



NELSON MANDELA  
UNIVERSITY



# Last initiatives and updates of Mechanized Planting in Brazil

Cássio Fagundes Gomes

October 18th - 2023



**CASSIO FAGUNDES GOMES**

*Forest Engineer  
MSc Agricultural Engineer*

Professional with a consolidated career in large companies in the Brazilian forest sector of operational development, excellence, mechanization and innovation in silviculture, harvesting and nursery operations.

Since 2018 is acting as an elective advisor member of the Technical Board of the Collaborative Program on Forestry Mechanization and Automation (PCMAF), Representing 13 of the largest forestry companies in Brazil.

## ACADEMIC GRADUATION AND POST GRADUATION



## WORK EXPERIENCES



≈ 35 thousand employees

1.3 million ha Planted forests

Eucalyptus

10.9 million tsa Pulp and paper



≈ 25 thousand employees

284 thousand ha Planted forests

Eucalyptus / Pine

3,6 million tsa Pulp and paper



≈ 8 Thousand employees

144 thousand ha Planted forests

Eucalyptus

1.2 million tsa Pulp



≈ 6 thousand employees

270 thousand ha Planted forests

Eucalyptus

1.8 million tsa / 4.2 million tsa\* Pulp

## TECHNICAL ADVISOR - COLLABORATIVE PROGRAM OF FOREST MECHANIZATION (PCMAF/IPEF)



PhD Saulo Guerra (Scientific Head Leader)  
PhD Guilherme Oguri (Executive ccoordinator)





# PRESENTATION TOPICS

1. INTRODUCING THE BRAZILIAN FORESTRY SECTOR
2. OVERVIEW OF PLANTING MACHINES AND ITS DEVELOPMENT STAGES
3. THE CHALLENGES OF PLANTING MACHINES







# INTRODUCING THE BRAZILIAN FORESTRY SECTOR





The forest-based industry closed 2019 with **US\$10.3 billion in trade balance**, the second best result in the last 10 years



Exports totaled around **US\$11.3 billion**, equivalent to 4.3% of Brazilian exports



The planted tree sector is also **responsible for around 3.75 million direct and indirect jobs** and those resulting from the income effect



Projects aimed at **increasing plantings**, expanding factories and new units are worth around **US\$10 billion by 2023**



Responsible for generating **US\$5 billion in federal, state and municipal taxes: 0.9% of national revenue**

## Planted forest distribution

9 milhões de hectares de árvores plantadas de eucalipto, pinus e demais espécies (acácia, araucária, paricá e teca), para os seguintes segmentos:



**36%**

Celulose e papel



**12%**

Siderurgia e carvão vegetal



**6%**

Painéis de madeira e pisos laminados



**10%**

Investidores financeiros (Timos\*)



**29%**

Produtores independentes



**4%**

Produtos sólidos de madeira

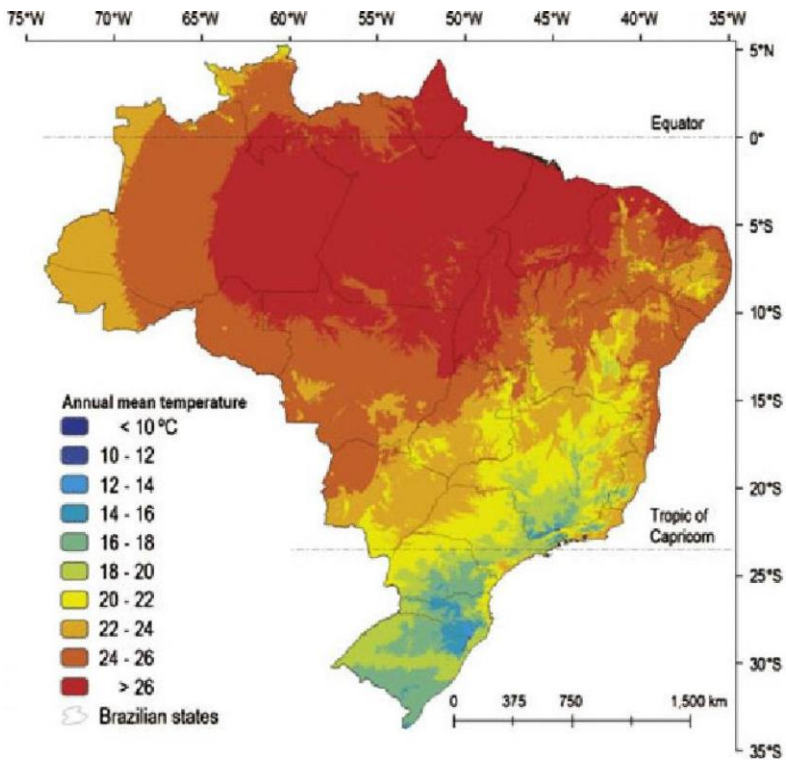


**3%**

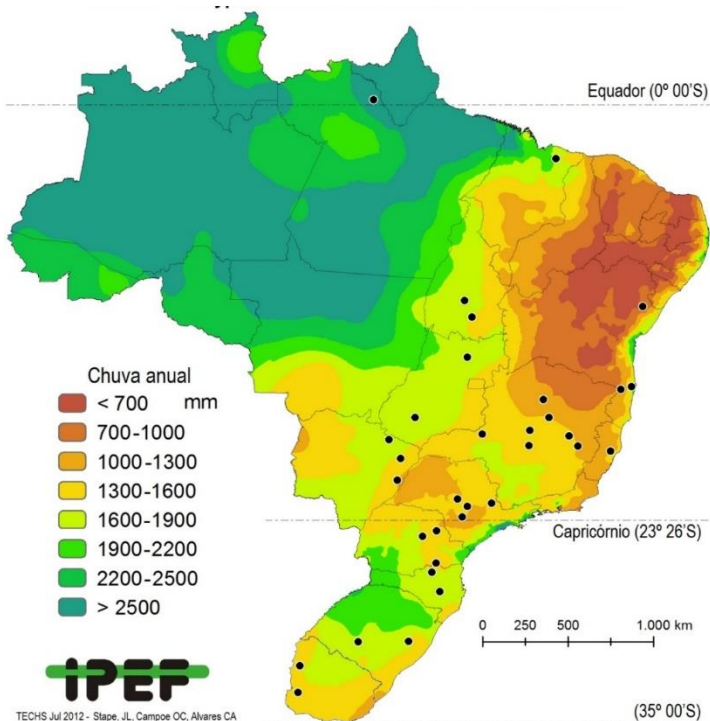
Outros



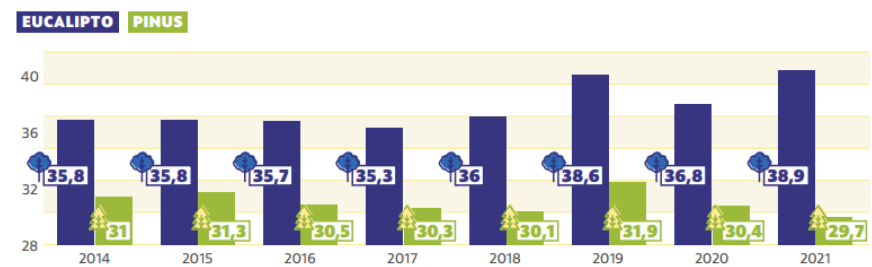
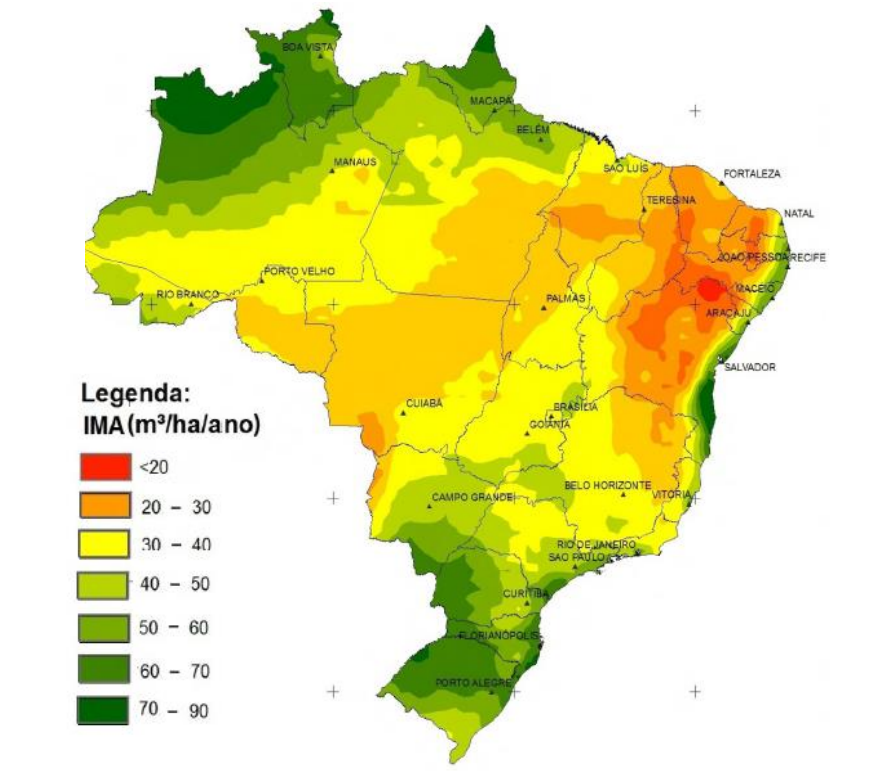
## TEMPERATURE



## PRECIPITATION



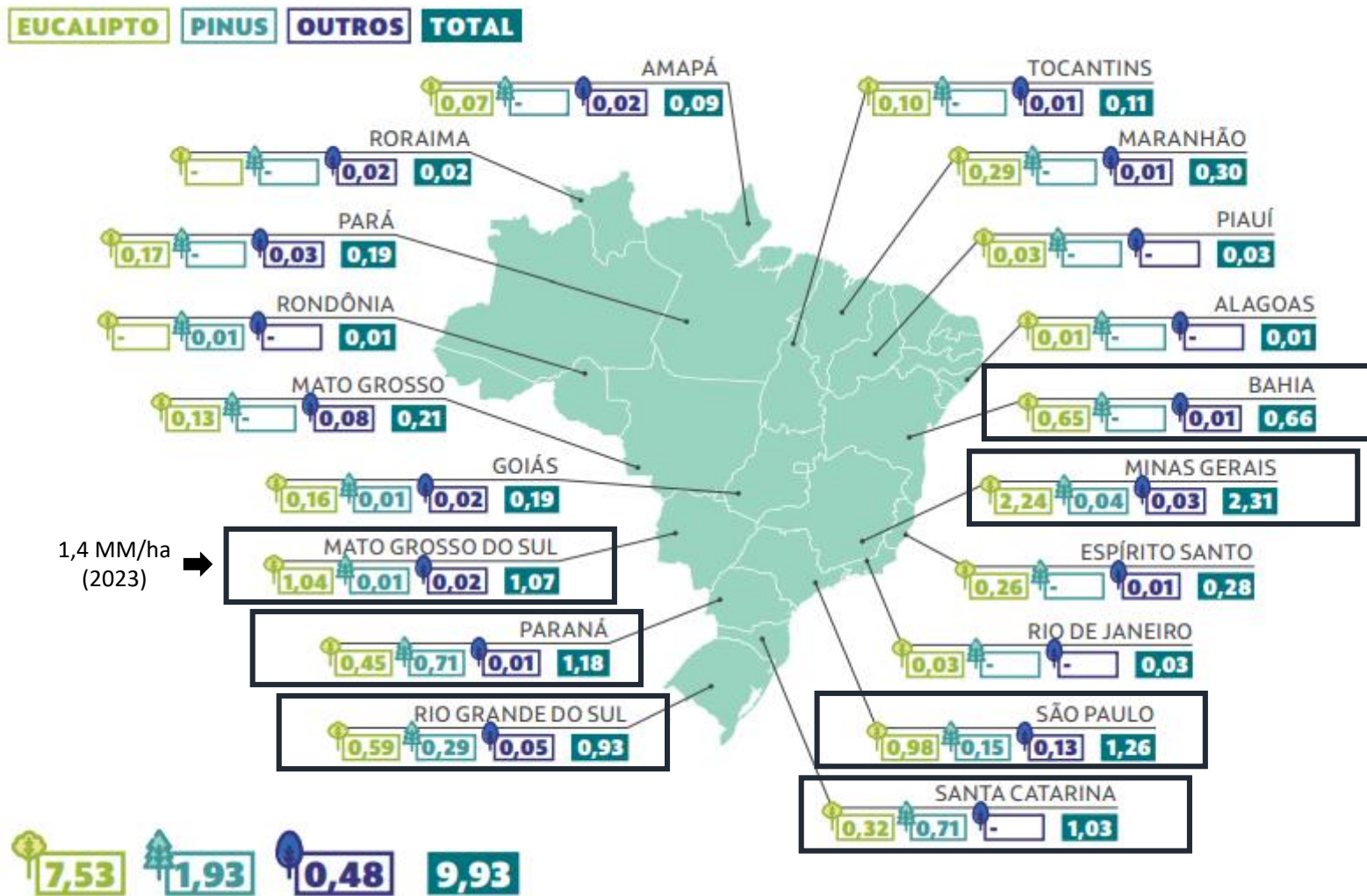
## IMA



EUCALYPTUS AND PINUS YIELD DEVELOPMENT IN BRAZIL (M³/HA/YEAR)



### FORESTRY ARE PLANTED IN BRAZIL BY STATE (MILLIONS OF HECTARES)



1,4 MM/ha (2023) →



**ENVIRONMENTAL  
CONSERVATION AREAS  
WITHIN THE SECTOR**

**6,05  
MILHÕES**

Source: FGV and Ibá 2022



**LEVANTAMENTO DO NÍVEL DE MECANIZAÇÃO NA SILVICULTURA**

**SILVICULTURE MECHANIZATION INDEX SURVEY**

EDIÇÃO EDITION 2022 2023

IPEF FCA Universidade Federal de São Carlos



The level of mechanization (overall and for the main silviculture operations) is presented separately for eucalyptus and pine, since the percentages are calculated according to each specific area where the implements or assemblies at each level are used and later classified according to the following definitions:

**MANUAL OPERATION:** any activity using tools that are exclusively human-powered.

**Level 1:** tools without mechanical actuation. Examples: hoe, axe.

**Level 2:** tools with mechanical actuation. Examples: seedling transplanter, ant bait applicator.

**SEMI-MECHANIZED OPERATION:** any activity using tools, mechanical assemblies, or implements that are human AND mechanically powered.

**Level 3:** tools driven by a motor. Examples: chainsaw, motorized pruners.

**Level 4:** mechanical assemblies and implements that require an operator and at least one other external person. Examples: continuous planter and conventional irrigator.

**MECHANIZED OPERATION:** any activity using mechanical assemblies or implements that are exclusively mechanically powered.

**Level 5:** mechanical assemblies and implements that require only an operator, without the use of an auto-pilot function. Example: tractor-drawn subsoiler.

**Level 6:** mechanical assemblies and implements that require only an operator, with the use of an auto-pilot function. Example: specialized subsoiler drawn by a track-drive tractor with geotechnology systems.

## PREPARO DE SOLO

## SOIL PREPARATION

Empresa / Company	MANUAL		SEMIMECANIZADA		MECANIZADA		AUTOMÁTICA	
	Manual		Semi-mechanized		Mechanized		Automatic	
	Nível 1	Nível 2	Nível 3	Nível 4	Nível 5	Nível 6	Nível 7	Nível 8
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
	% de área trabalhada para cada nível / % area worked for each level							
A	0,00	0,00	0,00	0,00	75,66	24,34	0,00	0,00
B	0,00	2,90	0,00	0,00	92,20	4,90	0,00	0,00
C	1,12	0,00	0,00	0,00	98,88	0,00	0,00	0,00
D	4,98	1,55	0,61	0,00	24,53	68,33	0,00	0,00
E	0,00	0,00	0,00	0,00	32,23	67,77	0,00	0,00
F	0,00	0,00	0,30	0,00	99,70	0,00	0,00	0,00
G	17,46	0,00	10,00	0,00	72,51	0,00	0,02	0,00
I	0,00	0,00	0,00	0,00	100,00	0,00	0,00	0,00
K	1,10	0,00	0,00	0,00	98,90	0,00	0,00	0,00
M	7,48	0,00	0,00	0,00	80,97	11,55	0,00	0,00
N	0,16	0,00	0,00	0,00	93,09	6,75	0,00	0,00
Q	9,28	0,00	0,00	0,00	90,32	0,00	0,00	0,00
S	1,27	0,00	0,00	0,00	80,76	17,98	0,00	0,00
T	0,00	6,32	0,00	0,00	93,68	0,00	0,00	0,00
Y	0,00	0,00	0,00	0,00	0,00	100,00	0,00	0,00
2022	2,88	0,72	0,73	0,00	75,56	20,11	0,00	0,00
2020	1,31	0,00	0,01	0,04	85,12	13,48	0,03	0,00
2018	9,40	0,00	2,20	8,70	74,90	4,80	0,00	0,00

Source: PCMAF/IPEF.

## PLANTIO

## PLANTING

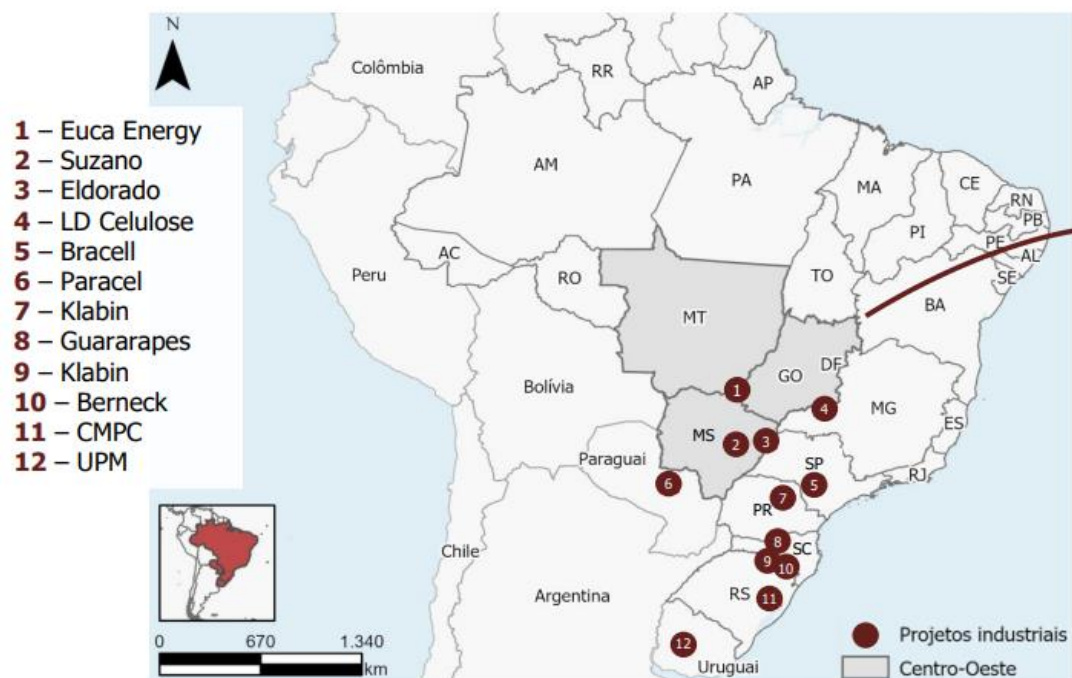
	MANUAL		SEMIMECANIZADA		MECANIZADA		AUTOMÁTICA	
	Manual		Semi-mechanized		Mechanized		Automatic	
	Nível 1	Nível 2	Nível 3	Nível 4	Nível 5	Nível 6	Nível 7	Nível 8
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
	% de área trabalhada para cada nível / % area worked for each level							
A	0,00	0,10	0,00	99,90	0,00	0,00	0,00	0,00
B	0,00	67,40	0,00	32,60	0,00	0,00	0,00	0,00
C	5,33	94,67	0,00	0,00	0,00	0,00	0,00	0,00
D	5,59	42,60	1,93	48,29	0,60	1,00	0,00	0,00
E	0,89	99,11	0,00	0,00	0,00	0,00	0,00	0,00
F	0,00	29,90	0,00	70,10	0,00	0,00	0,00	0,00
G	1,47	90,47	0,00	7,73	0,33	0,00	0,00	0,00
I	0,00	2,21	0,00	97,76	0,00	0,00	0,00	0,00
K	0,00	51,30	0,00	48,70	0,00	0,00	0,00	0,00
M	0,00	95,82	0,00	4,18	0,00	0,00	0,00	0,00
N	0,00	100,00	0,00	0,00	0,00	0,00	0,00	0,00
Q	0,00	100,00	0,00	0,00	0,00	0,00	0,00	0,00
S	0,00	13,54	0,00	86,46	0,00	0,00	0,00	0,00
T	0,00	41,12	0,00	58,88	0,00	0,00	0,00	0,00
Y	0,00	100,00	0,00	0,00	0,00	0,00	0,00	0,00
2022	0,89	61,88	0,13	36,97	0,06	0,07	0,00	0,00
2020	14,10	56,88	0,49	18,80	9,55	0,00	0,00	0,00
2018	0,00	65,00	1,30	33,30	0,30	0,10	0,00	0,00

Source: PCMAF/IPEF.



**3 industrial projects announced and estimated** should more than double demand for wood from the Central-West Region, another 9 projects are expected to change the market in nearby regions

**Location of the main industrial projects in the Central-West Region and nearby**



Fonte: compilação ESG Tech

Fonte: Site das empresas | Análise ESG Tech

**Wood capacity and consumption of main new projects industrial plants in the Central-West Region and nearby areas**

	Projeto	Capacidade	Consumo de Eucalyptus (Mi m <sup>3</sup> cc/ano)
<b>Região Centro-Oeste</b>	Suzano Projeto Cerrado	2,55 Mi ton/ano BHKP	10,2
	Eldorado Projeto Vanguarda	2,3 Mi ton/ano BHKP	9,2
	Euca Energy	2,0 Mi ton/ano BHKP	8,0
	<b>Subtotal</b>	<b>6,85 Mi ton/ano BHKP</b>	<b>27,4</b>
<b>Proximidades</b>	Paracel	1,5 Mi ton/ano BHKP	6,0
	Bracell Projeto Star	3,0 Mi ton/ano BHKP ou 1,5 Mi ton ano DP	12,0
	LD Celulose	0,5 Mi ton/ano DP	2,8
	<b>Total</b>	-	<b>48,2</b>

Em operação

Note: DP – *Dissolving pulp* (celulose solúvel) | BHKP - *Bleached hardwood kraft pulp* (celulose branqueada de fibra curta)



# PLANTING MACHINES

## THE PREVIOUS CONCEPT



## MACHINES CONCEPT USED IN 2000's UP 2020



Source: Dimel/Terramax



Source: Eldorado Brasil



Source: Roster

### MAIN LIMITATIONS:

- Staff Labour ergonomic / safety conditions
- Limitation for forestry implantations
- No strong after sales support
- Only flat conditions
- No technology (lot and GPS)
- Discontinued companies

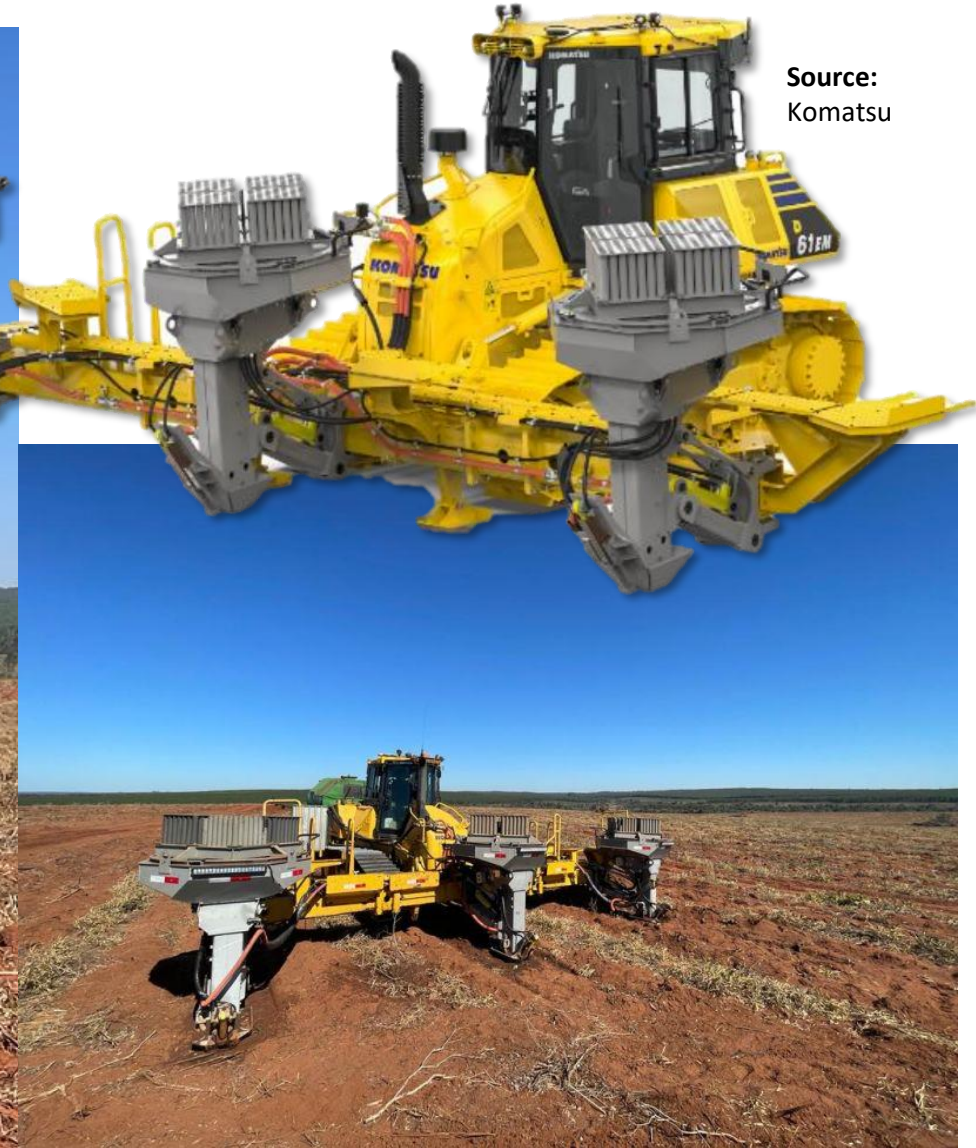


# PLANTING MACHINES

NEW CONCEPTS AVAILABLE  
FOR SALE ON MARKET



**KOMATSU**



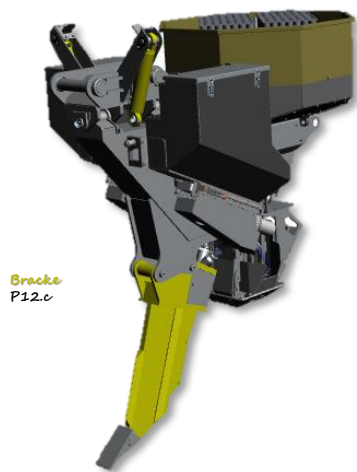
Source:  
Komatsu

Source: Komatsu, Author and Suzano





Machine de base	Excavatrice de 20 à 24 tonnes métriques
Poids	1 700 à 2 100 kg en fonction des options
Magasin de semis	196 cellules (tube de plantation de 60 mm)
<b>Exigences hydrauliques</b>	
Pression	170 BAR
Débit	170 l / min
<b>Système électrique</b>	
Alimentation	24V
<b>Accessoires</b>	
Tube de plantation de 75 mm	Magasin de 100 cellules
Outils de scarifiage	1 ou 3 tiges Profondeur de 400 à 800 mm
<b>Systèmes en option</b>	
Fertilisation	Applicateur à libération lente Engrais en position latérale Engrais en profondeur
Irrigation	Eau Gel à base d'eau
Inclinaison latérale	



Bracke P12c

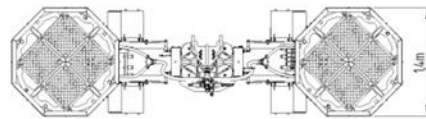
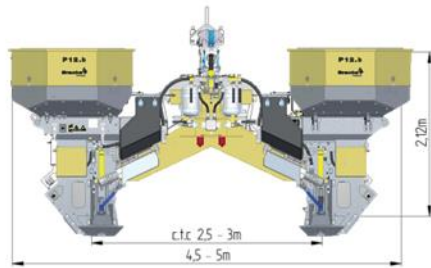
Source: Bracke Forest





### Technical data

Base machine	Excavator 24 metric ton
Weight	2.470 kg – depending on options
Seedling magazine	392 cells (45 mm planting pipe)
<b>Hydraulics requirements</b>	
Pressure	170 BAR
Flow	200-250 l / min
<b>Electrical system</b>	
Power	24V
<b>Optional systems</b>	
Fertilizing	Slow release applicator Side fertilizer
Irrigation	Water Water-based gel



The Bracke P22.b has a low planting position to concentrate the irrigation water

Bracke P22.b is mounted with a rotator and link that allows seedlings getting planted in a upright position

Source: Bracke Forest





COMMERCIAL MACHINE



Source: Jhartwich





## STANDARD VERSION TESTED



Source: Author.

## PROTOTYPE UNDER DEVELOPMENT



Source: Author.



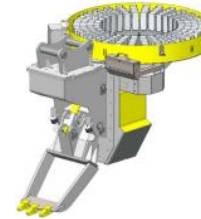


STANDARD SKB 120 ROUNDING TRIALS



Source: Grupo Timber

Risetec SKB-G



- 120-240 seedling cassette
- 18 tonne carrier
- Weight approx. 1700 kg (with cultivator)
- 160 bar
- 140 l/min
- 2500 mm length
- 1650 mm width
- 1570 mm height (bottom of frame)
- 2250 mm height (bucket down)

Ripper



Source: Risetec

- For deep soil preparation
- Cracking depth even 90 cm
- Can be used for removing the residue
- Suitable for plantations of pine, spruce and leafy trees
- Suitable for flat and hills



Source: Klabin





# PLANTING MACHINES

MACHINES UNDER DEVELOPMENT OR  
RUNNING FIELD TESTS





## 1<sup>st</sup> PROTOTYPE TESTED



Source: Author

## 2<sup>nd</sup> PROTOTYPE UNDER CONSTRUCTION



Source: HD Plan





## 1<sup>st</sup> PROTOTYPE DEVELOPED AND TESTED

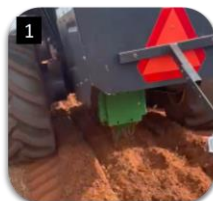


Source: Author

## 2<sup>nd</sup> PROTOTYPE UNDER DEVELOPMENT



Source: John Deere



1  
Movimentação do cabeçote plantador com a muda pré alimentada



2  
Movimentação do cabeçote plantador para o solo e transplanto da muda e início de irrigação



3  
Levante do cabeçote ainda com sistema de irrigação acionado (para fechamento da cova)



4  
Plantio finalizado.



5  
Resultado

Source: Author



## THE CONCEPT



## 1<sup>st</sup> PROTOTYPE



Source: Ponsse / Novelquip

Source: Ponsse / Novelquip





THE CONCEPT



Source: Mohogany Roraima

1<sup>st</sup> PROTOTYPE UNDER CONSTRUCTION



Source: Mohogany Roraima





## 1<sup>st</sup> PROTOTYPE



Source: YN4U

## 2<sup>nd</sup> PROTOTYPE UNDER DEVELOPMENT



Source: YN4U





THE CONCEPT



Source: Risutec

1<sup>st</sup> PROTOTYPE READY STARTING TRIALS



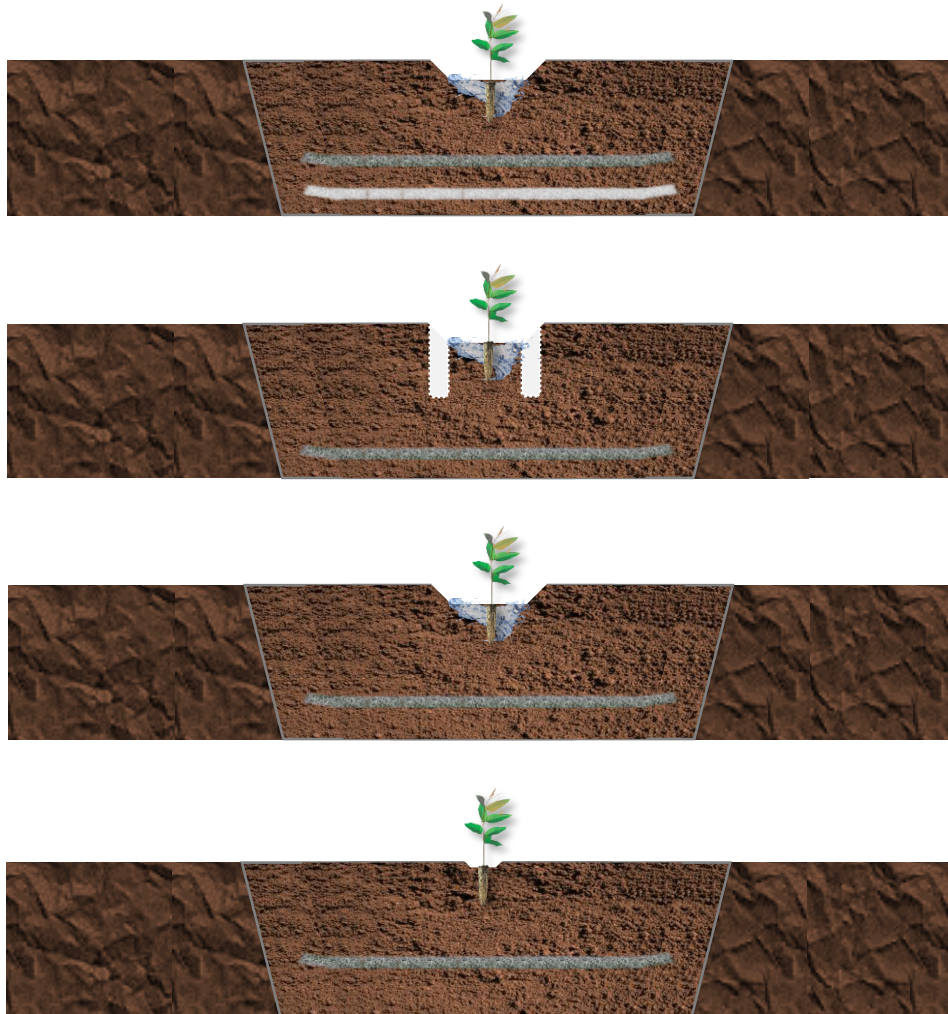
Source: Risutec



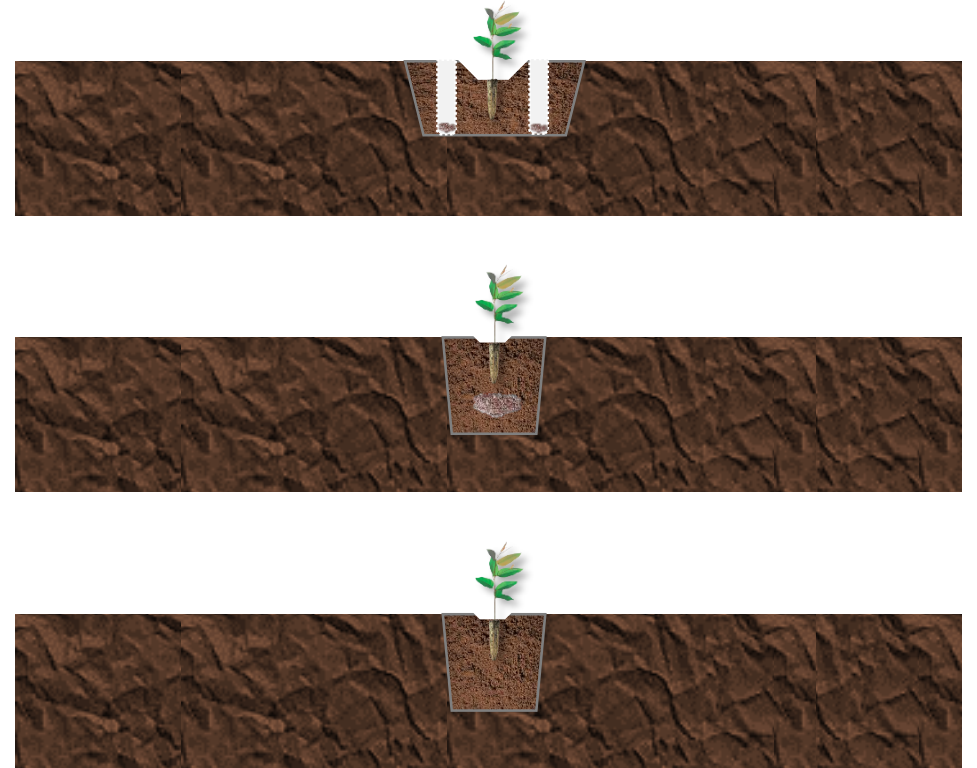


# THE CHALLENGES

### Ripping variation types



### Spot ripping/pitting



Source: Author



## The ripping system



Source: Author

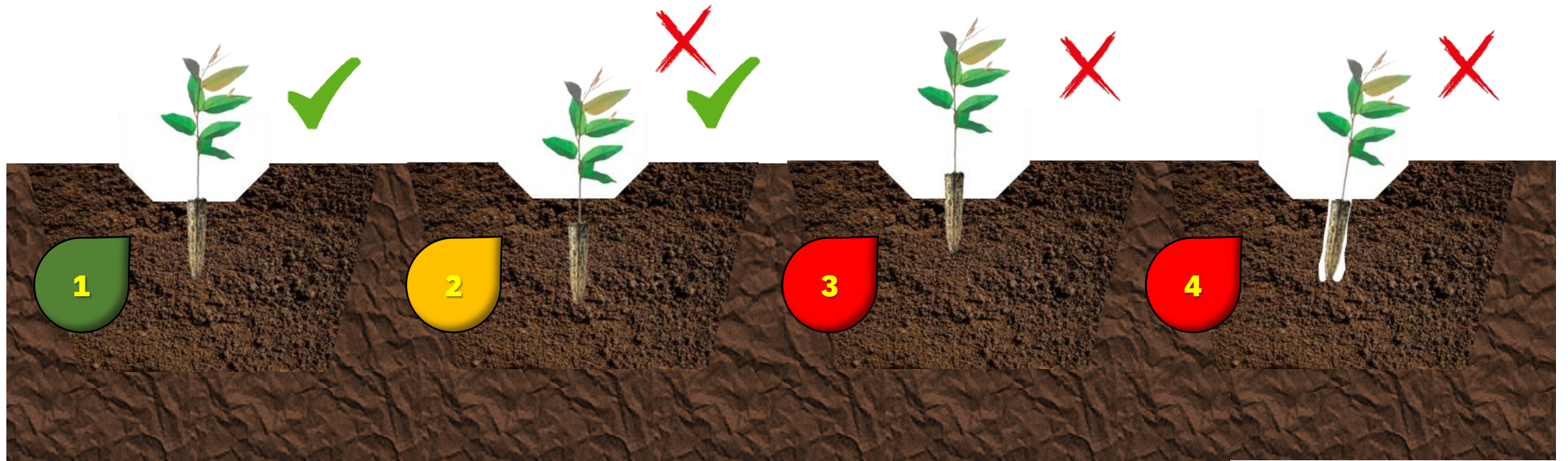
## Multiline guide variance



Source: Author



Amount of drowned stem  
Tolerance



Source: Author



Nude roots



Source: Author

Paper pots by Ellepot



Source: BCC

Biotubes by IN4Y



Source: Author

Plastic pots Sis BCG



Source: Author

SEEDLING QUALITY VARIATIONS



Source: Author



No water



Water + Gel

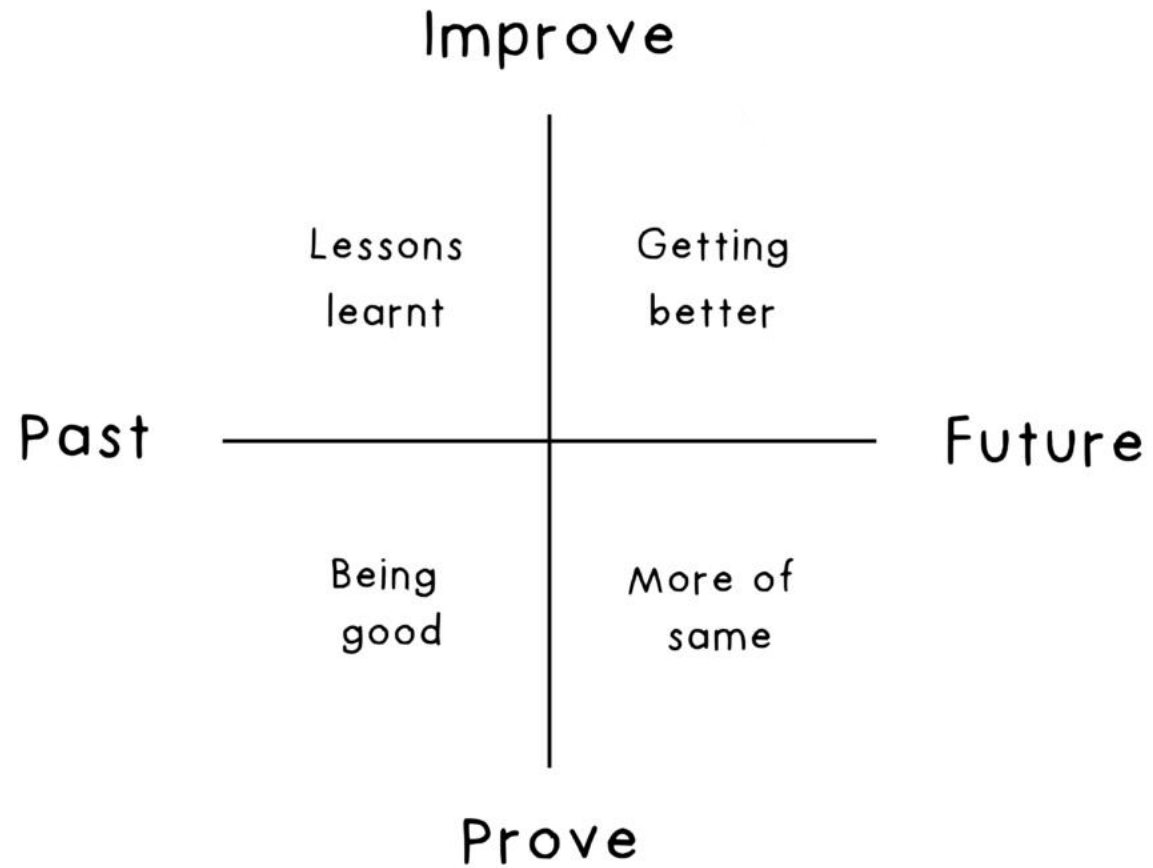


Water



Source: Author

# Thinking about my thinking



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Obrigado!







## Cássio Fagundes Gomes

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