

CHAPTER-IX
ARID FOREST RESEARCH INSTITUTE
JODHPUR

Arid Forest Research Institute at Jodhpur started functioning from April 1988 to cater to forestry research needs of Aravalli hills and desert regions of western India. Its jurisdiction covers the States of Rajasthan, Gujarat, Union territory of Dadra and Nagar Haveli and the arid and semi-arid parts of Punjab and Haryana. The mandate of this Institute is to develop technologies for arresting desertification in this region. The Institute has a sanctioned staff strength of 179 personnel consisting of 39 scientists, 60 research and technical staff and 80 administrative and supporting staff. The highlights of research carried out in the Institute during 1997-98 are briefly listed below :

PROJECTS COMPLETED DURING 1997-98

NIL

OLD PROJECTS CONTINUED DURING 1997-98

Project 1: International provenance trial on neem.

Objectives: To improve the genetic quality and adaptability of neem and tap its utilisation potential.

Achievements

The data recorded in this year show that maximum survival was from Sagar (99%) followed by Kulapachra (97%) and Mandore (96%) for Indian provenances and Chamwino (100%; Tanzania) followed by Doi Tao (96%; Thailand) and Tuang Luang (95%; Thailand) for international provenances.

Project 2: Provenance trial and propagation of fodder tree species.

Objectives : To screen geographical variations for adaptability and higher fodder yield.

Achievements

(a) *Acacia nilotica*: Provenance trial was started at AFRI, Jodhpur during 1991. The tree height attained by different provenances varies from a lowest of 335 cm to 571 cm in the year 1997-98. The ranking of height varies from year to year, Gurgaon is the only provenance which has remained in first three ranks since the beginning of the trial. It is followed by Agra, Etawah, Hastinapur, Aligarh, Haldwani and Jhabua in performance.

Seeds were collected from 45 different locations in 1997. During 1997-98 year, data have been recorded on seed parameters and seeds have been sown in the nursery to raise seedlings for field trial.

(b) *Ailanthus excelsa* : The seeds of *Ailanthus excelsa* were collected from thirty two seed sources and studies were conducted on seed parameters. Seeds were sown in the nursery for raising field trial and observations were recorded on the seedling growth parameters in nursery.

Project 3: Provenance trial of arid zone species.

Objectives : To screen out the geographical variability for adaptation and growth of arid zone species.

Achievements

In case of *Azadirachta indica* where thirty nine seed sources were used, Indore, Ujjain and Rewa provenances have shown good growth. In case of *Tecomella undulata* the trial was laid out with thirteen seed sources and Bhaislana provenance is the best so far. In case of *Dalbergia sissoo*, out of twelve provenances, Rudrapur gave the best result.

Project 4: To develop vegetative propagation technique for *Acacia nilotica* and *Ailanthus excelsa*.

Objectives: To develop a cost effective method/technology for cloning superior genotypes of *Acacia nilotica* and *Ailanthus excelsa*.

Achievements

(1) *Acacia nilotica*: Stem cuttings of *Acacia nilotica* were raised in the mist chamber and so far only shoot regeneration was observed in spite of giving IBA treatment from 500 ppm to 2500 ppm concentrations. Seasonal variation was also observed and sprouting response was recorded only during the period from March to September. However, low frequency (>10%) of rooting was observed when cuttings from CPTs were raised in the month of July, 1996 after treating them with 4000 ppm IBA solution.

(2) *Ailanthus excelsa*: To standardize the macropropagation techniques, stem cuttings of different types were tried. Different concentration of IBA were tried to induce rooting from stem cuttings. Only bud break was observed from these stem cuttings. Rooting was observed in the stem cuttings collected from 1-2 year old seedlings.

Project 5: To develop tissue culture technique for *Acacia nilotica* and *Ailanthus excelsa*.

Objectives : To develop the technology for faster multiplication and cloning of superior planting stock material.

Achievements

(1) *Acacia nilotica*: Experiments were conducted to initiate cultures from the material collected from lopped trees. Single or double nodal segments were inoculated to raise axenic cultures. Nodal shoot segments (1.25 x 0.4 cm) harvested during March 1997 were found to be the best explants for the initiation of cultures. A combination of IAA and BAP proved better for shoot initiation and without producing callus. Callusing was also observed in NAA and BAP containing medium. The shoots (size 2-3 cm long) were isolated and kept in half MS media containing IBA of varying concentration and kept at 35°C in growth chamber. Roots induced after 21 days.

(2) *Ailanthus excelsa*: Young shoots were collected from field grown plants and after removing the larger leaves. The material was cut into small (3-4 cm long) pieces along with single node per piece. After surface sterilization, explant was kept vertically in MS medium with various combination of plant growth regulators. Multiple shoots were observed after 2 week. Even 3-4 shoot were observed in a single explant. Multiple shoot cultures are being

maintained since last one and a half year. Rooting was observed on MS +0.25 mg/l NAA or MS + 0.25 mg/l BAP only after 40 days growth in the medium. Hardening experiments are in progress.

Project 6: Macropropagation and micropropagation of some arid zone tree species.

Objectives: To develop clonal propagation technique through macropropagation and micropropagation methods for some arid zone tree species

Achievements

Azadirachta indica: Rooting was observed in stem branch cutting of four years old unique genotype of *Azadirachta indica* in experimental field. Cuttings were treated with Auxin (IBA) powder (3%) at lower end and upper end was pasted with chopatia paste to prevent infection. The cuttings were raised in Mist Chambers where RH was maintained at (90%). Shoot formation was observed within a week. After a period of four week buds on almost 85% stem cuttings sprouted roots. After two month root initiation was observed in a few cuttings (3%).

Multiple shoot cultures are being maintained since last three years by timely subculturing them on fresh medium. No abnormalities were recorded due to long term subculturing. A trial on tissue culture raised and macropropagated plants of *A. indica* was laid down in field.

Project 7: Investigation of soil water plant relationship in respect of different tree species.

Objectives: (a) To Find out critical limits of stress tolerance of different tree species. (b) To screen tree species for efficient water use and growth under arid conditions.

Achievements

The results indicate that application of N increases biomass at 75-100% available water. However, as water availability decreased to 50-75% and 25-50% response to N application declined causing reduction in biomass. The plant samples are under process of analyses for nutrient status under different stress levels.

Project 8: Screening indigenous and exotic species for their tolerance to moisture stress and adverse site conditions.

Objectives : (a) To study the comparative growth of different tree species, under moisture stress conditions and find out their response to mulching. (b) To establish relationship between soil moisture stress and leaf water potential and identify water efficient tree species.

Achievements

Azadirachta indica continued to be the best performer attaining on an average 43.1 cm of girth and 511 cm of height at 78 months of age, followed by *Acacia nilotica* (31 cm girth and 524 cm height), *Albizia lebbek* (34 cm girth and 391 cm height), *Acacia planifrons* (35 cm girth and 380 cm height), *Prosopis cineraria* (22 cm girth and 279 cm height) and *Tecomella undulata* (23 cm girth and 262 cm height). Performance of all these species was better on mulched than unmulched plots.

Leaf water potential (LWP) values varied considerably from species to species. Lowest being -7.22 Mpa in *A. planifrons* followed by *A. lebbek* (-6.2 Mpa), *P. cineraria* (-6.70 Mpa), *T. undulata* (-6.20MPa), *A. indica* (-5.45 Mpa) and *A. nilotica* (-3.94 MPa). These values indicate that even at very high LWP of -5.28 Mpa, neem continued to exhibit best growth indicating its

high tolerance to moisture stress. For such sites, neem appears to be the most suitable species and *T. undulata* (rohida) the least suitable species.

Project 9: Screening of exotic and indigenous plant species on a salt land in arid zone.

Objectives: To screen exotic and indigenous species for their salt tolerance on arid salt land.

Achievements

Atriplex lentiformis continued to be the best performing species producing maximum biomass. Application of gypsum + FYM+ Urea + ZnSO₄ + drainage channel was the best management practice. Among the indigenous species, *Salvadora persica* performed the best followed by *P. juliflora*. *Tamarix aphylla* could not survive the site conditions. Soil properties registered general improvement with decrease in pH and EC and increase in percent organic matter.

Project 10: To develop soil moisture management practices for speedy and better plantation establishment.

Objectives : To evolve cost effective methods of rain water harvesting and conservation for maximising tree growth.

Achievements

A field experiment on different methods of micro-catchment water harvesting was initiated in July 1992. Different treatments were - T1 : Only pitting (control), T2 : Saucers, T3 : Ring pits, T4 : Trench cum mound, T5 : Trench and mound and T6 : Deep ploughing. Observations recorded on growth, leaf water potential and soil moisture show significant influence of different treatments. Trees on ring pits continued to exhibit best growth with *Azadirachta indica* (neem) and *Albizia lebbek* (Siras) attaining average height of 606 cm and 484 cm, respectively and average girth of 52 cm and 35 cm, respectively at 69 months of age. Leaf water potential varied only marginally from -3.41 to -3.67 MPa in neem and -4.21 to -4.69 in siras. Soil moisture storage was higher under treated plots than the control. Quantum of increase was higher in deeper layers.

Project 11: Studies on watering schedule and water requirement of different tree species.

Objectives: (a) To find out the optimum water requirement of different tree species for maximising their growth. (b) To find out water use efficiency of different tree species. (c) To study the effect of different irrigation practices on soil characteristics.

Achievements

The experiment was initiated in July 1995 with six treatment combinations of quantity of water (W1 & W2) and watering frequencies (I1, I2, I3). Three species viz., *Acacia nilotica*, *Dalbergia sissoo* and *Eucalyptus camaldulensis* were planted in split plot design and triplicated. Irrigation schedule is maintained on the basis of IW/CPE ratio. Growth data recorded at regular intervals showed considerable variation among treatments as well as species.

At the age of 29 months, maximum growth was registered in I3W2 where total water input was 2597 mm in contrast to I3W1 where total water input was 2792 mm. Among the species *E. camaldulensis* showed widest variation in growth depending on various treatments. No

remarkable change was observed with regard to soil pH, EC and organic matter content due to different treatments.

Project 12: To screen various plant species for high yielding commercial forestry under irrigated conditions.

Objectives: To screen different commercially important tree species under irrigated conditions on arid lands.

Achievements

The experiment was initiated in July 1995 to screen different tree species for their commercial potential with irrigation under arid conditions. Experiment was initiated with five tree species namely *D. sissoo*, *A. nilotica*, *E. camaldulensis*, *A. lebbek*, *Tectona grandis* and *Dendrocalamus strictus* as main treatment, and with two submain treatments of VAM inoculation and no VAM inoculation in three replications at a spacing of 3m x 4m.

After twenty eight months of growth, *Eucalyptus camaldulensis* is proving to be the most promising species as it attained maximum height and girth under uniform irrigation conditions. The average height and girth attained by this species was 531 cm and 24 cm, respectively followed by 393 cm and 22 cm for *A. nilotica* and 389 and 21.4 cm for *Dalbergia sissoo*. Application of VAM inoculum did not prove effective under irrigated conditions for *E. camaldulensis* and *A. nilotica* as growth data for inoculated and non-inoculated trees was nearly in the same range. However, VAM inoculation was effective in increasing the height and girth of *D. sissoo* as well as wood volume for all the three species.

Project 13: Research and development support for desert development programmes in hot arid regions of Rajasthan, Haryana and Gujarat (Funded by Ministry of Rural Development).

Objectives: (a) Survey of the most vulnerable sandy areas having moving sand dunes for priority treatment under desert development programme and development of technology for sand dune stabilisation. (b) Development of vegetative barriers with khus and other thorny bushes or stone walls in place of costly barbed wire fencing for plantation raised under the programme. (c) Demonstration of technology and extension.

Achievements

Demonstration trials were laid at Rohat (Pali), Jasol (Barmer) and Jodhpur sites. The various types of micro-catchment structure tried were saucers, trench and mound, and bunding in rectangular design. Trench and mound gave the best performance causing significant growth improvements.

Study on the effect of different tree density and agricultural crops on yield and productivity of agroforestry systems" and another study " Agroforestry for maximising fodder and fruit production " were continued at Jodhpur. Because of monsoon failure no crop yield could be obtained.

Trials were laid at Rohat (Pali) and Nagaur site with different fodder yielding trees and *Cenchrus ciliaris* grass. Initial trends indicate that *Ziziphus mauritiana* - *Cenchrus ciliaris* combinations yields maximum fodder at both the places followed by *D. nutans* - *C. ciliaris* at Rohat and *A. nilotica* - *C. ciliaris* at Nagaur.

A field trial was laid at Bikaner site with seven tree/shrub species with and without grass (*C. ciliaris*) and nitrogen fixing undershrub (*Cassia angustifolia*) for improving organic

matter and nitrogen status of sand dune to facilitate better growth of plants. *A. tortilis* showed maximum survival and *P. juliflora* showed the best growth among the tree species. Initial performance was better on bare sand dunes compared with interdunal planes.

Trials were laid at Rohat (Pali) and Nagaur sites with different trees and medicinal herbs as intercrops to study the effect of herbal species on tree growth and vice versa. In the first year, yield of only *C. angustifolia* was recorded which varied from 259 kg to 273 kg / ha on dry weight basis. The first year yield was on a par with different tree species.

Trials on shelterbelt were laid in September 1996 at Bikaner and in August 1997 at Nagaur with different combinations of trees and shrubs to study its effect on crop production, wind velocity and sand movement with the shrub species making the outer and inner row and the tree species making the middle rows. *Acacia tortilis* showed the best survival of 94% among all the tree and shrub species.

A trial was laid at Bikaner site to evaluate growth and biomass production of *A. nilotica*, *A. tortilis* and *A. indica* under different stand densities under unirrigated conditions in September 1996. Eight varying densities of 1667, 1111, 833, 667, 625, 500, 400 and 333 stems per ha were planted. Maximum survival of 100% was recorded for *A. nilotica* at a stem density of 400/ ha followed by 98% for *A. tortilis* at 1667 stem density. *A. tortilis* attained the best growth in terms of height indicating it to be the best species for early establishment.

Project 14: Growth and yield studies in the irrigated plantations of IGNP area.

Objectives: To study the growth of *Eucalyptus camaldulensis* and *Dalbergia sissoo* planted under irrigated conditions in IGNP area and preparation of volume/yield tables for these two species.

Achievements

Studies on the two most important species planted in the area viz. *Dalbergia sissoo* and *Eucalyptus camaldulensis* was continued under the World Bank aided FREE project. Seven new sample plots of *D. sissoo* and nine plots of *E. camaldulensis* were laid out at different locations in the area during the year making the total number of sample plots to 31 and 35, respectively. Plot computations for all the 66 sample plots laid out have been completed.

Project 15: Growth studies on neem in Gujarat.

Objectives : To prepare volume/weight tables of neem for Gujarat region.

Achievements

Re-measurements in old sample plots laid out in Palanpur and Gandhinagar divisions of Gujarat State were completed. Some more areas in North-Western Gujarat were surveyed for laying out new plots and permission from the PCCF, Gujarat SFD was obtained for the same. Preparation of weight table for neem is in progress.

Project 16: Lopping regime of important arid zone fodder tree species.

Objectives: To find out effect of different intensities of lopping on the growth parameters and fodder yield of important arid zone fodder tree species.

Achievements

The results indicated that lopping has positive effect on the growth of both the species under observation. In the case of *P. cineraria*, medium lopping causes better results in height growth while growth in crown width and dbh seems to be assisted better by low intensity lopping. In the case of *A. excelsa* low intensity lopping produces better results for all the three growth parameters.

Project 17: Pruning studies on *Prosopis cineraria*.

Objectives: To study the effect of pruning on the growth of *P. cineraria*.

Achievements

Annual pruning and measurements in the experimental plot of *P. cineraria* laid out during the previous year have been completed.

It has been observed so far that pruning has a positive effect on all the parameters (height, collar girth and crown width).

Project 18: Market survey on selected species from selected markets of Rajasthan and Gujarat.

Objectives: To collect prices of timber, bamboo and fuel-wood from selected markets of Rajasthan and Gujarat.

Achievements

Quarterly market prices of selected timber, fuel-wood species and bamboos were collected from Jaipur and Ahmedabad markets in prescribed formats. The information thus collected was compiled and sent to ICFRE HQ for publication of Timber/bamboo Trade Bulletin.

Project 19: Forestry statistics of Rajasthan and Gujarat.

Objectives: To collect forestry data of Rajasthan and Gujarat.

Achievements

ICFRE, Dehra Dun took the task of compiling and publishing "Forest Statistics - India, 1996" covering different aspects of Forestry in India. The period to be covered under this report was from 1994 to 1996. Information from Rajasthan and Gujarat States has been collected and sent to the ICFRE HQ.

Project 20: Disease spectrum of arid and semi-arid tree species.

Objectives: (a) To record/assess out break of diseases in different forest nurseries and plantations in different climatic zones. (b) To collect, isolate and identify the pathogens.

Achievements

Seedlings of all age groups were found to be affected due to leaf blight. In nursery beds with 25-80% defoliation. The disease could be managed by foliar spray with Blitox (0.2%) at monthly intervals.

Sporadic incidence (15-20%) of leaf spot disease was observed on young saplings of *Eucalyptus camaldulensis* planted in seedling seed orchard (S.S.O.) at Govindpura and Jaipur.

Similar problem was also observed in 2 year old plantation at Rohat, Pali where the incidence was 25-30%. The pathogen was identified as *Cylindrocladium* sp. For immediate management of the disease, foliar spray of bavistin (0.1%) at monthly intervals was recommended.

Charcoal root rot disease in *Tecomella undulata* was noticed for the first time in nursery plants. The pathogen was identified as *Rhizoctonia bataticola*. Pathogenicity test was carried out with 8-10 days old culture of the pathogen. The symptoms of the disease appeared within 48 hours in tender seedlings.

Project 21: Studies on seed borne mycoflora of selected tree species of arid zone.

Objectives: (a) Isolation and identification of pathogenic and non-pathogenic mycoflora of *A. indica*, *P. cineraria*, *A. nilotica* and *Tecomella undulata*. (b) To test the efficacy of fungicides/plant extracts on seed borne mycoflora. (c) To select best seed treatment in storage which can enhance the viability and germination.

Achievements

An experiment was laid out to test the efficacy of Eucalyptus oil (*E. camaldulensis*) in different concentrations (1 %, 5 % and 10 %) on seed borne mycoflora of neem seeds. The seeds were also treated with methanol. Untreated seeds were kept as control. Radial growth of mycoflora revealed that all the treatments were superior to control. However, among the treatments, the one with 10 percent Eucalyptus oil was superior in inhibiting the growth of mycelium. Concentrations of 5 percent and 1 percent were not as effective but performed better than control.

Project 22: Studies on VAM association in Irrigated Plantations and Agroforestry systems.

Objectives: (a) Survey, collection and identification of different VAM fungi associated with tree species growing in irrigated plantations and agroforestry system in arid zone of Rajasthan. (b) Testing the influence of different VAM fungi in combination with Rhizobium for plant growth and vigour in nursery and field conditions.

Achievements

Data on mycorrhizal colonisation in roots of *Azadirachta indica*, *Tecomella undulata*, *Ailanthus excelsa* and *D. sissoo* in root trainers showed more or less same percentage as in polybags. *A. indica* showed highest percentage of VAM colonisation in roots. Some of the root samples had extramatrical hyphae with *Glomus* species. The root segments of *Tecomella* and *D. sissoo* had broader fungal hyphal with large number of vesicular and arbuscular structures. It was noted that both VAM colonisation (%) and propagule number increased with the age of the seedlings.

Another experiment on different tree species of semi-arid zone showed that VAM root colonisation percentage is highest in *D. sissoo*, followed by *Pongamia*, *Cordia myxa*, *Mangifera indica* and *Atrocarpus*. Different species of VAM fungal genera, viz., *Glomus*, *Sclerocystis* and *Acaulospora* were identified and isolated from the rhizosphere soil of the seedlings.

Project 23: Morphology and bionomics of rohida defoliator, *Patialus tecomella*.

Objectives: (a) To study the morphology, bioecology and bionomics of *P. tecomella*. (b) To study the natural enemy complex of *P. tecomella* and to evaluate suitable control measures.

Achievements

The study revealed that the adults and larvae of *P. tecomella* survived alike in groups as well as in isolation. The larvae and the adults (both in groups and as isolated individuals) can tolerate minor desiccation. There was a significant difference in the attraction of weevils towards different colours when tested simultaneously. The attraction of *P. tecomella* towards white colour proved to be highly useful in evolving an effective devices for mechanical control. In addition about 64 insect species belonging to 32 families under 6 insects orders viz. Coleoptera, Hemiptera, Isoptera, Lepidoptera, Orthoptera and Thysanoptera have been recorded feeding on *Tecomella undulata*.

Project 24: Integrated pest management of forest insect pest.

Objectives : (a) To identify the natural enemy complex of major insect pests of arid and semi-arid region. (b) To identify more potent parasites/predator/entomopathogens against insect pests of arid and semi-arid regions and to develop technologies for mass production of entomopathogens. (c) Laboratory and field evaluation of entomopathogens/parasites for pest management.

Achievements

Detailed life history of pupal parasite *Billae* spp. and its efficacy in the field was studied. Maximum percentage of pupal parasitism was observed during the month of September. Survey to evaluate other parasites and predators of *Patialus tecomella* was carried out. Six species of predators found feeding on *P. tecomella* were identified. Experiments were undertaken to ascertain efficacy of plant extract of Neem, Ker, Ash and Datura against *P. tecomella*. In all cases, mortality of larvae started 48 hours after treatment but the difference among treatment was highly significant.

Project 25: Bioecology and management of insect pests of *Prosopis* spp. (Linn) with special emphasis to gall forming insects in Indian desert.

Objectives: (a) Survey, Evaluation and Identification of insect pests. (b) Host plant phenology and population pattern of target insect pests. (c) Impact of nutritional diversity on the growth and reproductive biology. (d) Biology and ecology of the gall forming insects of *Prosopis* species.

Achievements

Survey was conducted in different districts of arid and semi-arid areas of Rajasthan and a check list was prepared. Target insect pests and their natural enemy complex were identified. Population pattern with special reference to abiotic and biotic factors has been studied. Life stages responsible for shoot, flower, rachis and leaf gall initiation on *Prosopis cineraria* has been done.

Project 26: Studies on Pest problems in forest nurseries and their management in arid and semi-arid region.

Objectives: (a) Study on population biology. (b) Collection and identification of important pests in forest nurseries and standardization of control measures. (c) Study on host range of economically potential pests and their management.

Achievements

Outbreak of *Atteva fabriciella* infesting *Ailanthus excelsa* recorded in the month of October resulted in complete defoliation of the seedlings. Collection of pests and parasites was done. Insect pests were pinned and preserved for future reference.

Mollusc *Laevicaulis alte* was found to feed on *Azadirachta indica* and *Moringa oliefera* Crotons and Jacaranda. It showed preference towards very young plants with soft tissues.

Experiments were laid to study the swarming and post swarming behaviour, oviposition, brood care, egg character, hatching and post hatching behaviour of newly formed nymph and predators of *Microtermes unicolor* in the Indian desert.

Project 27: Studies on Seed Pest of forest tree species in arid and semi-arid region.

Objectives: Study on host range and population biology, collection and taxonomic identification of important seed pests and standardization of control measures.

Achievements

Insect infestation on seed samples collected from Jodhpur revealed the presence of seed pest bruchid *Caryedon serratus*. The seeds of *Acacia nilotica* collected from tree had minimum infestation of *C. serratus* in comparison with seeds collected from ground.

Life cycle of *C. serratus* in seeds of *Acacia nilotica* completes in 45-52 days. Hatchability ranges from 75-90 %. Infestation of *C. serratus* was found in *Acacia nilotica*, *Prosopis cineraria* and *Acacia tortilis*. *Bruchidius albizziae* infestation was found in *Albizia lebbek*.

Project 28: Developments of biopesticides for the management of forest insect pests of arid and semi-arid regions.

Objectives: (a) Laboratory and field evaluation of neem products against insect pests of arid and semi-arid regions. (b) Identification of other phytopesticidal plants and evaluation of their pest management properties.

Achievements

Neem seeds were collected, processed and neem cakes were prepared. An experiment was conducted in AFRI nursery to study the interaction of nutrients including neem cake on the insect incidence on *Acacia senegal* seedlings. The study has shown that application of microbial fertilizers with neem cake powder and phosphorus nutrient enhances plant growth and biomass. Application of neem cake powder has inhibitive effect on the incidence of the sucking pest babul whitefly *Acaudaleyrodes rachipora*.

Project 29: Study on the biocidal activity of arid zone plants.

Objectives: To conduct studies on *Azadirachta indica*, *Capparis decidua* and some other plants for their biocidal activities.

Achievements

Biocidal efficacy of different parts of *Capparis decidua* was tested against *Lepiphys erysimi*. The observed order of activity was : Seeds > bark > branches > wood. Efficacy was also tested against green peach aphid *M. persicae*. Total (100%) mortality was observed with 1 %

conc. in case of seeds and bark while it was 93.33 % in case of wood and branches. Neem seed kernel powder, neem leaf powder and neem seed oil, all were found to show high degree of fungicidal activity.

Project 30: Studies on the fatty oil of some important oil bearing plants of arid and semi-arid regions.

Objectives: To study the variation in oil content of important oil seeds from different localities of arid and semi-arid zones to determine higher oil yielding varieties and to select best areas of oil seeds production.

Achievements

Fatty oil content of *Salvadora oleoides* seeds collected from selected areas of Jhunjhunu district of Rajasthan was determined. The oil content has been found to be 38-42%. Oil extracted from *S. oleoides* seeds was studied for physio-chemical properties. Seeds of *Acacia chundra*, *Prosopis juliflora* and *Martynia annua* were analysed for their fatty oil content. They were found to contain 2.6, 3.43 and 10.2% of oil respectively. Fungal infestation in neem seeds collected from 3 different localities of Rajasthan was recorded and 6 different fungus species were isolated and identified.

Project 31: Studies on the proteins of arid zone plant species.

Objectives: (a) To select plants as protein sources for encouraging intake of protein rich food in conditions of drought. (b) To prepare leaf protein concentrate (LPC).

Achievements

Crude protein content of *Dalbergia sissoo* pods collected from different agroclimatic regions was determined using the Kjeltex digester and analyzer. Leaf Protein Concentrates of the following species was prepared: *Pullicaria falcata*, *Sesbania sesban*, *Achyranthus aspera*, *Pongamia pinnata*, *Cordia rothii*, *Azadirachta indica* and *Prosopis cineraria*.

Project 32: Development of seed bank facilities.

Objectives: To develop seed testing and storage facility for the tree species of the region.

Achievements

Neem seeds collected from dryer parts of the country were found to have smaller length, breadth and weight than those from other sources. Viability and germination capacity starts decreasing after second week of collection. However, seeds stored at low temperature (41°C) retained viability up to six months though with very poor germination (10%).

Mechanical scarification followed by soaking for 24h in ordinary water gave the highest (95%) germination in *A. indica* seeds and the method was recommended for large scale seedling production. Seeds of *Prosopis cineraria* also showed better germination percentage in mechanically scarified seeds (70%). *Dalbergia sissoo* required no or cold water soaking for (48h) pre-treatments. Cold water pre-treatment of 48h and 72h soaking had similar results. Removal of pod covering facilitate early germination of *Dalbergia* seeds.

Eucalyptus seeds did not require any pre-treatment and top of filter paper is the best substratum for germination studies. Freshly collected seeds gave over 95% germination under controlled conditions within 7 days.

Effects of seed size and pre-treatments (hot water, sulphuric acid and mechanical scarification) were studied in *Acacia nilotica*, and *Prosopis cineraria*. Seed size and pre-treatments affected the percentage germination and seedling vigour of both the seed types. Mechanical scarified seeds of both the species showed higher germination and seedling vigour followed by acid and hot water pre-treatments. Seeds having larger size also performed better than the seeds of smaller sizes.

Project 33: UNDP Project.

Objectives: (a) Strengthening the capability of AFRI and its personnel to carry out forestry research. (b) Poverty alleviation through enhancement of forestry research contribution to rural development. (c) Developing mechanism for effective transfer of technology to users for sustainable development of environment.

Achievements

About 6,000 seedlings of various species have been distributed among farmers of selected villages. Biofertilizers like VAM have been multiplied and inoculated in 3000 seedlings of various species. Seedling growth is being monitored.

Project 34: NABARD Project.

Objectives: To develop suitable agri-silvi, silvi-horti and silvi-pasture models for arid areas of the country.

Achievements

VAM has been inoculated in the silvi-horti model in Sangariya micro-watershed. The growth of inoculated seedling is being monitored. Fertilizer application and silvicultural operation are being carried out in the selected micro-watershed according to treatments and models. An area of 55 Bighas has been raised with agri-silvi (Boundary plantation of 35 Bigha), silvi-horti (8 Bigha), silvi-pasture (2 Bigha), agri-silvi (10 Bigha) in 18 farmers fields.

Project 35: Establishment of seed production area.

Objectives: To identify superior stands and convert them into seed production area.

Achievements

During this financial year 135 ha of seed stands, which were selected during last financial year have been revisited and sample plots have been laid out for empirical and subjective measurements. Out of this 135 ha, an area of 110 ha has been culled and converted into seed production areas. These 110 ha includes 55 ha of *Acacia nilotica*, 10 ha of *Eucalyptus camaldulensis*, 20 ha of *D. sissoo* and 25 ha of *Tectona grandis*.

Project 36: Establishment of clonal seed orchard.

Objectives: To establish clonal seed orchards of known superior clones.

Achievements

During the year, a total of 8 ha of clonal seed orchard has been planted. It includes 4 ha area of *Tectona grandis* and 4 ha area of *D. sissoo*. Apart from this, about 700 cuttings have been

placed in the mist chamber for rooting. An additional area of 13 ha has been surveyed/identified and prepared for future clonal plantations.

Project 37: Establishment of seedling seed orchard.

Objectives: To make available genetically superior quality of seeds for raising plantations.

Achievements

Thirty one ha of seedling seed orchard has been established at Govindpura experimental farm of Rajasthan State Forest Department, Jaipur. This includes 15 ha of SSO from 40 CPTs of *D. sissoo* at 5m x 4m spacing, 10 ha of SSO from 50 CPTs of *Acacia nilotica* at 5m x 4m spacing and 6 ha of SSO from 30 CPTs of *E. camaldulensis* at 4m x 2.5m spacing.

Project 38: Establishment of Multiplication Garden.

Objectives: To raise hedge garden of superior clones for their easy and quick multiplication.

Achievements

An additional area of 0.2 ha has been planted with 13 clones of *D. sissoo* this year.

Project 39: Establishment of model nursery.

Objectives: To establish a model nursery at AFRI, Jodhpur.

Achievements

Different types of root trainers are being tried out at AFRI to ascertain their suitability for use in arid conditions. Experiments are being conducted to ascertain the best potting mixture using locally available organic materials. The root trainer technology was demonstrated to senior forest department officials from Rajasthan and Gujarat.

NEW PROJECTS TAKEN IN HAND DURING 1997-98

Project 40: Sand dune stabilisation studies.

Objectives: To study the effect of an arrow design in and opposite to the wind direction on sand movement and studies on relative performance of some fodder species on a sand dune.

Progress made

A new species trial involving *Acacia planifrons*, *Dichrostachys nutans* and *Ziziphus nummularia* has been laid out during the year on a sand dune following RBD design in three replications. An experiment to study the effect of an arrow design in and opposite to the wind direction on sand movement has been laid out during the year on an active sand dune at the site. The species chosen is *Acacia tortilis*.

Project 41: Studies on Integrated Nutrient management and water harvesting techniques.

Objectives: (a) To study the effect of integrated nutrients managements in tree plantation in arid region of Gujarat. (b) To study the effect of water harvesting techniques on growth and establishment of tree plantation in arid region of Gujarat.

Two separate experimental trials have been laid out to meet the objectives.

Progress made

Data indicate that on an average babool attained a maximum height of 76 cm followed by Shisham (60.5), Neem (57.9), and Ardu (32.2 cm). Maximum survival has been recorded in Neem (92.5 %) followed by Babool (85.5), Shisham (70.5) and Ardu (34.1). As regards effect of different fertilizer treatments, preliminary data indicate that T9 (3g P/ Plant +VAM) and T5 (5g N+3g P/ Plant) give maximum height and survival respectively in babool. In case of Neem, maximum height is observed in T5 (5g N+3g P/ Plant) while T6 (10g N+ 3g P/ Plant) has given maximum survival. In Shisham T6 (10g N + 3g P/ Plant) and T7 (VAM) have given maximum survival and height, respectively. The survival and height of Ardu were best influenced by T9 (3g P+ VAM) and T4 (3g P/ Plant) respectively.

A trial with different water harvesting techniques viz., Ring pit, T-pit, U saucer and Saucer (control) was started in July, 1997. Initial results indicate that irrespective of different treatments, Neem recorded maximum survival percentage at both the spacings of planting. Irrespective of the species, maximum survival has been observed in U saucer (89%) followed by T pit, Saucer and Ring pit.

EXTENSION

- 1. Training:** Under UNDP Project, a short term training was organised for SFD officials and NGOs. In addition to research carried out in the Institute, the trainees were exposed to important forestry issues. A computer training was organised by the Institute to train scientists and other officials with latest softwares like- MS Word, MS Powerpoint, MS Excel, etc. In total 80 persons have been trained.
- 2. Teaching support:** Officers and scientists of AFRI have delivered lectures at eight different training/workshop forums.
- 3. Field Demonstration:** Under UNDP and NABARD Projects, plantation activities has been taken up in 10 villages and 3 macro watersheds. Planting Techniques have been demonstrated to the farmers in these villages.
- 4. Demonstration Plantations:** Demonstration plantations have been raised in 10 selected villages under UNDP Project. Species used in these plantations are *Dalbergia sissoo*, *Acacia nilotica*, *Eucalyptus*, Pomegranate, lemon and ber. During the year, 7000 plants have been planted on farmers' fields as demonstration plots under different agroforestry systems.
- 5. Seminars and Workshops:** In joint collaboration with IFFDC, a workshop on "Plantation Establishment Technology for Wastelands" was held from 13th January to 15th January 1998 at AFRI, Jodhpur. Workshops have been conducted on *Acacia nilotica* and *Azadirachta indica* for peer review.

FINANCIAL STATEMENT

S.NO.	HEAD/PROJECT	EXPENDITURE (in Rupees)
A. REVENUE EXPENDITURE		
a.	RESEARCH	1,13,29,581.00
b.	ADMINISTRATIVE SUPPORT	39,92,793.00
TOTAL FOR REVENUE EXPDT.		1,53,22,374.00
B. LOANS AND ADVANCE		
i.	LOANS/ADV. (CONVEYANCE)	63,200.00
TOTAL "B"		63,200.00
C. CAPITAL EXPENDITURE		
1.	BUILDING & ROADS	46,00,000.00
2.	EQUIPMENTS, LIB. BOOKS	1,96,503.00
3.	VEHICLES	
TOTAL CAPT. EXPDT. "C"		47,96,503.00
D. EXTERNAL AIDED PROJECT		
	NABARD	3,11,627.00
TOTAL PLAN		2,04,93,704.00
1.	R.D.P.	18,16,018.00
2.	U.N.D.P. PROJECT	3,62,319.00
3.	WORLD BANK PROJECT	36,81,718.00
SUB TOTAL EXTERNAL AID "D"		58,60,055.00
GRAND TOTAL (A,B, C & D)		2,63,53,759.00