

EXTERNALLY AIDED PROJECTS

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

Status: Two multilocal clonal field trials have been established at Haldughati, Udaipur. The first trial was established in the month of November 2007 with 12 accessions and the second clonal trial was established with 8 accessions in the month of September 2008 in RBD with four replications.

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

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

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

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

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

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

Status: Performance Trial of *Jatropha* Accessions: A total of 185 accessions (24 elite and 161 native) were collected/exchanged with participating Institutes and planted in September 2005 and 2006 showed variation in plant mean height, mean collar diameter and mean number of

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

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

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

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

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

Pollarding trial: Trial was established in July 2007 in RBD design with five replications and four treatments (T₀: No Pruning; T₁: Pruning Height 30cm; T₂: Pruning Height 45cm and T₃: Pruning Height 60cm. The number of plants per treatment was 10.

The treatments were imposed in February 2008. The initial survival is 100 percent and average height in T₀ was 167.1±28.68cm, mean number of branches 7.82±1.62 and collar diameter 5.862±0.95. Analysis of variance suggested that there is insignificant effect of pruning on average plant height. However, T₀ and T₂ varied significantly for mean number of branches only. Collar diameter was unaffected by the treatments.

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

Status: Trial was maintained in Kumatia enclosure, Kailana Forest Area, Jodhpur. Percent moisture in thinner branches was ranging from 36.6-39.4% in various treatments in the month of April 08. Growth data (Height, crown diameter) was recorded in September 08. Height increment was maximum (4 - 32 cm) in trees treated with FYM and I₁ (irrigation after 20 days) and minimum



Visit of DG, ICFRE (July 2008)

in trees with no FYM and No irrigation (2-15 cm). Crown diameter was maximum in FI₁ (207-287cm) while all other treatments were in similar range F₀I₀ (207-226cm), FI₀ (172-226 cm) and FI₂ (183-210 cm).

All the trees, where tapping was undertaken in February, 08 were healthy up to August 08, even those branches did not dry where cuts were given. Gum exudation completed till 15th April 2008. Casualties started in September end and total nine trees out of total 48 trees died till December 08, after ten months of gum extraction. Protection measures were applied in January 09 and no further casualty observed after that. Casualties were maximum (77.78%) in C₃ (450 mg ethephone) followed by in C₂ (22.22%) treatment with or without irrigation. There was no casualty in C₁ dose (150 mg of ethephone) and control.

Leafing occurs in 70-80 % plants in April –May due to rain but plants were completely leafless in June 08. Plants were lush green after rains in monsoon (July to September 08). Association of *Asparagus racemosus* was with all the plants. Leaf started yellowing in late October and all the plants were completely leafless in November 08. Flowering was noticed in January 09 in all the plants with leaf initiation in some plants of I₁ treatment. Fruit setting was observed in February 09.

Twigs (Pre & post ethephone treatment in 07-08) were pulverized and soxhlet extracted with petroleum ether and ethyl acetate. The petroleum ether contents was 1.7 to 1.9 % in the pre ethephone treated plants. It was ranging from 2.12 to 2.78 % in various treatments in post ethephone treated trees.

Organic manure (2 kg/plant) was applied in September'08 in experimental trees as per the treatment. Treatment wise irrigation schedule (at an interval of 20 & 30 days) was imposed from November 2008 to January 2009. Tapping experiments were initiated in third week of March 09. Ethephone doses were modified (0, 100, 200 & 300 mg in place of 0, 150, 300 and 450 mg) and injected at two to three places in a tree and cuts were given simultaneously. Gum was collected after six days; yield is low probably due to tapping in March end. So far, all the trees are healthy.

DG, ICFRE visited the experimental site in July 2008.

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

Status: This project is funded by the Ministry of Water Resources (MoWR), New Delhi. It was initiated in 2004 with two field experiments in Indira Gandhi Nahar Pariyojana (IGNP) and one in *in-filled* non-weighing type of Lysimeters (2 x 2 x 2 m³) at Jodhpur.

Among the tree species (*Eucalyptus camaldulensis*, *E. fastigata*, *E. rudis*, and *C. tessellaris*) tried in the field, performance of *E. rudis* has been found to be the best with respect to growth, biomass, transpiration rate and overall bio-drainage potential. Soil working at the

site resulted in heavy regeneration of *Eucalyptus camaldulensis*. The regenerated plants were mostly concentrated between 6 and 10 m from the tree trunk of the mother trees situated at the edge of the experimental site. Number of seedlings varied between 13 and 36 per m² area.

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

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

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

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



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

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

Status: The experimental area is located in Kordha, Sami Range in Patan (23.83° N latitude 72.12°E longitude) of Gujarat, India. After 20 months, *Acacia bivenosa* and *A. ampliceps* recorded 86.0 and 72.6 % as mean survival and there is almost negligible change in mean survival from Aug 08 to March 09. There is no effect of treatments on percent survival for *A. bivenosa*, however, in case of *A. ampliceps*, treatments influenced the survival and T₂ and T₃ treatments recorded significantly higher survival compared to other treatments. Survival of *Atriplex* spp was poor as they were planted on very shallow and waterlogged soil. Maximum survival was for *A. amnicola* (39.5 %) followed by *A. lentiformis* (18%) in March 09.

At 18 months of age mean height of *A. ampliceps* is 161.3 cm (55.5% more) and crown diameter 169.5 cm (38.9% more). While, in case of *A. bivenosa*, the mean height is 97.9 (60.7% more) and crown diameter 182.2 (65.3% more). T₂ (FYM) and T₃ (Wheat husk) treatments recorded significant higher growth compared to other treatments for both the plant species. Overall *S. persica* recorded maximum mean percent survival (92.8) at 18 months. Plants record appreciably high growth between 12-18 months. Mean increment in height and crown diameter was (40.4%) & (38.6%) respectively ranging from 26.2-49.5% and 26.2 – 51.5%. So far T₅ was the best treatment attaining maximum height 112.6 cm and crown diameter (154.1 cm).

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

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

Sub project B: Trials with four tree species namely *Cordia gharaf*, *Prosopis cineraria*, *Ziziphus mauritiana* and *Colophospermum mopane* and three grass species, namely, *Cenchrus ciliaris*, *C. setigerus* and *Dicanthium annulatum* were laid in RBD in three replication at Mochirai, Bhuj in July 06. Experiment one with *D. annulatum* grass is abandoned due to destruction of one and half replication due to passing of Narmada pipeline in June 08. **Survival:** Plant species maintained more than 90% survival in both the experiments. Overall periodic percent survival recorded after 30 months of age was in similar range, *Cenchrus setigerus*, 95.6% and *Cenchrus ciliaris*, 95.4% (almost no change between 24-30 months growth period).

However, survival with grass was higher in case of *C. ciliaris* (98.1%) compared to *C. setigerus* (92.0%). Species wise maximum survival was with *Prosopis cineraria*, 94.9%, *Cordia gharaf*, 99.5%, and *Zizyphus mauritiana*, 93.5%.

Height & Crown diameter: At the age of 26 months, tree species recorded 15.2 to 17.5 % and 12.2 to 28.7% mean height increment under control and with grass treatment for *C. ciliaris* and *C. setigerus*, respectively compared to height at 14 months. Mean height and crown diameter of control trees was significantly more (p-0.45) than trees grown with grass in case of *C. setigerus*. However, difference was insignificant for *C. ciliaris* (Table 2). Within species, height difference was highly significant (p-0.00), due to less height growth of *P. cineraria* compared to *Z. mauritiana* and *C. gharaf* which almost attained similar height with *C. setigerus* and *C. ciliaris*. Incremental growth for crown diameter was 7.7 to 5.7 and 11.9 to 25.7 % respectively for various tree species with *C. ciliaris* and *C. setigerus*, respectively, between the growth periods (14-26 months). Low rainfall (287 mm) is the reason for less growth. Effect of grass growth significantly influenced the overall crown diameter only with *C. setigerus* (p-0.00) at 14 and 26 months where it was 39 & 37.4 % more in control

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

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

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

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

Status:

- Contract agreement has been signed and sent to AFRS, Australia
- Selection of 4 experimental locations *i.e.*, Jodhpur Pali (Selibandh Forest Nursery), Bharatpur (Keoladeo National Park) and Hanumangarh (Kohla Forest Nursery) in Rajasthan and Gandhinagar, Junagarh and Bhuj in Gujarat.
- Extensive field survey were made covering Rajasthan State and samples of entomoherbivores and disease infected plant parts were collected
- A severe primary attack of *Ganoderma lucidum* was noticed in 2005- *A. nilotica* plantation at Sadri (Desuri) in Pali Forest Division followed by a secondary infestation of a termite species *Odontotermes sp.*
- Heart rot of *Acacia nilotica* tree caused by *Fomes sp.* collected from Keoladeo National Park, Bharatpur.
- Charcoal root rot was recorded in young plantation of *A. nilotica* collected from Desuri (Pali)
- 20 to 25% seedlings (12 weeks old) were found attacked by two species of *Myloccerus* (Curculionidae : Coleoptera) at Sadri -Desuri (Pali) during the month of August, 2008
- Active larvae of one species of bag-worm, *Pteroma sp.(nr.plagiophleps)*(Psychidae: Lepidoptera) was noticed on 30 to 40% trees at Sadri Range, having *Acacia nilotica* plantation in an area of 25 ha .
- Plant height was maximum when the seedlings were kept under canopy whether treated or untreated while numbers of shoots were maximum when the seedlings were exposed to sun. similarly, maximum number of leaves were recorded in the seedlings which were exposed to sun
- In nursery, Fusarium root rot, leaf blight, leaf spots were recorded on *Acacia* seedlings. Among insects whitefly, myllocerus, lac insects were recorded.
- Among pathogens powdery mildew fungus and rust was found to be very promising and host specific for acacia seedlings.
- The infestation of gall insect belonging to the family Lepidoptera was recorded for the first time in Desa Forest Range. The samples have been sent to Australia for identification.