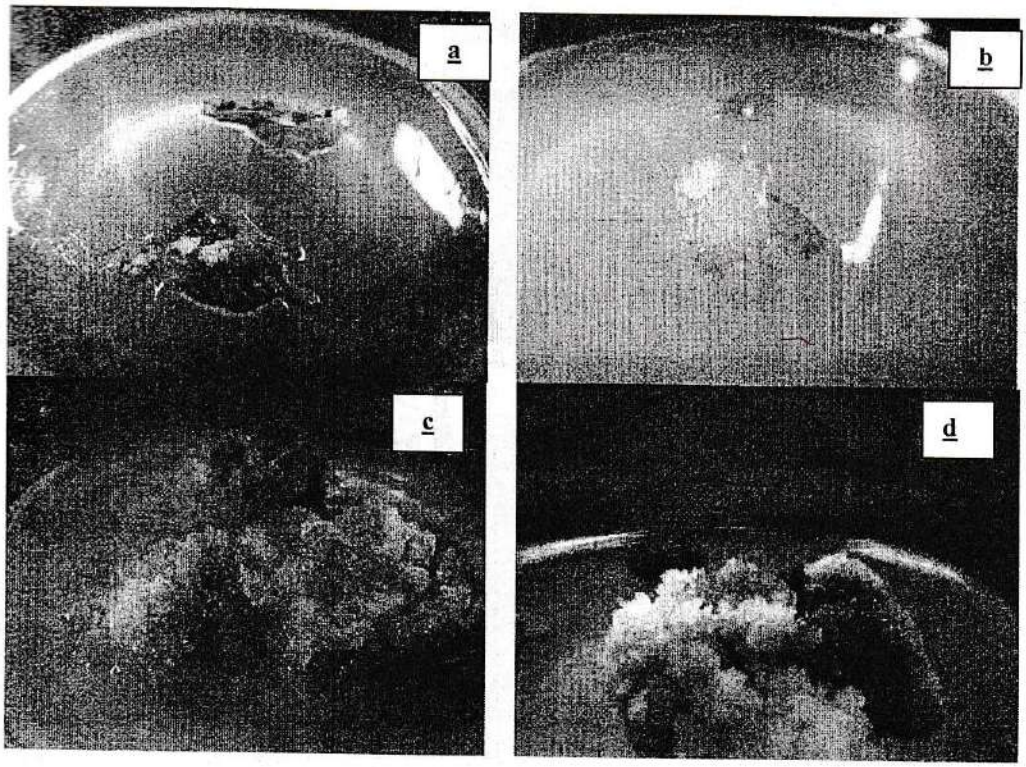


Fig 7: *In vitro* cultures

Callus Browning: Callus nearer to media gradually turns brown with in 7-10 days of induction. There is always a growing upper shiny zone of callus with lower creamish to dark brown callus. Experiments are also underway to check this browning.

Somatic embryogenesis: Collected immature fruits are dissected under sterile conditions after surface sterilization. Immature zygotic embryos are inoculated on B5 media with IBA, BA, and 2, 4-D. This callus is now on the way of multiplication and also for differentiation of somatic embryos.

Bud break, multiplication and shoot elongation: Nodal explants from mature plants were used for multiplication. Time of explants collection, place very critical role in achieving good bud break. Surface sterilized 1- 1.5cm. long nodal explants shows good bud break responses [Fig. 8a, b] on MS media with NAA and BA. Gibberellin helps in elongation of microshoot [Fig.8c,d] up to 2-2.5cm. We are trying for further multiplication, elongation and rooting of microshoots. This experiment is also repeated by using cotyledanary node [Fig. 8e] as explant source. Here up to six fold multiplication [Fig. 8f] had already been achieved.

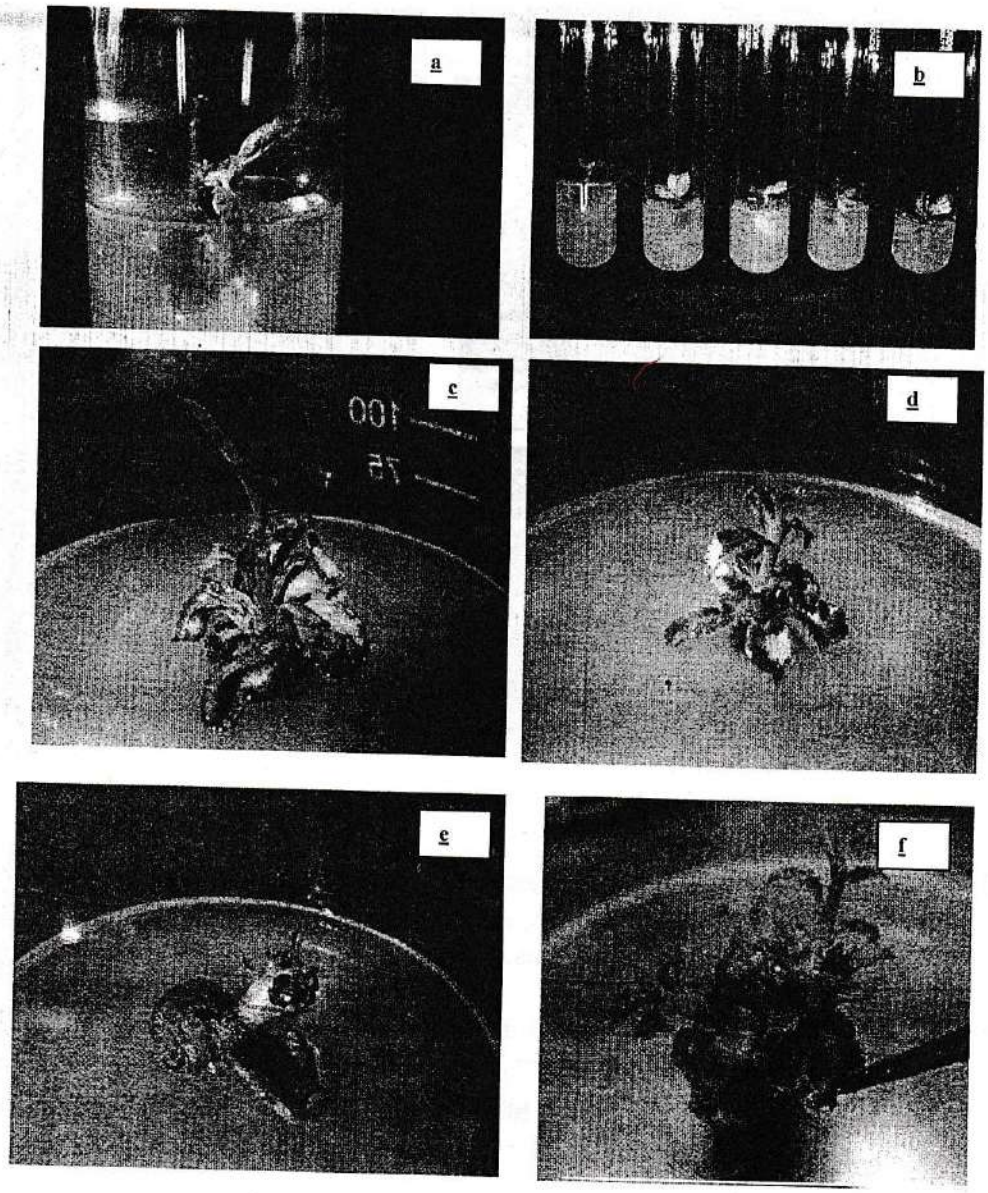


Fig 8 (a-f): *In vitro* cultures

Project 8: **Genetic Improvement of T*ecomella undulata* [AFRI- 33/FGTB-9/2002-05]**

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

Status:

Survey conducted for availability of candidate plus trees (CPTs) in different areas. Selected 30 CPTs in the irrigated tract of IGNP canal area from the plantation raised in 1987 and 35 CPTs in the unirrigated areas in the Farmers Field. The data has been recorded for the total height, clear bole, d.b.h., and the colour of the flower. The tree bears yellow, deep red and orange colour of flowers. The clear bole percentage was calculated over the total height of the CPTs selected, the maximum clear bole over the total height was recorded 46.5 per cent and

minimum 17.9 per cent. The number of trees in each range of the clear bole percentage over the total height is presented below:

S.No.	Range in percentage		No. of trees
	From	To	
1.	17.9	20	5
2.	21	25	3
3.	26	30	7
4.	31	35	6
5.	36	40	4
6.	41	45	2
7.	45	46.5	3

Fig. 9: Photographs of the CPTs selected

Project 9: Screening of high oil and azadirachtin in Neem [AFRI-34/FGTB-10/2002-05].

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

Status:

Twelve hectares of progeny trials of summer and winter flowering CPTs at AFRI, Jodhpur and high azadirachtin & high oil containing CPTs at Govindpura Jaipur are being maintained.

Project 10: Identification of mortality factors of *Prosopis cineraria* and development of suitable management strategies [AFRI- /2001-2005].

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

Status:

It has been examined that this devastating problem has primarily been arised with the cumulative effects of indiscriminate and successive lopping followed by a secondary infestation of three species of root and shoot borers viz., *Aeolesthes holoserecea* Feb, *Derolus iranensis (discicollis)* Gahan and *Hypoeschrus indicus* Gahan. The affected samples reveal the presence of three highly infective species of fungi *imperfectii* viz., Alternaria spp. Phoma sp, and Botryodipldia sp, which cause the die-back disease in mature trees of Khejri as a result of which the tree starts drying from the top. Among the other problem contributory factors: (i) continuous depletion of water table in Rajasthan; (ii) increasing number of tube-wells or over exploitation of ground water; (iii) effect of low rain fall; (iv) change in soil property and agricultural practices and (v) over maturity of trees are some of the suspected causes which may play an important role in large scale drying of khejri in north western zone of Rajasthan.

A. Entomological observations and findings:

The extensive surveys on the khejri mortality in nort-west Rajasthan have been taken up and the observations on various biotic and abiotic aspects have been completed. Data on the following aspects have been collected in order of evolving possibilities of finding out the responsible causes for the mass scale morality of *P. cineraria* in northwestern districts of Rajasthan.

1. Biotic stresses: Data on insect pest and disease problems.

2. Abiotic stresses: Data on lopping intensity and interval; water table depletion in study areas; surface water exploitation through tube-wells; change in agricultural practices.

- The insect borers viz., *Aeolesthes holoserecea* Feb, *Derolus iranensis (discicollis)* Gahan and *Hypoeschrus indicus* Gahan along with infested materials of khejri trees have been collected. The insect specimens got identified from Forest research Institute, Dehradun.

- Studies on the bionomics of potential insect borers viz., *Derolus iranensis (discicollis)* and *Aeolesthes holoserecea* Feb. is in progress. Studies on the collection and identification of plant pathogens and preparation of a check list of potential pathogens infecting *P. cineraria* is in progress.

Table 5: Percentage Khejri mortality in the selected localities of four districts of Rajasthan

Districts	Site	Minimum	Site	Maximum
Nagaur	Pachori	04.67	Ren	36.30
Sikar	Kishnawa	06.16	Sola	42.78
Jhunjhunu	Sihor	03.70	Gowia	41.00
Churu	Dorajsar	02.33	Lambarbari	37.69

- Maximum percentage of khejri mortality in the four north western districts of Rajasthan viz., Nagaur, Sikar, Jhunjhunu and Churu has been recorded as being 36.52, 38.87, 42.78 and 26.08% respectively.The mortality percentage is being correlated with the other biotic (pests and diseases) and abiotic (soil and water quality, water table depletion, lopping intensity and interval, use of ploughing implements and status of hard pan etc.) factors.
- The incidence was maximum in 71 to 100 cm girth class under which 9,537 trees had an attack of heart wood borer/ heart rot disease, followed by 30-70 cms where 8300 trees were found attacked. The incidence was less in lower and higher girth class. The minimum incidence was in the girth class 161 and above where only 165 were found attacked.
- Maximum mortality was observed in 71-100 cm girth class in which 2122 trees were killed followed by 1570 in 31-70 cm girth class, 850 in 101-130 cm, 700 in 21 – 29 cm, 165 in 131-160 cm and only 47 in 161 cm and above girth class. The highest incidence of borer attack as well as the maximum mortality were observed in the girth class 71-100 cm and this gradually decreased on the lower as well as higher girth classes. Higher girth class (161 and above) had lowest mortality as well as incidence of borer attack.
- Collection of various relevant abiotic factors viz., soil, water and studies on their interaction with the khejri mortality is in progress. Studies on the the nutritional factors for soil (N, P, K, Cu, Fe, Mn, Zn) and plant nutrients (N, P, K, Ca, Mg, Cu, Fe, Zn, Mn) and their correlation with the concerned problem is in progress.

B. Pathological observations and findings:

- The root samples of khejri (*P. cinearia*) were analysed in the laboratory and two species of *Fusarium* and *Rhizoctonia solani* were isolated and identified. All the three pathogens are wilt and root rot causing pathogens which enters through roots damaged by mechanical /insect injury.
- The high incidence of moratlity in khejri was noticed in agroforestry as compared to trees grown in undisturbed land i.e., Oran and Gochar lands at Salasar Tahsil, Sikar District.
- The pathogen, *Colletotrichum* sp. was found associated with diseased branches of Khejri from Sikar. The root samples of Khejri (*P. cineraria* L. Druce.) were anaysed in the laboratory and two species of *Fusarium* and *Rhizoctonia solani* were isolated and identified. All the three pathogens are wilt and root rot causing pathogens which enters through roots damaged by mechanical /insect injury.

- More than 35 Khejri infected wood samples collected from various localities we analysed in laboratory and nine various fungal species

Field experimental trial:

A field experimental trial for the management of Khejri mortality has been laid out Basuwa in Sikar district during January, 2004 in order to test the relative efficacy of differe treatments for the management of infected Khejri trees. The experiment was laid out randomized block design (RBD) with seven treatments. The treatments were taken wi different combinations of fungicides, insecticides and growth regulators. The lopped branch were pasted with AFRI paste (a modified chaubattia paste). The diseased samples were analys in the laboratory and *Colletotrichum* sp. was isolated and identified.

The most effective root treatment comprises Chloropyriphos 20 EC (300 ml) + Bavist (300 gm) + Leader (400 ml) in 200 lt of water whereas the potential shoot treatment contai linseed oil (2 lit) + copper carbonate (1 kg) + red lead (1 kg) + Monocrotophos (2 ml).

Project 11: Studies on improving tree productivity of *P. cineraria* throug VAM/Biofertilizers [AFRI-36/Silvi-8/2002-06] .

Principal Investigator: Dr.K.K. Srivasta

Status:

- VAM population studies showed that maximum number of propagules we isolated from agro-forestry plantation of *P. cinearia* at Sikar and minimum fro Churu.
- *Glomus fasciculatum* and *G. aggregatum* were found dominant gene *Scutellospora* and *Sclerocystis* were less in number.
- Maximum spore population was recorded 0-10 cm depth of soil and gradual decreasing in deeper layers.
- Nursery experiment on biofertilizer stydy in *P. cineraria* has been laid out Completely Randomised Design (CRD) with eight treatments with differe combinations of bacterial biofertlizers and VAM. and three replications.
- The inoculum containing different species of VAM fungi brought from IFGT CBE were maintained in vermiculite in pots.
- VAM inoculum production of five different species of VAM fu (indigenous and non-indigenous) started in sterilized vermiculite at Mod Nursery, Jodhpur and TRC, Gandhinagar (Gujarat).
- The stock culture of five bacterial biofertilizers including *Rhizobiu Azospirillum* and *Bacillus* sp. were maintained in suitable media for furth experimental purpose.

Project 12: **Ethanomedical Property of Phyto pathogenic Fungi: Screening And Isolation of Therapeutic Products.**

Principal Investigator: Ms. D. Thangamani

Status:

In Screening and identification of antimicrobial activity study, Fomes *species, Aspergillus ochraceous, Aspergillus niger and Aspergillus flavus* were screened. These pathogenic fungi were isolated from infected trees of *Prosopis cineraia.* In that study, the products were analysed in submerged as well as in stagnant condition. The result was noticed under both conditions and the products production and standardization has been done. The results showed inhibitory action against Fusarium sp. The Shaked culture of the *Aspergillus flavus* showed two compounds with inhibitory activity against pathogenic fungi. Further analysis in progress.

Project 13: **Project 13: Studies on seed quality improvement in respect of various tree species of arid and semi-arid areas [AFRI-35/Sil-7/2002-07].**

Principal Investigator: Dr. D.K. Mishra

Status:

Seeds of *Dalbergia sissoo* and *Ailanthus excelsa* collected during last year were stored at various moisture and temperature levels and were tested for moisture and germinability during this year also and it was observed that the variability of both types of seed reduced significantly. Neem seeds collected and tested showed that physiologically mature green, green yellow and yellow fruits showed >90% germination. During storage, yellow green seeds performed better. Seeds of *Prosopis cineraria* collected by SFD, Rajasthan from four Agro Climatic Regions (ACRs) are under seed testing. 100 seed weight varied from 3.87-4.42g while variation in germination % was from 73% to 91%. Black coloured seed of *Commiphora wightii* gave 45% germination while white coloured showed only 5% germination. The performance of seeds of *Dalbergia sissoo* collected during the last year is tabulated below.

Table 6: Seed studies on *D. sissoo*.

Zone	100 pod wt. (g)	%G	MGT	V index
IA	6.0	45.3	12.0	353
IB	5.9	33.8	12.7	257
IIA	6.3	56.8	11.4	542
IIB	6.2	61.3	11.7	616
IIIA	6.4	68.5	10.5	690
IIIB	5.4	57.0	10.9	531
IVA	6.0	66.8	10.1	722
IVB	6.8	71.8	10.6	762

Project 14: Market survey on selected species in selected markets [AFRI-24/FRM 1/1994-Continue].

Principal Investigator: Dr. V.P. Tewa

Status:

The data regarding prices of various forest produces viz., timber, fuel-wood, bamb were collected from the markets of Jaipur and Ahmedabad on quarterly basis. After compilatio the same were sent to the ADG (Stat.), ICFRE, Dehradun on prescribed format for publicati of Timber and Bamboo Trade Bulletin.

Project 15: Stand dynamics of some important tree species of Gujarat [AFRI-25/FRM 2/2001-2006].

Principal Investigator: Dr. V.P. Tewa

Status:

Annual measurements carried out in 36 sample plots of *E. hybrid* and 22 of *A. nilotic* laid out in Gujarat State. Data processing and plot computations have been completed whic include information on stems/ha, BA/ha, Dominant height, average height and quadratic mea diameter of the trees in the plots, volume/ha etc. The MAI in respect of total wood volume (ob for *E. hybrid* and *A. nilotica*, ranged from 0.77 to 32.14 m^3/ha/year and 0.60 to 10.7 m^3/ha/year, respectively depending upon age, density and site. The dominant heights in t stands varied from 5.8m to 34.1m for *E. hybrid* and from 4.6m to 21.1m for *A. nilotic* depending upon site quality and age. Annual height & diameter increments and form factor f the stands have also been calculated. Preliminary total wood volume equations (over-bark under-bark) were developed for both the species using combined variable model for estimati total volume yield in the stands. Finally total wood and merchantable volume equations for *nitotica* constructed and validated.

Project 16: Screening of exotic and indigenous plant species for their performance o salt affected soil with different management project [AFRI-6/FRME-4/199 2003]. *Principal Investigator: Dr. Ranjana Arya*

Status:

A total of seven experimental trials exist at the salt affected area of Gangani in Jodhp district laid out in different years (from 1997 to 2003) out of which Experiment-1 & 4 we concluded in 2003 2, 3 and 6 are concluded in the year 2004-05.

Experiment 2: Concluded

Salvadora persica (L.) is a preferential halophyte, evergreen multipurpose tree, howev its slow growing nature resists its cultivation. An experiment was initiated on saline alkali sand loam soil with eight treatments comprising of four levels of nitrogen (0, 9, 18 & 27 g of N) a two levels of gypsum (0 & @ 100% soil GR) application in a randomised block design. Resu of sixth year of plant growth and biomass yield indicate that despite deficient rainfall conditio appreciable survival, from 85.2 to 66.7%, was recorded in different treatments. Treatme positively influenced the growth and application of nitrogen in combination with gypsum g better results as compared to application of nitrogen only. T_6 (gypsum + 9g N) was the b treatment attaining 207 cm of height and 212 cm of crown diameter, which was 38% and 2

more than the untreated plants. The above ground biomass study revealed that T_6 treatment produced 12.0 kg/tree of fresh biomass followed by 10.7 kg and 8.8 kg in T_8 (gyp + 27g N) and T_2 (9 g N) respectively, which was 71%, 53% & 27% more than the control (untreated plants). Good coppice growth observed in all the 24 trees cut for biomass. Changes in protein concentration in various plant parts of *Salvadora persica* was determined. Protein concentration was least in gypsum + nitrogen treated plants as compared to nitrogen treated plants. There is decreased accumulation of proteins in gypsum treated plants showing the reutilization of the stress-induced proteins for growth and biomass yield of the species. Crescent shaped drainage trenches for individual plants helped in plant establishment and growth as it served the dual purpose of leaching of salts and water harvesting as well. The site has shown substantial improvement in soil status (reduction in soil pH and electrical conductivity and improvement in percent organic carbon content) during the study period. Growth of *S. persica* promoted the natural regeneration, dominated by halophytes, the number of plant species increased gradually. Green biomass yield of associated species was highly dependent on rainfall and 762 gm^{-2}, 768 gm^{-2}, 58gm^{-2} (drought year) and 620gm^{-2} was recorded third year onwards after planting. It can be concluded that *S. persica* has the potential to make the barren salt affected area productive.

Experiment 3: Concluded

Acacia ampliceps was planted with and without gypsum in Sept 1998 on highly degraded soil. Species suffered with some casualties (more on shallow soil area) due to deficient rainfall and now the overall percent survival was 55.4 (-5%) for control and 65 (-6%) for gypsum treated trees on deeper soil as compared to 45 (-13%) for control and 35.2 (-26 %) for gypsum treated trees on shallow soil area. Height and crown diameter registered increase (5 & 8 and 2.5 & 10 %) on deep soil for control and gypsum treated plants (G_1) but there was slight decrease in both parameters on shallow soil except for height of G_1 plants. Soil depth influenced the biomass production also and the biomass estimation of 12 trees carried out in Nov. 2003 showed that green biomass yield difference was more than two fold (12 kg/tree to 5.43 kg/tree for gypsum treated and 8.1kg to 3.9 for untreated trees). Moderate flowering was recorded in 50% trees of *A. ampliceps* in deeper soils (with or without gypsum) while only 27% trees flowered in control in the shallow soil area as against 87% for gypsum treated. It can be concluded that *Acacia ampliceps* (exotic tree species) performs very well on deep saline-alkali soils (soil depth 60 cm to 75 cm minimum).

Experiment 5:

An experimental trial of *A. amnicola* was laid out in August 2000 with three planting treatments (double ridge mound S_1, elevated slope planting S_2 and simple bund planting S_3) with full gypsum requirement G_1 and control G_0. Treatment combinations were $T_1 = S_1Go$, $T_2 = S_2G_0$, $T_3 = S_3G_0$, $T_4 = S_1G_1$, $T_5 = S_2G_1$, $T_6 = S_3G_1$. In spite of severe drought survival was maintained at 48 months of age the survival varies from 80.6% to 61.4% in different treatments. However, there was either no change or marginal decrease in height and crown diameter. Gypsum application positively influenced the dry biomass yield, increase was ranging from 4% in DRM, 19% in Bund and 42 % on SRM. Cut biomass estimation in *A. amnicola* trial was determined data analysis is under progress. Complete flowering and seed setting is observed in *A. amnicola*. Percent protein content was estimated in dried leaf (13.6–15.8%) and branch (8.1–10.8%) of various treatments.

Experiment 6: Concluded

Trial was laid with three salt tolerant species namely, *A. lentiformis, A. stocksii* a *Sueda nudiflora* and three planting techniques. *Sueda nudiflora* adapted well to the dry h stress & salt conditions. It was the best species recording nearly 100% survival, attaining m growth and biomass in all the three planting treatments(Double ridge mound (DRM), Circu dished mound (CDM) and control) followed by *Atriplex lentiformis. Atriplex stocksii* w poorest performer.

S. nudiflora produced maximun total dry biomass on all the three structures (2.16 th in DRM, 2.25 tha^{-1} in CDM and 1.09 tha^{-1} on control followed by *A. lentiformis* (1.18 tha^{-1} DRM, 1.30 tha^{-1} in CDM and 0.23 tha^{-1} in control). *Atriplex stocksii* produced minim biomass (1.13 tha^{-1} in DRM, 0.72 tha^{-1} in CDM and 0.26 tha^{-1} in control) Overall DRM was best planting practice producing maximum 1.49 tha^{-1} mean dry biomass, closely followed CDM (1.42 tha^{-1}) while control was poor third with 0.53 tha^{-1}.

Ash content- *A. lentiformis* (21-24%) *S. nudiflora* (27-34%), *A. stocksii* (30-38%)

Experiment 7:

A trial with two tree species, *Acacia colei* and *Azadirachta indica* was laid with thr treatments of planting in August 2001. No change in survival (from 24-36 months) was record and good survival was maintained in DRM (69.0%) followed by CDM structure (46%) a control (23.8%). Specieswise, *Acacia colei* showed better survival than *Azadirachta indic* Height, crown diameter and collar girth was not influenced by structure for A. colei but in ca of neem crown diameter and collar girth was significantly high in CDM as compared to oth structures. Total biomass (above and below ground) of both the species on three structures w done. CDM was best structure for *A. indica* producing maximum aboveground a belowground fresh biomass, which is more than double as compared to control, while in case *A. colei* DRM produced maximum biomass but structures were not significantly different.

Experiment 8:

A new experimental trial was laid in August 2003 with two fodder species name *Zizyphus mauritiana* (Ber) and *Colophospermum mopane*. The trial was laid with two levels gypsum (0 and 100% soil G.R.) and three doses of nitrogen (0, 9 and 18 g of N in the form urea) on two modes of planting (control and circular dished mound). *C. mopane* registered 95 survival on CDM and 90% in control after one year of planting, while it was 81 and 72% for *mauritiana*. Growth data recorded at 18 months showed that Ber recorded better overall avera height (61 cm to 39cm) while crown diameter was more for *C. mopane* (52 cm to 47.5 cm). case of Ber, 10 and 16% more height and crown diameter was recorded on CDM as compared control, while for mopane no difference in height and 10% more crown diameter was recorded. Nitrogen application increased both height and Crown diameter (16%) for Ber. In case mopane influence was on crown diameter only (15%).

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

Project 17: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time. [AFRI-15/NWFP-4/ 2002-2005]. ***Principal Investigator: Dr. Mala Rathore***

Status:

The yield of petroleum ether and methanol extractives of flowers of *Calotropis procera* collected for three seasons viz., monsoon, winter & summer was determined and it was found that the yield was highest in monsoon and lowest in summer season. The yield of fractionated extracts of methanol extract showed that in case of petroleum ether, benzene and chloroform fractions, the yield was higher and in case of acetone & methanol fractions the yield was lower in monsoon season as compared to winter season. In case of ethyl acetate fraction, the yield was almost the same.

Project 18 : Studies on post harvest technologies on non-traditional, under-exploited locally available timber species for suitability to handicraft and other small scale Industries [AFRI-37/NWFP-5/2002-2006].

Principal Investigator: S.H. Jain

Status:

Wood logs of *Acacia tortilis* (Israili babool), *Prosopis cineraria* (khejri), *Prosopis julifora* (Vilayathi babool) have been taken from experimental fields of AFRI. The logs have been sawn and treated with preservatives, 2% CCA and 2% chloropyriphos solution under pressure of 80 psi. Moisture has been brought down to 10-12% in kiln seasoning chamber and further seasoned under natural condition. The durability of these plantation-grown wood exhibiting better shelf life compared to control. Value added products like Sofa set and utility boxes have been made out of treated wood.

Small handicraft items like pen/pencil stand have been made from treated and seasoned wood of *Acacia tortilis, Prosopis cineraria, Prosopis julifora* for display in fairs/exhibitions to popularise the utilisation of lesser-known species with value addition.

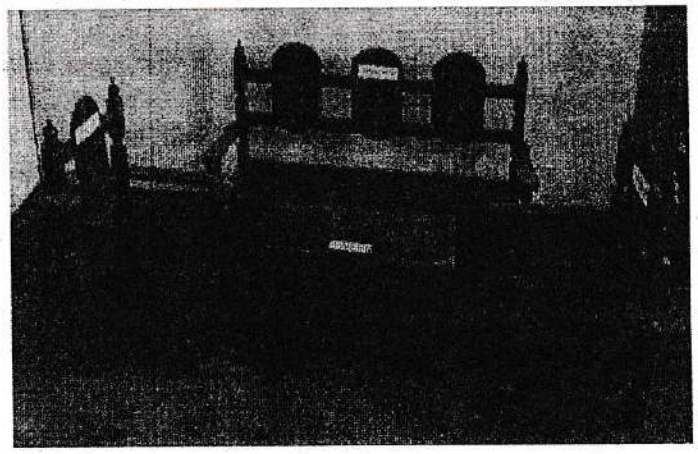


Fig 10: Furniture from treated wood

Furniture were made from preservative treated (CCA and Chloropyriphos) under pressure treatment plant and seasoned wood of all the three plantation grown lesser known timber species viz. *A. tortilis, P. juliflora and P. cineraria.*

Project 19 : Survey of sandal population in Rajasthan and Gujarat states and evaluation of heartwood content and oil content [AFRI-44/NWFP-6/2003-2007].

Principal Investigator: S.H. Jain

Status:

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

Project 20: Transfer of technology on forestry through training and demonstration [AFRI-38/SF-1/2002-2006].

Principal Investigator: Dr. S. Mohan
Co-PI: Balbir Singh

Status:

An Extension and Interpretation Centre has been established which was inaugurated by the DG, ICFRE on 04.07.2004 during his visit to the institute.

Fig 11. DG ICFRE during inauguration of Ext. & Interpretation Centre

Civil works like Maintenance of Hall, Construction of 4 stepped circular & semi-circular CC platforms for display of 3 D Models, Fabrication of wooden box for display of exhibits, building name letters (steel-bilingual), display boards, backlight printing board, metallic folding photo album and laminated photographs, etc. depicting the research activities of the institute are completed. 3D models on research findings and technologies developed for transfer to the end users are being prepared after inhouse discussion with the scientists & officers.

Project 23: Identification of key indicators and suitable strategies for sustainable Joint Forest Management in Gujarat and Rajasthan [AFRI-39/JFM-1/2002-2006].

Principal Investigator: Dr. Sunil Kumar

Status:

Survey work on collection of information pertaining to socio-economic status and present status of Joint Forest Management committee, in the well developed detailed questionnaire is in progress. Sofar, 125 JFM villages committees (85-Rajasthan & 40 –Gujarat) have been covered and the sampling survey have been completed. The committee members & villagers were interviewed and information regarding JFM Committees were collected. The information is being fed in the computer for analysis.

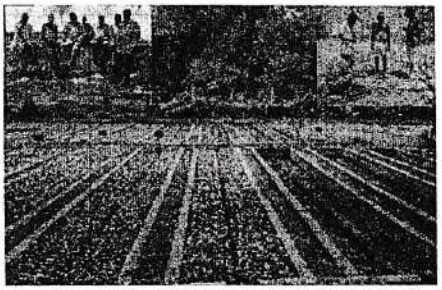


Fig 12. Discussion with people and forest field functionaries during

Project 22: Development of suitable multi-tier farm forestry models in IGNP command area [AFRI-39/JFM-1/2002-2006].

Principal Investigator: Dr. B. M. Dimri

Status:

Site at 155 RD Charanwala branch in IGNP area has been finalised and some surve y work and soil samples were also collected & analysed. For want of funds under Plan, the project could proceed further during the current financial year. However after constant persuasion, the Rajasthan Forest Department has agreed for implementation and funding the project in collaboration with AFRI. Silvicultural tree species seedlings have been raised at AFRI model Nursery. Further actions will be taken after chalking out the details with Rajasthan Forest Deptt.

Project 23: Standardization of nursery practices in respect of selected species suitable for arid & semi arid region [AFRI-33/ Silvi-5 / DRDA/2002-06].

Principal Investigator: H.C. Choudhary

Status:

- Planting stock required by various research divisions for undertaking various experimental trials during the year have been successfully raised and supplied.
- Various aspects of nursery technology suitable for raising planting stock in arid and semi-arid region have been demonstrated to IFS & SFS probationers, farmers, trainee forest rangers/ foresters/ forest guards, members of various watershed development committees who visited the nursery during the year.

EXTERNALLY AIDED PROJECTS

Ongoing Projects

Project 1: Development of silvipasture model for *Maru Gaucher Project* suitable f arid & semi arid region of Rajasthan [AFRI-45 / Silvi-9 / MGP/ 2003-06].

Principal Investigator: H.C. Chaudh

Status:

Provided technical guidance to two gram panchayats for execution of silvi-past rehabilitation of oran/gauchar as being undertaken by them under the centrally sponsored 'Ma Gauchar Yojna' on an area of 16 ha. at each of the two villages.

Project 2 : Development of suitable models for urban aesthetic forestry suitable for ar & semi arid region of Rajasthan [AFRI-28 / Silvi-4 / UIT / 2001-06].

Principal Investigator: H.C. Chaudh

Status:

- 2.23 kilometre long experimental avenue plantation raised during the year 2001-02 funding from UIT Jodhpur has been maintained during the year.
- 1.04 kilometre long experimental avenue plantation raised during the year 2002-03 funding from the Jodhpur Pardushan Nivaran trust, Jodhpur has been maintained duri the year.
- 3.50 kilometre long experimental avenue plantation raised during the year 2003-04 funding from the Rajasthan Urban Infrastructure Development Project (RUIDP) h been maintained during the year.
- Growth and survival data in respect of the plants raised under the experimen plantations have been recorded. Average height and diameter growth of vario ornamental tree species raised under the experimental plantations have been observed the order of *Dalbergia sissoo* > *Azadirachta indica* > *Cassia siamia* > *Tecome undulata* >*Pongamia pinnata* > *Alistonia scholaris* > *Casia fistula* > *Delonix regia.*
- In respect of *D. regia* even under the liberal irrigation condition, severe die back ha been observed during the winter season making the species less suitable for urb aesthetic forestry in arid region.
- Under the liberal watering of sewage water exceptionally high average top height ha been observed in respect of *D. sissoo, C. siamia* and *A. indica.*
- Foliar spray of dilute monocrotophos solution at an average interval of 15 days has be found very cost-effective solution for controlling browsing of *A. indica* by blue bulls.

Project 3: **Raising of arboretum cum Botanical Garden for native flora of Rajasthan [AFRI-34/Silvi-6/2002-06].** *Principal Investigator: Shri K.K. Chaudhuri*

Status:

- Plants belonging to 82 native tree species of the Rajasthan have been maintained.
- Construction of improved shade house with underground water tank has been completed.

Project 4: **Survey and silvicultural management practices for commercially exploitable medicinal plants of arid and semi-arid areas of Rajasthan [AFRI 35/Silvi 8/MPB/2002-05].**

Principal Investigator: Dr. D.K. Mishra

Status:

More than 210 species of medicinal plants are being traded in 18 Districts of Rajasthan and maximum number of units are in Jaipur followed by Udaipur and Jodhpur. *Emblica officinalis* has maximum demand followed by *Cassia angustifolia* Vahl. Total quantity of medicinal plants traded in Rajasthan is more than 7,30, 000 kg. Jaipur tops among the surveyed districts with 40% trading of medicinal plants followed by Jodhpur (22%), Ajmer (16%), Udaipur (10%) and Chittorgarh (4%). Other districts amount 8% of trade. Most units (40-50%) are not working. They are either closed, untraceable or doing other business. Germplasm bank has been established with 150 medicinal plants. Field trials/cultivation trials on *Commiphora wightii* (Guggal), *Aloe vera* (Guarpatha), *Catharanthus roseus* (Sada Bahar), *Withania somnifera* (Aswagandha), *Ocimum sanctum* (Tulsi) and *Asparagus racemosus* (Shatavari) are in progress.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: **Ecological and environmental assessment in the on-shore area of RJ-ON-90/2 block, Rajasthan.**

Principal Investigator: Dr. G. Singh

Status:

Literatures on floral diversity, faunal diversity, nesting place and migration paths of wild life were collected from various sources. Field visits were carried out and interactions were made with the villagers and staff of forest department. Based on the literature and people interactions, a preliminary report was prepared and submitted to the funding agency. Predominant tree species are: *Prosopis juliflora* (bilayati babool), *Acacia senegal* (kumatha), *Salvadora oleoides* (mitha jal), *Salvadora persica* (khara jal), *Prosopis cineraria* (khezri), *Tecomella undulata* (rohida). *Capparis decidua* (ker), *Zizyphus nummularia* (jhar ber), *Acacia jacmontii* (bhoo bavali), *Lycium barbarum* (murali), *Clerodendrum phlomoides* (irna) are the shrubs species. Shrubs include *Leptadenia pyrotechnica* (khimp), *Crotalaria burhia* (sinia), *Aerva pseudotomentosa* (bui), *Tephrosia* species (bipni) etc. Grasses include *Cenchrus biflorus* (bhurat), *Aristida* species (lapda), *Lasiurus sindicus* (sewan), *Dactyloctenium sindicum* (ganthia), *Indigofera* species (beker), *Tribulus terrestris* (gokharu or kanti), *Boerhaavia hirta*

(punarnva). The creepers are *Citrulus colosynthesis* (tumba) and *Citrulus allatus* (matira). The *Cocculus pendulus* (pilwan) is mostly found in association with *P. cineraria* tree. Amongst the mammals, chinkara (*Gazella bennetti*), Indian fox (*Vulpes bengalensis*), desert fox (*Vulpes vulpes pussila*), jackal (*Canis aureus*), desert cat (*Felis chaus*), jungle cat (*Felis lybia*), desert hare (*Lepus nigricollis dayanas*), nilgai (*Boselaphus tragocamelus*), wolf (*Canis lepus pallips*), black buck (*Antelope cervicaps*), spotted deer (*Axis axis*) and wild boar (*Sus scrfa*) are the animals of the region. Conclusively, despite of the adverse climatic conditions, region has some important floral and faunal species and some of them have been endangered or are at a verge of extinction. The concentration of wild life is more in the northeastern, central eastern and southwestern parts of the RJ-ON-90/1 block particularly the Luni river basin of Sindari, Gudamalani and Sanchor areas.

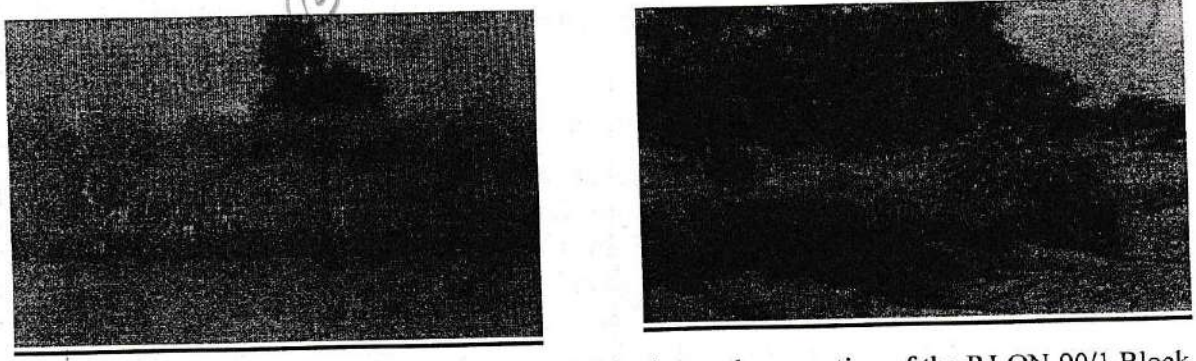


Fig 13: Indian gazelle (left) and Blue Bull (right) in the southern portion of the RJ-ON-90/1 Block.

Project 2: Study of Characteristic Features Pertaining to Bio-drainage Potential of Some Selected Tree Species.

Principal Investigator: N. Bala

Status:

The project has been funded by the Ministry of Water Resources (MoWR), New Delhi and initiated in April 2004. Three sites have been selected for the experiment. One is near Masitawali head of IGNP in Hanumangarh district of Rajasthan.

Fig 14: Water logged area near Masitawali

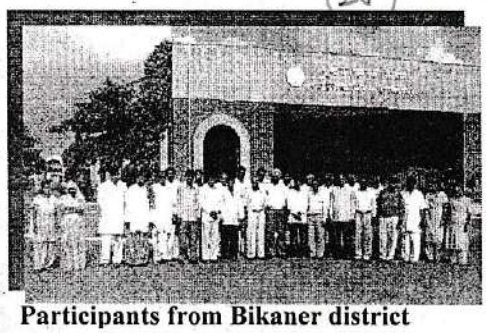
This site is having extremely high salinity ranging from 37 dSm^{-1} to 42 dSm^{-1}. The other sites are located at 1357 RD of main IGNP and Anupgarh branch of IGNP having low salinity regime. Seeds have been procured and seedlings are being raised at Hightech nursery at Mohangarh, Jaisalmer. An interactive meeting was organized at Arid Forest Research Institute, on 20th August 2004 to establish liaison with various end users and possible collaborators for smooth implementation of the research project. Three JRFs and one Field assistants have been appointed. Procurement of necessary equipments is in progress. Lysimeters are being restructured as per experimental design to maintain various water logging and salinity levels at AFRI experimental site.

Project 3: **Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems.**

Project Leader: Shri Balbir Singh

Status:

- The training programme for the PRI functionaries i.e Village Sarpanch, Up-Sarpanch, panch, BDO's , Gram Sevaks. Gram sabha members, farmers etc. of the 10 Desert districts, in two phases has been prepared.. The project period is over two years.
- In the Phase I, 10 Trg. Programme at AFRI in 10 batches of 40 each of PRI functionaries and forest field staff in 4:1 ratio were organised from 23rd August, 04 to 6th Oct, 2004. In total 437 participants comprising of 269 PI Functionaries, 1 BDO, 89 Grem Sevak & 79 Forest officials including 8 women attended the training programme.
- The topics covered during Phase I Trg. Prog. include Agroforestry models for arid region, Medicinal plants, Increasing productivity through tree improvement, Biofertilizers, Plant protection measures, Water harvesting techniques, Afforestation - Plant raising with latest technologies, Saline land reclamation, Sand dune stabilization, Pasture development, Animal resource development, crop management & organic farming, Pisciculture, Role of women in forestry and allied activities, Horticulture.



Participants from Bikaner district

Fig 15:

Inagural session of Jasailmer district

In Phase II, 30 training programmes in 10 desert districts (3 Trg. Prog. of two days duration, each district) at the convenient places, identified/decided by the Forest Department will be organised for gram sabha members. The training programme for Jodhpur district at three different places has already been completed from 22nd –27th February, 2005.

Research Achievements State-wise under Institutes jurisdiction

Name of State	No. of Projects completed in 2004-05	No. of ongoing Projects in 2004-05	No. of Projects initiated in 2004-05
Rajasthan	2*	24	3
Gujarat	-	3	-
Common to both Rajasthan & Gujarat	-	6	-

* Project concluded during 2003-2004 but report submitted by PI during 2004-05.

Technology Assessed and Transferred

- Preparation of AFRI paste and its application to the affected Khejri trees has bee demonstrated through training programmes of the farmers and through impartin training to the agricultural officers.

- Indigenous and exotic species *Atriplex lentiformis* and *Acacia amliceps* screened ou with afforestation technology on salt affected lands. Seeds of these species wit afforestation technology were supplied to State Forest Department Gujarat & Rajasthan.

- VAM production facility was developed at TRC, Gandhinagar, State Forest Departmen Gujarat. Demonstration for preparation of VAM inoculum containing five differen combinations of species of VAM fungi Viz., *G. fasiculatum*, *G. microcarpum* and *G aggregatum* including Consortium inoculum was given to the field officers.

Education & Training

(a) Trainings attended by AFRI Officials

I. International

- Dr Tarun Kant has been awarded one year Post Doctoral Fellowship from 16th Augus 2004 to 15th August 2005 under "Biotechnology Overseas associateship 2003 2004. Govt. of India, Dept. of Biotechnology" at the Department of Plant Sciences, University of Cambridge, U.K.

- Sh. N. Ravi, R.O. attended "Third Country Training Programme on genetic conservatio of indigenous species for breeding purposes at Yogyakarta, Indonesia from 6th March 2005 to 19th March' 2005.

II. National

- Sh. R.L. Meena, IFS attended one week compulsory training programme on "Biodiversity conservation" at southern Forest rangers college, Coimbatore from 25th - 29th October, 2004.
- Sh. Balbir Singh, IFS attended one week compulsory training programme on Financial Management and Audit sensitization for IFS officers at National Academy of Audit and Accounts, Shimla from 26th -30th July, .2004.
- Sh. Balbir Singh, IFS attended one week compulsory training programme on Natural Resources Management and Conflict Resolution at Institute of Rural Management, Anand (Gujarat) from 03rd –07th January, 2005.
- Dr. Pramod Kumar attended training on Natural Resources Management for Sustainable Rural Development from 20th -24th September, 2004 at Bhopal organized by Indian Institute of Forest Management.
- Shri N. Bala attended ISO 14001 EMS Lead Auditors training organised at ICFRE, Dehradun from 23rd –27th November 2004.
- Sh. H.C. Choudhary, IFS, Deputy Conservator of Forests attended one week training on 'Learning Lessons from Externally Aided Projects' at Forestry Training Institute, Jaipur from 25th -29th October, 2004.

(c) Trainings Imparted by Institute:

1. Organized 10 No. of 3 days training programme on Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems from 23rd August to 6th Oct., 2004 for the PRI functionaries i.e Village Sarpanch, Up-Sarpanch, Panch, BDO's, Gram Sevaks, Gram Sabha members, farmers etc. of the 10 Desert districts in Phase-I at AFRI in 10 batches of 40 each of PRI functionaries and forest field staff in 4:1 ratio. In total 437 participants comprising of 269 PI Functionaries, 1 BDO, 89 Gram Sevak & 79 Forest officials including 8 women attended the training programme.
2. As a multidisciplinary approach of watershed management, inputs on Nursery & plantation techniques, biofertilzers, agroforestry models, moisture & soil conservation techniques, horticulture, on animal husbandry, pasture management were given by the resource persons from both within the institute and outside.
3. In Phase II, 30 training programmes on Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems in 10 desert districts (3 Trg. Prog. of two days duration, each district) at the convenient places, identified/decided by the Forest Department will be organised for gram sabha members. The training programme for Jodhpur district at three different places has already been completed from 22nd –27th February, 2005.
4. Three students from three Universities were given one month training for tissue culture and biotechnology.

Educational Visits:

- 10th batch of Forest Rangers trainees, Southern Forest Rangers College Coimbatore visited the institute from 8th -9th April, 2004 for study of Arid ecology.
- Children from Girls Senior Secondary School, Jalori gate, Jodhpur visited Interpretation Centre at AFRI.

Linkages and Collaboration

National:

1. National Bureau of Plant Genetic Resources, New Delhi
2. Tata Energy Research Institute, New Delhi
3. Central Arid Zone Research Institute, Jodhpur
4. National Botanical Research Institute, Lucknow
5. Rajasthan Forest Department
6. Gujarat Forest Department
7. Ayurvedic units

International:

1. Asia Pacific Association of Forestry Research Institutions (APAFRI), Malaysia
2. Centre for International Forestry Research (CIFOR), Indonesia
3. International Union of Forest Research Organizations (IUFRO)
4. The Guangdong Forest Research Institute, Longdong, Guangzhdou, P.R. China.

Publications

A) Chapters in books :

1. U.K. Tomar, N.K. Sharma, Parveen & CJSK Emmanuel (2003). Literature review on clonal propagation of important arid zone species. In: B.B.S. Kapoor (ed) *Advances in Resource Management,* Madhu Publication, Bikaner, pp. 70-98.
2. S.I. Ahmed, K.K. Chaudhuri, Meeta Sharma, Shivesh Kumar, Sahadev Chouhan, S.D. Paunikar and A.U Khan (2004). Insect pests and mites of important forest tree species and their management in arid and semi -arid region. "*Compendium on arid zone insect pests*" CAZRI, Jodhpur (In press).
3. K.K. Srivastava, S.I. Ahmed and D. Thangamani (2004). Biostresses on arid and semi-arid tree plantations and their possible management strategies. In the Dr. K. Bagchee Memorial Book on Forest Pathology to be published by Forest Pathology Division, FRI, Dehradun.
4. K.K. Srivastava and Y.C. Tripathi (2004). Potential of phytochemical in controlling pathogenic mycobionts. In: D. Reddy, B.P. Dabral, Vinai Singh and K.K. Sood (eds.). *Forest conservation and Management in challenges of the millennium.* pp. 594-612.

B) Research Papers in Scientific Journals

International

1. G. Singh (2004). Growth, biomass production and soil water dynamics in relation to habitat and surface vegetation in hot arid region of Indian desert. *Arid Land Research and Management* **17**(2): 1-17.
2. G. Singh (2004). Influence of soil moisture and nutrient gradient on growth and biomass production of *Calligonum polygonoides* in Indian desert affected by surface vegetation. *J. Arid Environment* **56**(3): 541-558.
3. R.L. Meena and G. Singh (2004). Integrated Ecosystem Approach for Management of Degraded Arid And Semi-Arid Areas of Northwestern India. *Journal of Arid Land Studies* **14**(S): 211-214.
4. K.K. Chaudhuri, G. Singh and N. Bala (2004). Traditional knowledge and technological innovations for productivity enhancement of degraded land of arid region. *Journal of Arid Land Studies*. **14**(S): 221-224.
5. G. Singh, N. Bala, Sarita Mutha, T.R. Rathod and N.K. Limba (2004). Biomass production of *Tecomella undulata* agroforestry in arid India. *Biological Agriculture & Horticulture* **22**(2): 205-216.
6. G. Singh, Sarita Mutha, N. Bala, T.R. Rathod, N.K. Bohra and G.R. Kacchawaha (2005). Growth and productivity of *Tecomella undulata* based on an agroforestry system in Indian desert. *Forests, Trees and Livelihood* **15**(1):89-102.
7. V.P. Tewari (2004). Stem number development and potential stand density in the unthinned even-aged *Azadirachta indica* plantations in the Gujarat State of India *International Forestry Review* **6**(1): 51-55.
8. V.P. Tewari (2004). Desertification and its control through afforestation activities to increase productivity. *Journal of Arid Land Studies* **14** (S): 57-60.
9. V.P. Tewari and Ranjana Arya (2005). Degradation of arid rangelands in Thar Desert, India: A review *Arid Land Research and Management* **19**(1): 1-12.
10. D. Thangamani, M. Ghosh, M. Thapliyal, R. Yasodha, K. Gurumurthi (2004). Purification of antifungal protein against blishter bark pathogen of *Casuarina equisetifolia*. *Acta Botanioca Croatica* **63**(2): 75-82.
11. D. Thangamani, M. Ghosh, M. Thapliyal, R. Yasodha, K. Gurumurthi (2004.) Isolation of Andrographis paniculata leaf protein with antifungal property. *Acta phyto pathologica et Entomologica Hungarica* **39**(4): 377-381.

National

1. Tarun Kant and C.J.S.K. Emmanuel (2004) Tree Biotechnology and Environmental Concerns, *J. Plant Biotechnology* **6**(1): 1-7.
2. G. Singh, T.R. Rathod and Sahadeo Chouhan (2004). Growth, biomass production and the associated changes in soil properties in *Acacia tortilis* plantation in relation to stand density in Indian arid zone. *Indian Forester* **130**: 605-614.

3. Pramod Kumar, N. Bala, G. Singh, S. Mutha, N.K. Limba and N.K. Bohra (20[illegible] Socioeconomic conditions with special reference to common access resources: A case study from Gujarat and Rajasthan. *Indian Forester* **130**(9): 981-990.
4. N. Bala, Pramod Kumar, Kurdaram and G. Singh (2004). Reclamation of saline waterlogged area through community participation. *Wasteland News*, XIX (4): 33-36.
5. Mala Rathore and Rajendra Meena (2004). Nutritional evaluation of famine foods of Rajasthan, *Indian forester* **130**(3): 304-312.
6. S.I. Ahmed, and Shivesh Kumar (2004). Seasonal fluctuations in the population of *Eurytoma settitibia* Gahan (Eurytomotidae: Hymenoptera), a potential stem gall chalcid of khejri (*Prosopis cineraria* Linn) in Rajasthan. *Indian Forester* **130** (8): 885-892.
7. Meeta Sharma and S.I. Ahmed (2004). *Beauveria bassiana*. Vuillemin, a potential entomogenous fungal pathogen isolated from marwar Teak defoliator, *Pagiocerus tecomella*. Pajni, Kumar and Rose (Coleoptera: Curculionidae). *Indian Forester* 130(9): 1060-1064.

C) Scientific Reports Prepared:

1. Concluding report on Agroforestry project entitled "Agro forestry research for sustainable production in arid and semi arid regions of Rajasthan."
2. S.I. Ahmed and K.K. Srivastava (2003). A report on the scientific approach to study the causes of mortality of *Prosopis cineraria* (L) Druce (Khejri) in Western Rajasthan. Min. Govt. of India.
3. G. Singh (2004). A report on floral and faunal diversity for the parts of Jalore and Barmer district under the project `Ecological and environmental assessment in the onshore area of RJ-ON-90/2 block.

Proceeding of Workshops on: Paper-abstract of IUFRO conference

D) Technical Bulletin:

E) Scientific Brochures:

Azadirachta indica A. Juss. APFORGEN Priority Information Sheet. V.P. Tewari and D.K. Mishra. Published by the APFORGEN Secretariat, c/o APAFRI Secretariat, FRIM, Kepong, 52109 Kuala Lumpur, Malaysia.

F) Scientific Films/Documentary: NIL

G) Research Papers Presented in Seminars/Symposiums/Workshops:

1. S.I. Ahmed and Shivesh Kumar (2004). Biology and efficacy of *Tetrastichus spirabilis* and *Eupelmus sp.*, the potential biocontrol agents of gall forming insects of *Prosopis cineraria* (L) Druce. Paper presented in International conference on *Multipurpose trees in the Tropics: Assessment, Growth and Management* organized by Arid Forest Research Institute Jodhpur, November 22-25.

2. S.P. Chaukiyal and T. C. Pokhriyal (2004). Effects of Nitrogen treatment and seasonal variation on growth and biomass production in *Pongamia pinnata*. Pirre. seedlings. Presented in IUFRO conference held at AFRI on 22-25 November 2004.
3. G. Singh and Bilas Singh (2004). Biomass production and water use in *Dalbergia sissoo* seedlings in relation to soil water stress. Presented in IUFRO conference to at AFRI on 22-25 November 2004.
4. G. Singh and T.R. Rathod (2004). Lysimetric study of soil water utilization by tree seedlings in arid environment. In: National workshop on Forest and Water conservation: Mythes and Realities held at FRI, Dehradun on June 8 –10, 2004.
5. G. Singh, T.R. Rathod, S. Mutha, S. Upadhyaya and N. Bala (2004). Tree associated diversity and productivity of vegetation recovered after a severe drought in Indian desert. Presented in IUFRO conference held at AFRI on 22-25 November 2004.
6. R.L. Srivastava, N. Bala and G. Singh (2004). Biological pumps to reclaim waterlogged areas and to reduce soil salinity. In: National workshop on 'Forest and Water conservation: Mythes and Realities' held at FRI, Dehradun on June 8-10, 2004.
7. V.K. Gour, C.J.S.K Emmanuel and Tarun Kant (2004). Direct *in vitro* shoot morphogenesis in desert date (Balanites) from root segments. Paper presented in the IUFRO International Conference on Multipurpose Trees in the Tropics: Assessment, growth and Management, organised at AFRI, Jodhpur from 22 to 25 November 2004.
8. K.K. Chaudhuri, D.K. Mishra, Ved Pal Singh and J.K. Shukla (2004). Analysing the availability of medicinal plants and their export potential in India. Presented in the IUFRO International Conference on Multipurpose trees in the Tropics: Assessment, Growth and Management held at AFRI, Jodhpur, November 22-25, 2004.
9. K.K. Chaudhuri, D.K. Mishra, Vedpal Singh and J.K. Shukla (2004). Harnessing Thar biodiversity for medicinal uses. In: National Workshop on 'Conservation and sustainable utilization of lesser known tree species', FRI Dehradun, March 8-10, 2004.
10. Mala Rathore and Rajendra Meena (2004). Trees Outside Forest as a Source of Leaf Protein Concentrate for Improving Nutritiion. Paper presented in the IUFRO International Conference on Multipurpose Trees in the Tropics held on 22-25 Nov'04 at AFRI, Jodhpur.
11. Mala Rathore, R. Arya, Rajendra Meena, K.K.Chaudhuri (2004). Potential of some lesser known oilseed tree species from Indian Arid Zone. In: National workshop on "Conservation and Sustainable utilisation of lesser known tree species", 8th to 10th March 2004 at FRI, Dehradun.
12. N. Bala, Pramod Kumar, G. Singh (2004). Forests influence water regime. In: National workshop on Forest and Water conservation: Mythes and Realities, held at FRI, Dehradun on June 8 –10, 2004.
13. N. Bala, Pramod Kumar, Kurdaram and G. Singh (2004). Poverty alleviation and resource restoration through community participation. Submitted for the 17th Commonwealth Forestry Conference to be held between 28th February and 5th March 2005.
14. S. Prajapati S., C.J.S.K. Emmanuel and Tarun Kant (2004). Micropropagation of an endangered medicinal tree species of the arid zone: *Commiphora wightii*. Paper presented in the IUFRO International Conference on Multipurpose Trees in the Tropics: Assessment, growth and Management, organised at AFRI, Jodhpur from 22 to 25 November 2004.
15. R.L. Srivastava, K.K. Chaudhuri, R.L. Meena, D.K. Mishra and J.K. Shukla (2004). Important medicinal plants of Thar Desert: cultivation and market potential. 2nd Global Summit on Medicinal and Aromatic Plants, New Delhi, October 25-29, 2004.

16. Ranjana Arya (2004). Effect of plant species on soil properties under irrigated conditions in hot arid regions of India. Paper presented in the IUFRO International Conference on Multipurpose Trees in the Tropics held on 22-25 Nov'04 at AFRI, Jodhpur.
17. Ranjana Arya and R R Lohra (2004). Growth and biomass yield from *Salvadora persica* with management practices on salt affected soil under hot arid conditions in India. Paper presented in the IUFRO International Conference on Multipurpose Trees in the Tropics held on 22-25 Nov'04 at AFRI, Jodhpur.
18. Ranjana Arya, Mala Rathore and R.L. Srivastava (2004). Changes in Protein Concentration in Various Plant Parts of *Salvadora persica* under the Influence of Gypsum and Nitrogen in Arid Salt Affected Soils. Paper presented in the UGC seminar on Trends in Analytical chemistry, held on 29-1 Dec'04 in Dept. of Chemistry, JNV University, Jodhpur.
19. S.H. Jain and Ranjana Arya (2004). Utilisation of plantation grown timber species with application of appropriate post harvest technology to substitute traditional timbers in arid/ semi arid region. National seminar on wood substitution through engineered wood, bamboo and other lignocellulosics, held on 17th dec 2004 at IPIRTI Bangalore.
20. S.H. Jain, Hemant Kumar, Ranjana Arya and K.K. Chaudhuri (2004). Sandal (*Santalum album* L.) a high value tree (HVT) species potential multipurpose tree of arid/semi arid region. Presented in IUFRO international conference on MPTS held on 22-25 Nov, 2004 at AFRI Jodhpur.
21. K.K. Srivastava, Neelam Verma and D. Thangamani (2004). Mycorrhizal Dependency (MD) of some Multipurpose Tree species (MPT,S) Of Arid Zone. Paper presented in International conference on *Multipurpose trees in the Tropics: Assessment, Growth and Management* organized by Arid Forest Research Institute Jodhpur, November 22-25.
22. K.K. Srivastava, D. Thangamani and Neelam Verma (2004). Antagonistic activity of AM fungi against fusarium wilt disease of Rhoida (*Tecomellaa undulata* sm. seem.) Paper presented in *National conference on "Microbes for Mankind'* conducted by Dept. of Microbiology, Karpagam Arts and Science college, Coimbatore on January 9-10.
23. D. Thangamani, and K.K. Srivastava (2004). Purification and characterization of single cell protein from *Aspergillus wentii*. Paper sent to National conference on *"Genomics for health"* held on 11-12 December 2004 at Department of Biotechnology and Microbiology, Karpagam Arts and Science College, Coimbatore.
24. D. Thangamani, K. K. Srivastava and Neelam Verma (2004). Identification and Purification of antifungal proteins from *Trigonella foenum* graceum against the charcoal rot causing organism *Macrophomina phaseolina*. Paper presented in National conference on *"Microbes for Mankind'* conducted by Dept. of Microbiology, Karpagam Arts and Science college, Coimbatore on January 9-10.
25. D. Thangamani, K. K. Srivastava and Neelam Verma (2004). Noval antifungal protein from staphylococcus aureus against Macrophomina phaseolina. Paper presented in National conference on *"Microbes for Mankind'* conducted by Dept. pf Microbiology, Karpagam Arts and Science college, Coimbatore on January 9-10.
26. D. Thangamani, K.K. Srivastava and K. Swaminathan (2004). Mycobial Gene(s) In long term Management of Some Multipurpose tree species(MPTS). Paper presented and abstract published in International conference on *Multipurpose trees in the Tropics: Assessment, Growth and Management organized by Arid Forest Research Institute Jodhpur* ,November 22-25.

27. P. Chaudhry and V.P. Tewari (2004). Use Value – a case study of Mahatama Gandhi Marine National Park, Andaman & Nicobar Islands, India, Paper presented during the IUFRO International Conference on ' Multipurpose Trees in the Tropics: Assessment, Growth and Management' organized at AFRI from 22-25th Nov. 2004.
28. V.P. Tewari (2004). Individual tree growth models for an *Ailanthus excelsa* roxb. plantation in the hot arid region of India. Paper presented in the IUFRO International Conference on 'Multipurpose Trees in the Tropics: Assessment, Growth and Management" held at AFRI from 22-25th Nov. 2004.
29. Ranjana Arya and R.R. Lohra (2004). Utilization of degraded arid salt lands with different management practices. Paper presented in National Seminar on "Rehabilitation of lands under Anthropogenic Stress & Degradation at IFP Ranchi on 20th January 04.
30. S.H. Jain, Ranjana Arya and K.K. Chaudhuri (2004). Rational utilization of plantation grown lesser know timber species presented in National workshop on "Conservation and Sustainable utilization of Lesser known tree species" 8th to 10th March 2004 at FRI, Dehradun.
31. D.K. Mishra, J.K. Shukla and R.L. Srivastava (2005). Rare and threatened medicinal plants of Rajasthan and their conservation concern. Paper presented in the National symposium on emerging technologies and their application in assessment, conservation and management of threatened wild medicinal plants and their habitats, held at SFRI, Jabalpur, 23-25th Feb. 2005.

H) Research Papers Communicated/Accepted/ in Press:

1. S.I Ahmed, K.K. Chaudhuri, Meeta Sharma and Shivesh Kumar (2004). New insect pest records of khejri and rohida from Rajasthan and their possible management strategies. *Indian Forester* (communicated).
2. B. Singh and G. Singh (2004). Influence of soil water regime on nutrient mobilization and uptake by *Dalbergia sissoo* seedlings. *Tropical Ecology* (revised).
3. B. Singh and G. Singh (2004). Effects of controlled irrigation on water potential, nitrogen uptake and biomass production in *Dalbergia sissoo* seedlings. *J. Environment and Experimental Botany* (In press).
4. B. Singh and G. Singh (2004). Growth, biomass production and nutrient uptake of *Dalbergia sissoo* seedlings under water deficit and phosphorus nutrition. *J. Plant Nutrition and Soil Science* (Revised).
5. B. Singh and G. Singh (2004). Influence of water deficit on biochemical activities in *D. sissoo* in dry environment. *J. Environment and Experimental Botany* (In press).
6. B. Singh and G. Singh (2004). Influence of water deficit on the growth and root growth potential of *D. sissoo* seedlings in arid environment. *Indian Forester* (Submitted).
7. D. Kumar, D.K. Mishra and Ranveer Singh (2004). Physical indices of seed maturity: Effect of maturity indices on seed qualities and storability of *Azadirachta indica* A. Juss. (neem) seed. *Seed Sci. Technology* (communicated).
8. G. Singh (2004). Tree influenced carbon sequestration in the degraded land of arid region under different agroforestry systems. *Indian Forester* (Revised).
9. G. Singh and B. Singh (2004). Productivity and nutrient uptake in *Dalbergia sissoo* seedlings grown at varying irrigation levels in Indian Desert. *J. Plant Interactions* (Submitted).

10. G. Singh and Bilas Singh (2004). Changes in soil and foliage nutrient composition in different aged *Prosopis cineraria* plantation. *Indian Journal of Forestry* (submitted)
11. G. Singh and Bilas Singh (2004). Variation in soil properties and foliage nutrient status under the influence of stand age of *A. nilotica*. *Tropical Ecology* (revised)
12. G. Singh and M. Bhati (2004). Effect of municipal effluent irrigation on plant mineral status and biomass productivity in *Acacia nilotica* seedlings and soil chemical changes. *Environmental Conservation* (in press).
13. G. Singh and M. Bhati (2004). Growth of *Dalbergia sissoo* in Desert regions of western India using municipal effluent and the consequent changes in soil and plant chemistry. *Bio-Resource Technology* (In press).
14. G. Singh and M. Bhati (2004). Soil and plant mineral composition and productivity of *Acacia nilotica* (L) under irrigation with municipal effluent in an arid environment. *Environmental Conservation* (in press).
15. G. Singh and M. Bhati (2004). Soil properties and seedling performance in artificially contaminated soil through effluent irrigation of varying chemistry. *J. Indian Soc. Soil Science* (Revised).
16. G. Singh and T.R. Rathod (2004). Irrigation levels, nutrient uptake and productivity in *Acacia nilotica* seedlings in Indian desert. *Agricultural Water management* (Submitted).
17. G. Singh and T.R. Rathod (2004). Rehabilitation of degraded drylands of Indian arid Zone through direct seeding. *Indian Forester* (submitted).
18. G. Singh, Bilas Singh and T.R. Rathod (2004). The impact of soil water availability on carbon sequestration in biomass and soil in northwestern India. *Indian Forester* (Revised).
19. G. Singh, M. Bhati, T.R. Rathod and U.K. Tomer (2004). Mineral accumulation and physiological response in trees seedlings irrigated with municipal effluent. *Tree Physiology* (submitted).
20. G. Singh, N.Bala and R.L. Meena (2004). Biological Diversity and Conservation Measures in Dry Ecosystems. *Van Vigyan* (submitted).
21. G. Singh, N. Bala, Sarita Mutha, T.R. Rathod and N.K. Limba (2004). Biomass production of *Tecomella undulata* agroforestry in arid India. *Biological Agriculture & Horticulture* (In press).
22. G. Singh, Sarita Mutha, N.Bala, T.R. Rathod, N.K. Bohra and G.R. Kuchhawaha (2005). Growth and productivity of *Tecomella undulata* based agroforestry system in Indian desert. *Forests, Trees and Livelihood* (In press).
23. G. Singh, T.R. Rathod, S. Mutha, S. Upadhyaya and N. Bala (2004). Effect of isolated trees on diversity and productivity of vegetation recovered after drought in Indian desert. *Tropical Ecology* (submitted).
24. G. Tripathi, S. Ram, B.M. Sharma and G. Singh (2004). Faunal biodiversity and its role in nutrients turnover in different silvipasture systems of Indian dry zone. *Environmental Conservation* (Submitted).
25. Ranjana Arya S.H.Jain, K.K.Chaudhuri (2004). Status of lesser known trees in Rajastan. *My Forest* (Communicated).
26. Ranjana Arya, K.R. Chaudhary and R.R. Lohara . Effect of Nitrogen and Gypsum on establishment and early growth of Salvadora persica in salt affected soils under hot arid conditions in India. *Forest Trees and Livelihood* (Accepted).

27. M. Rathore and Hemant Sharma (2005). Therapeutically useful tats and oils of forest origin. *Van Vigyan* (Accepted).
28. N.K.Sharma, C.J.S.K.Emmanuel, and U.K.Tomar (2004). Variation in seed characteristics of *Ailanthus excelsa* Roxb. *My forest* (Submitted).
29. K.K. Srivastava, M.E Ostry, and Sunil Kumar (2004). Effect of Armicarb ™100 against *Sirococcus clavaganti jugladacearm"* (A butternut canker pathogen) Indian Journal of Forestry (submitted).
30. K.K. Srivastva, H.P. Srivastava and Sunil Kumar (2004). Standardization of inoculum dose in *Tecomella undulata* Sm Seem. *Indian Forester (*Communicated*)*.
31. V.P. Tewari and Bilas Singh (2004). Comparison of Bruce's formula and other methods for log volume estimation. *Indian Forester* (accepted).
32. V.P. Tewari (2004). Stem number development and basal area growth in the unthinned irrigated plantations of *Eucalyptus camaldulensis* in the hot desert of India, *Bioresource Technology* (Communicated).
33. V.P. Tewari (2004). Generalised diameter-height equations for even-aged stands of *Azadirachta indica* in Gujarat State of India, *Indian Forester* (accepted).
34. V.P. Tewari and Bilas singh (2005). Provisional equations for estimating total and merchant table wood volume of *Acacia nilotica* trees in Gujarat State of India. *Forest Trees and Livelihoods* (Communicated).
35. Ranjana Arya and R.R. Lohra (2004). Studies on mound practices for establishment and growth of various plant species on saline and waterlogged soil in hot arid zone of India. *Indian Forester* (Communicated).
36. Ranjana Arya (2004). A Silvi-pastoral study combining *Cenchrus ciliaris* and three species of trees in arid India. *J. of Arid Environment* (Revised).

Consultancy

1. Ministry of Rural Development, Department of Land Resources, Government of India and Department of Rural Development, Land development cell, Government of Rajasthan assigned the evaluation work of following projects.
2. Ecological and environmental assessment in the on-shore area of RJ-ON-90/2 block, Rajasthan

Patents Obtained/ filed: NIL

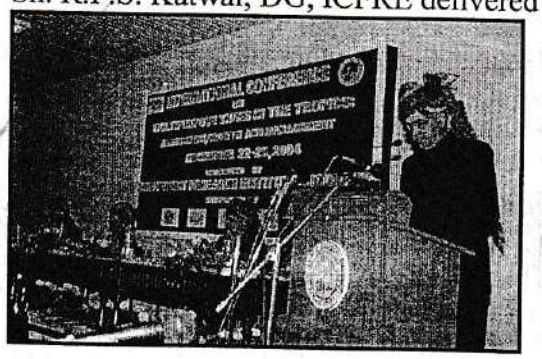
Commercialization of technology: NIL

Organized and Participation in conference, meetings, workshops, symposia, Exhibitions:

(a) Organised

1. Organized IUFRO International Conference on "Multipurpose Trees in the Tropics: Assessment, Growth and Management" from 22-25th Nov. 2004. 32 foreign and 170 Indian delegates participated in the conference. The conference was inaugurated by the Hon'ble Minister of State for Environment & Forests, Govt. of India, Sh. Namo Narain Meena and the function was presided over by Dr. Sim Heok-Choh, Executive Director,

APAFRI. Prof. Christoph Kleinn, IUFRO representative, delivered the keynote address Sh. R.P.S. Katwal, DG, ICFRE delivered the welcome address.



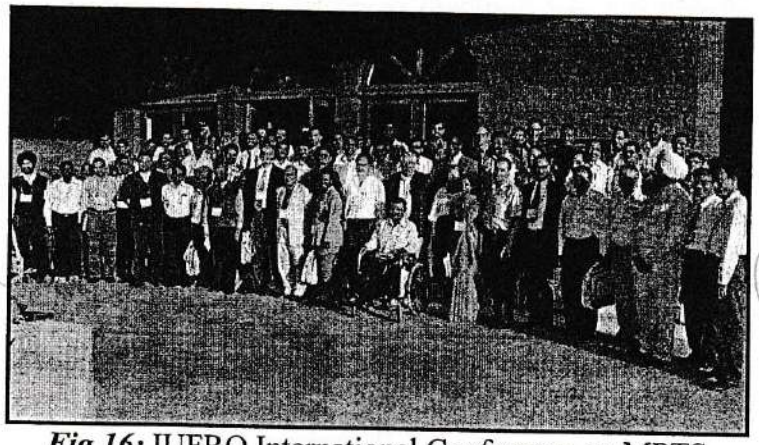


Fig 16: IUFRO International Conference on MPTS

2. An interactive meeting was organized at Arid Forest Research Institute, on 20th August 2004 to establish liaison with various end users and possible collaborators for smooth implementation of the research project. Eighteen (18) delegates representing different departments, NGOs and farmers and 25 Scientists/ Officers from the institute participated and discussed on the abovementioned points in the meeting.
3. Research Advisory Group (RAG) meeting organized from 15-16th February' 2005. The twenty eight ongoing research projects were presented before the RAG members for necessary recommendations and five new projects were presented for their prioritization.

(b) Participation:

1. Dr. R.L. Srivastava, IFS, Director has participated and chaired one session in National symposium on "*Conversing Space Technologies for national Development*" at Jaipur on November 3-5, 2004.
2. Dr. R.L. Srivastava, IFS, Director has participated and chaired one session in National seminar on *"Recent advances in analytical chemistry*" at JNV, Jodhpur on November 29- December 1, 2004.
3. Sh.R.L. Meena, IFS, GC(R) has attended Regional Workshop on "*Emerging trends and issues in forestry"* at Gandhinagar, Gujarat from 4-5 November'2004 and made

presentation on *"Thar Biodiversity: its traditional and technological conservations efforts"*.

4. Dr. G. Singh attended 'National Seminar on Recent Advances in analytical Chemistry' held at Jai Narain Vyas University, Jodhpur on November 29- December 1, 2004 and presented paper on *"Changes in soil properties as a result of irrigation with effluent of varying chemistry and impact on tree seedlings"*.
5. Dr. R.L.Srivastava, IFS, Director AFRI, Sh. R.L. Meena, IFS, CF attended workshop on "Rehabilitation of mined land: Protection of environment and helping livelihood" organized at Hotel Taj Hari on 18th -19th June.
6. Dr. R.L. Srivastava- Director participated in 'Paryavaran Padyatra 2004' from Parsusram Mahadev to Rajpura nursery (Pali) organized by Rajasthan Forest Department.
7. Sh. R.L. Meena, CF and Sh. Arvind Apte- DCF attended '*Khejdli Shahid Mela*' at Khejarli and joined 'Paryavaran Padyatra 2004' organized by Rajasthan Forest Department from Jaswantpura to Sundhamata (Jalore).
8. Dr. R. L. Srivastava, Director, Sh. K .K. Chaudhuri and Dr. D. K. Mishra, participated in the Brain Storming session on "Herbs for the health of armed forces in desert area" at Defence Lab., Jodhpur on 13.08.04.
9. Dr. R.L. Srivastava, IFS, Director, attended & chaired the technical session during the workshop on "Integrative Approaches for Assessing Extent and Cause of Degradation in Arid Community Rangelands" organized at CAZRI on 26th May 2004.
10. Dr. R.L. Srivastava, IFS, Director, attended National workshop on "Famine and water conservation-myths and realties" from 8th-10th June 2004.
11. Dr. R.L. Srivastava, IFS, Director, attended "2nd Global summit on medicinal plants" to be held on 25th-29th Oct.' 2004 at New Delhi.
12. Dr. G. Singh, Scientist E attended one day workshop on "Persistent organic pollutants at Vadodara" (Gujarat) on 19.05.2004
13. Smt. Sangeeta Tripathi, RAI and Sh. R.K. Gupta, RAI attended workshop on Training module of Integrated Watershed management Programme at IGPR&GVS, Jaipur from 15th –17th April, 2004 at Jaipur.

(c) Exhibition

Nehru Yuvak campus

Extension publications

1. "AFRI Darpan"- quarterly newsletter for the period from April to June' 04. Also updated the AFRI brochure which constituted a part of reading materials for the delegates of International Conference on Multi Purpose Tree species-Assessment, Growth & Management held at AFRI from 22nd –25th Nov., 2004.
2. Updated the AFRI brochure in Hindi, depicting the research findings and technology developed by the institute.
3. Study Material for the training programme- Sh. Balbir Singh, Head, AF&E Div., Smt. Sangeeta Tripathi & Sh. R.K. Gupta.

4. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Cassia angustifolia* Vahl.: A green gold for arid areas. Extension brochure.
5. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Chlorophytum borivilianum* Sant. & Fernandes.: Tuberous power for healthy life. Extension brochure.
6. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Emblica officinalis* Gartn.: The store house of vitamin C. Extension brochure.
7. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Commiphora wightii* Arn.: A shining tree of golden gum. Extension brochure.
8. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Ashwagandha, *Withania somnifera* Linn (Dunal): Winter Cherry.
9. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Giloe, *Tinospora cordifolia* (Wild). Miers: The Climber of Longevity.
10. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Sarpgandha, *Rauwolfia serpentina* Benth. Ex. Kurz: Bitter root to better high blood pressure.
11. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Isabgol, *Plantago ovata* (Forsk.): Natural defence to digestive disorders.
12. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Bhui Amla, *Phyllanthus amarus* Schum & Thonn: The wonder herb.
13. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Tulsi, *Ocimum santum* Linn: The sacred plant.
14. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Ratanjot, *Jatropha curcas* L: The bio-diesel plant.
15. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Mulhatti, *Glycyrrhiza glabra* Linn: Sweet Root sweeter than sugar.
16. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Shatavari, *Asparagus racemosus* Willd.
17. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Kalmegh, *Andrographis paniculata* (Wall) Ness. The King of bitters.
18. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Guar Patha, *Aloe vera* (Linn.) Burm.f. Lily of the Desert.

News Articles:

Regularly meetings were held with media personals to publicize the research findings.

Awards:

1. Dr. G. Singh, Scientist E and Sh N. Bala, Scientist C have been awarded S.K. Seth Prize for best paper in Environment and Ecology in *Indian Forester* 2002.
2. Dr. G. Singh, Scientist E has been conferred ICFRE AWARD for excellence in Forestry Research for the year 2003-2004.

Distinguished Visitors:

1. Hon'ble Minister of State for Environment & Forests, Govt. of India on 23rd Nov. 2004.
2. Dr. Sim Heok-Choh, Executive Director, APAFRI, Malaysia; Dr. Markku Kanninen, Director, Environmental Services and Sustainable Use of Forests Program, CIFOR and 30 other foreign scientists during 22-25 Nov. 2004.
3. Sh. Atul Sharma, IAS, Divisional Commissioner, Jodhpur visited the institute on 20th Aug., 2004.

Miscellaneous

1. Organized sports meets and cultural activities on 15th August, 2004.
2. Organized sharamdan, planting of trees and cultural programme for the children on Environment day, 2004. As Environmental awareness programme, organized a camp at Shastri Circle to motivate people for Do's & Don'ts for healthy & hygienic environment.
3. Organized planting of seedlings during Van Mahatosava, 2004, Drawing & Painting and Quiz programme on this occasion.