Uruguay Tour Report

Introduction:

It is to submit that, IUFRO 2023 (International Union of Forest Research Organizations) is organised a conference on enhancing the performance and sustainability of Eucalyptus plantations to broaden benefits in Colonia del Sacramento Uruguay from November 20th to 28th 2023.

The enhancing performance and sustainability are the two challenges faced in TSFDC over the years.

With respect to performance TSFDC started with seed origin Eucalyptus plantations and currently switched to hybrid clones. The productivity is enhanced from average of 10 tons per hectare to current average of 70 tons per hectare at the same time rotation period is brought down to half that is currently 6 years. There is tremendous scope to increase productivity beyond 100 tons per hectare and with 4 years rotation period. We need to understand details and experiences across the globe.

The sustainability of productivity is another challenge faced by the TSFDC, for the past 50 years same Eucalyptus is cultivated and harvested for 7-8 rotations on the same land. For sustaining the soil productivity and get sustained yield, measures are to be implemented in a wholistic manner and we need to understand this with experiences across the globe

The conference at Uruguay provides ample opportunities for TSFDC to learn from experts in forest research, share knowledge, and establish connections with other professionals in the field. The event is also a platform to discuss and collaborate on solutions to global challenges related to forests and sustainable forest management.

As per the GORT No.1498 GAD (SPL.B) Department dated 28.10.2023, the following officers are attend.

S. No	Name of the Officer	Designation	Working Place
1	Dr.G.Chandrashekar Reddy, IFS	PCCF / Vice Chairman & Managing Director	TSFDC
2	Sri Laxman Ranjeet Nayak, IFS	Executive Director, Eco-Tourism	TSFDC
3	Sri Rayi Ravi	TSFDC Board of Director / Additional Secretary, Finance Department	Secretariat
4	Dr.G.Skylab	Sr. Divisional Manager, Head Office	TSFDC
5	Smt V. Tanuja	Divisional Manager, Paloncha	TSFDC
6	SmtT.Sreesravani	Divisional Manager, Kagaznagar	TSFDC
7	Sri. G. Chandramohan	Divisional manager Kothagudem	TSFDC

Tour Schedule:

We stared from Hyderabad on 18.11.2023 AN from Rajiv Gandhi International Airport to Doha International Airport. Reached @ 18:45 PM, then after 19.11.2023 @ 01:25 AM by Qatar Airlines from Doha International Airport to Guarullhos Airport to Sao Paulo reached at 09.11.2023 @ 11:00 AM then after Sao Paulo International Airport to Carrasco Airport, Montevideo reached at 19.11.2023 @ 17:00 PM then after we reached to Colonia del Sacramento @ 20:30 PM by Road and Halt at Sheraton Colonia Golf & Spa Resorts where IUFRO Conference is conducted.

20.11.2023:

Today morning perambulated surrounding areas and observe the local species, maintenance of Gardens, plantations and sea coasts etc., then after site seeing of Colonia Town then afternoon took the registration and evening participated opening ceremony of IUFRO Conference with officials of Uruguay.

21.11.2023

Today we have participated conference from 08:00 AM to 17:20 PM

In morning session:

1) **Tree Breeding Strategies**

   i) The global importance of Eucalypts and role of science to sustain it by Nuno Borralho, Consultant in Forest Genetics and breeding.

   ii) Environmic analisys for prediction of *Eucalyptus globules* genotype-environment interaction and mapping of breeding zones.
   By Andrew Calister (treehouse Forest Reserch LLC)
   Bew Brashew (Australia Blue gum plantations)
   Jeremy Brawner (University of Florida)

   iii) Unleashing natures potential of Corymbia-Development of Commercial genotypes and adoption of populations for the Forestry Industry by Paulo Silva

   iv) Eucalyptus dunnii clonal strategy implementation in Montes del Plata by Monica Heberling.

   v) Conservation domestication and breeding of Eucalyptus benthamii, a threatend, cold-tolerant subtropical species species with a restricted genetic base and lot of potential by David bush

   vi) Moving towards a rolling front strategy for VERACEL advanced-generation eucalypt hybrid breeding program by Ana Letycia Basso Garcia.

   vii) A Novel open pollinated seed production strategy to exploit both additive and non additive genetic effects in Eucalyptus dunnii by Michael Bird

Summary of the Tree Breeding Strategies:

Tree breeding strategies are very effective in Uruguay, Brazil, Eucalyptus plantations for enhancing of yield and they have a genetic improvement programme based on traditional breeding techniques to enhance wood yield and fibre quality. Beside this, they ensure that trees adapt to different forestry sites and climate conditions. This programme also increases the uniformity of the logs, which augments efficiency in harvesting and logistics operations,

To maximise genetic benefits, the best trees from each species are selected and controlled crossing is carried out. In the micropropagation laboratory, trees are multiplied using the vegetative propagation process, with a view to achieving mother plants from new clones.

Mainly they are growing Eucalyptus grandis and E. dunnii but they have also developed hybrids between different species.

Afternoon session:

2) Molecular and genomic technologies:

i) Twelve (12) years into genomic selection in Forest trees climbing the slope of enlightenment of markers assisted tree breeding by Dario Grattapaglia.

ii) Genomic selection in Eucalyptus globulus as an assisted selection tool for growth rate and disease resistance by Milena González Chavez, Ignacio Aguilar, Marianella Quezada, Gustavo Balmelli

iii) Identification of cold stress-responsive microRNAs and mRNA in Eucalyptus grandis by Joaquina Farias, Patricia Basile, Facundo M. Giorello

Summary:

Molecular and Genomic technologies used as molecular biology tools in breeding crop plant. It includes approaches such as marker-assisted selection and qualitative trait loci mapping. Marker-assisted breeding is used to improve plant traits and applies molecular markers in consolidation with linkage maps and genomics.

3. Posters presentation by TSFDC

We presented a poster for ***Genotype-environment interaction in wood basic density of Eucalyptus camaldulensis and its four inter-specific hybrid clones***.

Objective:

Conserving and improving the quality and productivity of the existing Eucalyptus plantations by adopting the latest gains of biotechnology and improved site preparation and thereby realizing better financial returns on a sustained basis.

Eucalyptus Species of TSFDC:

• EC X ED – Eucalyptus camaldulensis X E. deglutpa – suitable for normal soils and high rainfall areas and water logged areas.

• EC X EU – Eucalyptus camaldulensis X E. urophylla – suitable for normal soils and low rainfall areas also.

• 283 – Europhylla X Grandis (Urograndis)- Suitable for all type of soil including saline alkaline soil, water logging areas and low rainfall areas.

405 – Eucalyptus terticornis (Pure species) – suitable for all type of soils including alkaline soils with lime and calcarious stone.

Yield data at 3 years:

Clone no.	PVL		SAT		RR		KGM		KGZ	
	D. bora		J. puram		M. peta		Pentlam		Gurajala	
	yield/ha	Survival%	yeild/ha	Survival%	yeild/ha	Survival%	yeild/ha	Survival%	yield/ha	Survival%
2021	121.00	98.33	55.87	85.00	24.59	59.92	65.08	88.10	49.05	82.48
2022	127.40	96.10	41.37	76.30	25.95	63.47	56.09	84.68	71.86	96.91
ECXED	107.95	98.47	45.07	43.76	16.90	57.45	49.31	75.36	43.68	94.75
1803	121.31	98.74					61.05	89.44	52.93	97.17
Corymbia	81.16	95.58	52.18	80.39	23.86	68.14	40.03	78.16	48.73	97.52
EC X EU							39.84	68.26		
7	48.46	89.81	26.20	71.21	33.05	89.82	6.20	36.44	36.22	87.93

To achive 150-200 Mt/ Ha the following points to be implemented

Apart form planting of High yielding clones Improvement in Siliviculutural Practices in the below areas will help to achieve our desired targets

- Land development
- Timely planting
- Planting site specific clones
- Timely line weeding and soil working
- Weed and undergrowth Management with the help of mechanical tractor ploughing with MB plough and Cultivator
- Appropriate Fertilization Practices based on soil reports.
- Timely fire protection measures
- Harvesting the plantation in 4- 5 years if the spacing is 3X2 and 7 years at the spacing 3 X3. Delay in harvest leads to economical Loss.

Coppice management after felling the plantation. Previously in TSFDC 100% plantations are raised by a single clone no. 7. The mean productivity is 10 MTs/ha/yr. in the last 5 years. Productivity increased to 25MTs/ha/yr by giving proper conditions like
1. soil,
2. improved clonal genetic material and Silivicultural practices

Summery:

Most of the soils at TSFDC are sandy loams which are preferred by Eucalyptus. Based on the soil report site specific clones are planted.

Soil test reports revealed that due to repeated planting of single speices soil are becoming acidic in some areas pH level gone down below 5 this will have serious impact on productivity. Implementations of the recommendations Green Manure crop Successfully implemented recommendation of growing sun hemp and incorporated into the soil made it a success.

4. **CTFM Conference "Presentation of the Forestry and Timber Technology Center"**

Geographical location very suitable for forestry – excellent climate and soils

Forestry policy, clear purposes & legal frame work (the Forestry Act 1981, parts law, investment law)

Free trade zone law industrial technology parks Act, investment agreements new infrastructure, Tax incentives

Native forest conservation: 847318 Ha protected (5% unchanged & grazing)

A forestation today: 1,108371 Ha (6%) (Forestry priority land use: 4189636 Ha (24%)

Industrial sustainable development

22.11.2023

Morning Session:

Forest Management & Productivity:

i. Environmental, social & economical benefits by Rafael Rubilar Department of Silviculture, faculty of Forestry science, university of Concepcion Chile.

ii. Effect on fire on the weed dynamic effect of fire on the weed dynamics and the behavior of pre-emergent herbicides in Eucalyptus spp plantations by Lucia Airaudov

iii. Insect pests affecting Eucalypts in Portugal Current situation and future prospect by **Carlos Valente**

Afternoon Session:

Breeding for resistance to biotic and abiotic stress:

i. Development and allocation of improved eucalyptus for biotic an abiotic tolerance by Luis Fontes, Joao Pedro Pina, Luis Ferreira, Luis Leal

ii. Indicators of efficiency in operational crosses of Eucalyptus dunnii and hybrids in Montes del Plata Current progress and challenges by Mónica Heberling

iii. Rooting screening in Eucalyptus dunnii clones inverting the order in a clonal selection process by Mónica Heberling, Ana Laura Márquez, Álvaro Alonso

PONSEE:

CTL – the perfect cut

Efficiency and sustainability in time harvest by Diego Kartz, Ponssee Acadomy training & Digital services coordinator

Ponsse is one of the leading manufacturer of Forestry machines in the world

It is specialized in production sales, service and technology of Forestry machines with cut to length method .
Ponsse develops and manufactures sustainable harvesting solutions and innovative based on customer needs.

Main markets, Finland, Sweden, Germany, France, North America and Latin America

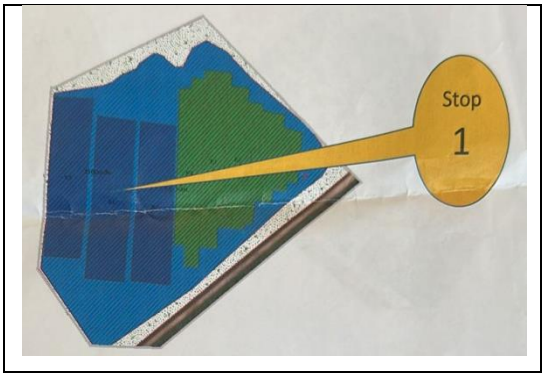
All forestry machines are manufactured in veranda and Epic is responsible for manufacture all the electronic components seinajokl, Finland.

23.11.2023 – Field Tour:

Today morning proceeded to field tour conducted by the IUFRO to UPM plantations

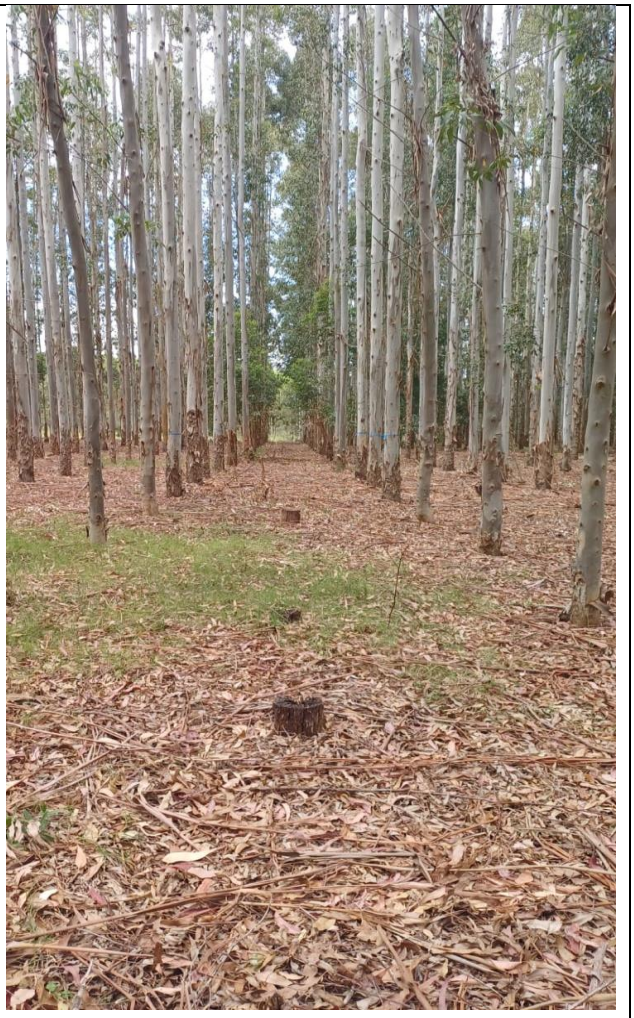
Name of the plantation T1 Clonal T236

- Planting Date: 05/11/2009
- Area: 1.78 hectares
- Linear plots of 5 plants per treatment
- Number of treatments: 165 (including 1 control)
- Replications: 3
- Total number of plants: 2475
- Experimental design: Alfa Lattice



Species

E. benthamii	28
(E. grandis x E. dunnii) x E. Grandis	1
(E. grandis x E. dunnii) x E. Grandis	1
E. dunnii x E. Globules	2
E. dunnii x E. Urophylla	2
E. grandis x E. Dunnii	4
E. dunnii x (E. grandis x E. dunnii).	5
E. dunnii x E. Grandis	19
E. dunnii	100
E. grandis	1
Seed E. Dunnii	3
Total	**166**



Observations:

It is a clonal trail plot. This is 14 years age plantation

The majority of species is Eucalyptus grandis hybrids is 90% E Dunnaii 10%

The plantation soil type is Grass lands (Black cotton soil) and soil PH is 5-6

No termite, average rotation age is 10 years, average yield is 200 cmt

Major problem is weed control i.e., Cynodon doctylon

Average rain fall is 1000 – 1200 MM

Major threat is fire (January to March is summer)

The plantation is monitoring by GPS tracking system

To alert the fire through Radio communication entire country, Agriculture weed control fire is prohibited

Near plantation smoking is prohibited.

If anybody do the intentional fire it will be crime and punishable by the Government

The fire control is effectively managed by the UPM.

Afternoon proceeded to visit the plantation of Montes del plata company

170000 Ha of Foresrty plantations in 13 Departments. 60% own plantations and 40% leasing

Raising of plantation:

Micro planning

Objective:

Maximize the ADT production improve quality of plantation (30-90-180-365 days)
Reduce the environmental and operational events impacts (Frosts, drought, foot prints, erosion)

Tools: SWISAGA, DTM, Agrocad/ Automatic pilot

What did we do ?

Generate a stand prescription (UMOX) for sites with water logging problems
Factors considered

1. Slope
2. Furrow design
3. Ridge height / plantation height
4. Vertical tillage

Precision Forestry:

Objective:

Execute planning accurately, avoiding non-compliance (legal/MdP regulations) and maximizing ADt per ha at a cost less than or equal to the current one.

What did we do?

We evaluate the accuracy of different GPS on tractors: 4D Global and Trimble. We evaluate cost, integration into the current monitoring system, accuracy, stability and robustness of the solution.

We use Automatic pilot to execute Micro-planning (Agrocad Maps)

Detect areas with greater mortality problems and their spatial distribution by equipping the Sarapico (manual planting tube) used in the replenishment with GPS

Results:

Desired accuracy on the machinery (<30 cm), working with solution stability.

Planning's correct execution using autopilot.

Successful adaptation of the Sarapicos with the STA loggers, demonstrating to be robust equipment with 48 hours of autonomy, metric accuracy and proper integration into GIS.

Irrigation with Artificial intelligence

Objective:

Increase irrigated area per day with the same machinery:
plantation insurance.
Reduce cost by increasing operation efficiency
Reduce water consumption.
What did we do?
We developed an equipment that irrigates 3 furrows simultaneously, recognizing the seedlings using computer vision (trained algorithm), with a 90,9 % Recall
Recall: Plants Detected / (Plants Detected + Plants Not Detected)..
What are we currently doing? Improving irrigation quality
Improving distance calculation.
Automatic lateral adjustment of the irrigation heads.
Watering at the right time.

Montes del Plata and its commitment forest health

Objective

Sustainable management based on and early warning systems in Nurseries and plantations, not only for emerging pathogens, but also for pathogens with knows destructive potential for Eucalyptus, allowing the establishment of an adequate action plan, based on a correct identification of the casusative agent and a suitable methodology to understand the potential impact.

Nurseries

Weekly monitoring

Targeted monitoring

Insect traps

Commercial plantations

Semiannual monitoring (fall and spring) in fixed plots of 30trees from plantations from 0 to 3 years old.

Continuation surveillance in all plantations throughout the entire crop cycle

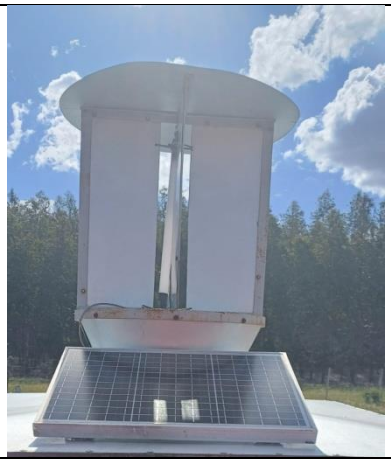
Spraying of Weedicide with AI

Watering with AI technology

	
Planting tool	Plantation

Black Light Trap:

The black light trap is very useful tool to know the insect population fluctuation with nocturnal activity, since obtains information about the seasonal periods of flight and the moments of abundance. The numbered of adults captured is recorded weekly to calculate in degree days when the eggs and larvae will be.

Key learnings:

1. Soil Preparation: we can use ripping operation for soil working up to 40 cm depth to gain higher wood productivity.

2. Automation in raising areas like watering with Artifical intelligence and sparing of weedicide.

3. The monitoring of plantations with GPS Tracking technology (7G) office to field monitoring.

24.11.2023

Morning session:

1) Environmental, Social and economic benefits by Claudio Balocchi

2) Breeding for wood properties

Genetic parameter estimates for Eucalyptus dunnii wood properties assessed by multiple methods by Craig Hardner

Conclusion:

With barely 17 million hectares of land and a population of just over three million, Uruguay is now home to two mega pulp mills. The mill run by Finnish company UPM (ex-Botnia) has an annual production of 1.3 million tons, and is located on the Uruguay River.

Commercial forestry in Uruguay is mainly based on non-native *Eucalyptus* and *Pinus* plantations. *Eucalyptus* is the most planted genera and covers approximately 730,000 ha. Currently, forest products represent one of the top three exports of the country.

In Uruguay UPM's sustainable eucalyptus plantations are situated on grasslands that were previously used for cattle grazing. UPM does not, and will not, convert natural forests into plantations.

UPM manages around 250,000 hectares of land, of which roughly 60% is planted with eucalyptus. The rest of the land area consists of unplanted grassland, infrastructure and protected valuable sites such as native forests. On 60% of the total land area, eucalyptus cultivation is combined with cattle grazing. All UPM plantations are certified to both FSC® and PEFC™ forest standards.

They have a genetic improvement programme based on traditional breeding technics to enhance wood yield and fibre quality. Beside this, they ensure that trees adapt to different forestry sites and climate conditions. This programme also increases the uniformity of the logs, which augments efficiency in harvesting and logistics operations,

To maximise genetic benefits, the best trees from each species are selected and controlled crossing is carried out. In the micropropagation laboratory, trees are multiplied using the vegetative propagation process, with a view to achieving mother plants from new clones.

Mainly they are growing Eucalyptus grandis and E. dunnii but they have also developed hybrids between different species.

The growth and quality of plantations is monitored closely. When the plantations are approximately one year old, he says, UPM undertakes an aerial survey with drones to count the number of trees per hectare.

Fertilisers have the same minerals that are present in the soil. They use slow release fertilisers that are put underneath seedlings at the time of planting. This ensures that

trees use nutrients very efficiently so there is no risk that the added nutrients would end up in water streams

In their field work they have been incorporating mechanisation efficiently by combining two or three activities in one tractor operation. This strategy has also helped them to keep costs under control.

Harvesting

Trees are harvested when they are around 10 years old. In the mechanised harvesting operations field workers are using machinery that cuts, trims, debarks and slices the tree. Then trunks are stacked and left at the side of the road for transport.

The target is to conserve the quality of internal and provincial gravel roads during rainy days or even after the rain. They have various log yards located by asphalt roads to ensure that they can continue using the fleet even during rainy days without getting onto gravel roads

Safety

To improve road safety in wood logistics, UPM provides constant training and has incorporated a scoring system that has decreased incidents of speeding. A GPS control system is used to monitor the routes and distances as well as the speed of trucks.
If drivers are exceeding the speed limits or they are caught causing dangerous situations, they will start losing their scoring points. If a truck reaches a certain level of scores, it has to have a day off as a penalty,

Symbiosis with traditional farming

UPM has been co-operating with private landowners since 2005 within the framework of the FOMENTO Programme. Under the programme, UPM Forestal Oriental supplies the tree seedlings and is responsible for planting and harvesting the trees later on.

The plantations offer income for agriculture, while the forest industry is expanding its planted areas with the support of farmers.

Today, approximately one third of the plantations managed by UPM are located on privately owned lands.

During the conference important topics were discussed like tree improvement, silviculture, Water use of Eucalyptus, Harvesting & management, total genome sequencing, gene editing related to eucalyptus improvement which was very informative& effective for our plantation program.

Key learnings to TSFDC:

1. **Species:** we can introduce Eucalyptus grandis & Eucalyptus urograndis for our planting programme as both have very good productivity &pulping properties.

2. Soil Preparation: we can use ripping operation for soil working up to 40 cm depth to gain higher wood productivity.

3. Robust R & D network: they have given more focus on plantation R & D to improve wood productivity & pulp yield.

4. **Seedlings plantations:** Presently we are focusing on clonal eucalyptus plantations, but this has very narrow genetic base. We can promote 10-15 % good quality seed plantation supported by breeding & hybridization programme to have broad genetic base plantations.

5. **Harvesting Machines:** They are using harvesting heads for cutting debarking & loading machines for other activities. Cost per MT harvesting: 10 US $. Harvesting capacity of machine: 3 MT/hour. We can introduce small scale harvesting machine.

6. Automation in nurseries like fustigation, media/container filling, sprinklers modification etc.

7. **Real Time Monitoring**: They are monitoring of plantations with GPS Tracking technology (7G) office to field monitoring. The same may be introduced in TSFDC recently.

8. TSFDC average yield is competitive to Brazil (15 m^3/ha), China (15 m^3/ha), Uruguay(10 m^3/ha) and TSFDC (10 m^3/ha) per Ha productivity

We like to thanks to getting of permission from Government & Board of Directors.