Effect of High Density Planting on growth and yield of selected RRIM 2000 series

By

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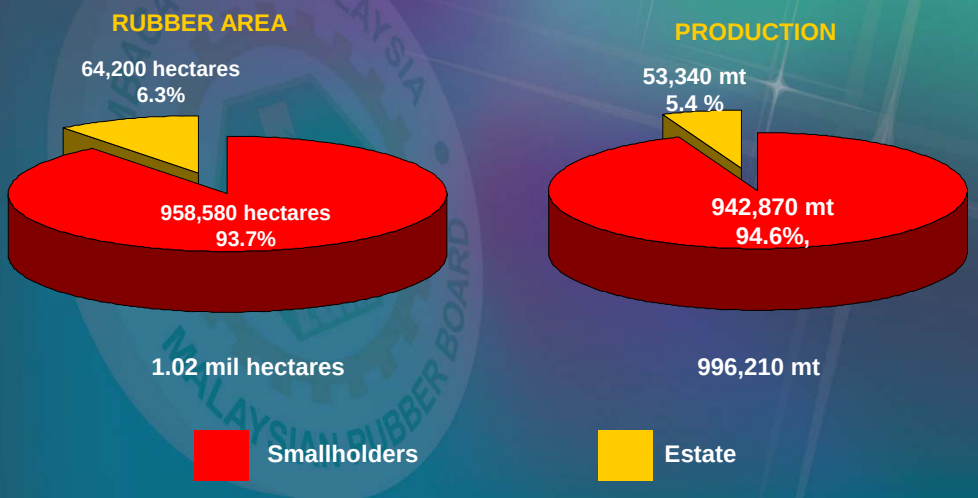
LEMBAGA GETAH MALAYSIA

Kreatif • Inovatif • Progresif

RUBBER GROWING IN MALAYSIA

Predominantly a smallholder's industry (2011)

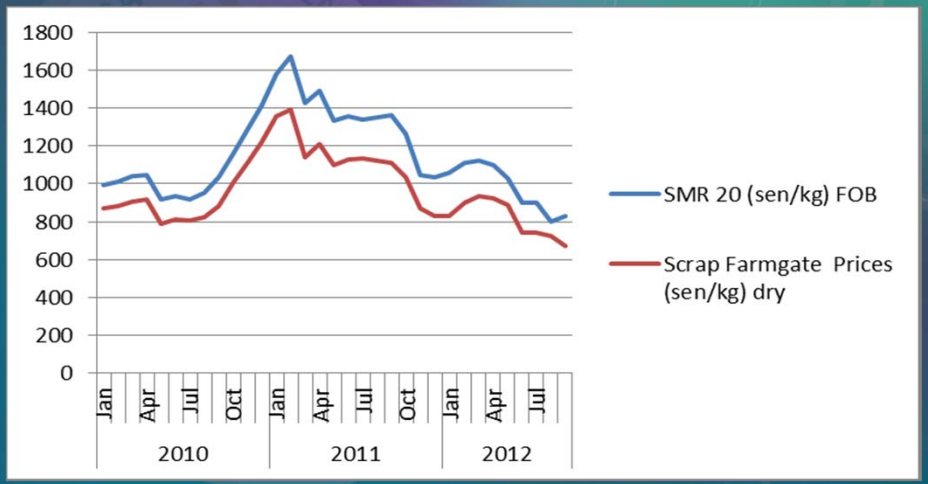


SOURCE: Rubber Industry Statistics, 2011

ISSUES & PROBLEMS OF RUBBER SMALLHOLDER IN MALAYSIA

- Uneconomic sized of holdings (< 2.5 ha)
- Low productivity (average 1500 kg/ha/yr, 2011) and income (Estimate average Income per month per RM 1430 (2009)
- unstable of rubber price

Average Rubber Price (SMR 20 & Scrap Farmgate price)



How to Increase land Productivity For Rubber Smallholders

- Stimulation- gaseous (RRIMFlow, G-Flex) and non-gaseous (Etephone, MORTEX)
- Agroforestry – integration of rubber with short/medium/long-terms crops
- High density planting

High density planting:

Refers to any density of rubber planted over conventional planting (450 trees/ha)

Previous Research on High Density Planting Found as Higher Tree Densities:

- Smaller tree girth
- Taller tree
- Higher crotch height and clear bold
- Lighter branching and canopy
- Percentage of un-tappable trees increase
- Bark renewal rate decline
- Lower yield per tree
- **Yield per hectare increase**

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- Under estate conditions (labour constraint) , density of 400 trees/ha was optimum
- However under smallholders condition (free labour), density of 740 trees/ha was suggested.

Research Objective:

To determine the effect of three planting densities and two rubber clones on growth and yield of rubber.

Materials and Methods

- Site: FELDA Jenderak Utara, Pahang
- Soil series: Durian and Gajah Mati.
- Planting: February 2000
- Treatments:
  (A) Density (Main plot):
  i. 500 trees/ha (4m x 5m)= 48 trees/plot (D1-)
  ii. 700 trees/ha (4 m x 3.6 m) = 60 trees/plot (D2)
  iii. 1000 trees/ha (4 m x 2.5 m) = 90 trees/ha (D3)

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(B) Clone (Sub-plot):

i. RRIM 2025

ii. RRIM 2016

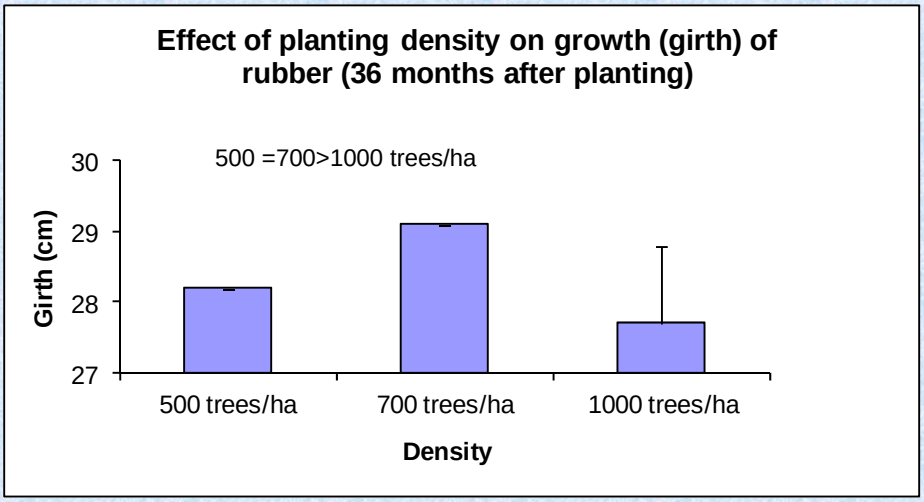
iii. RRIM 2001

- Experimental Design: Split Plot Design with 3 replications.
- 3 Clones x 3 Densities x 3 Rep = 27 plots
- Plot size = 20 m x 35 m (700 m^2)
- Research area: 2 ha

RESULTS

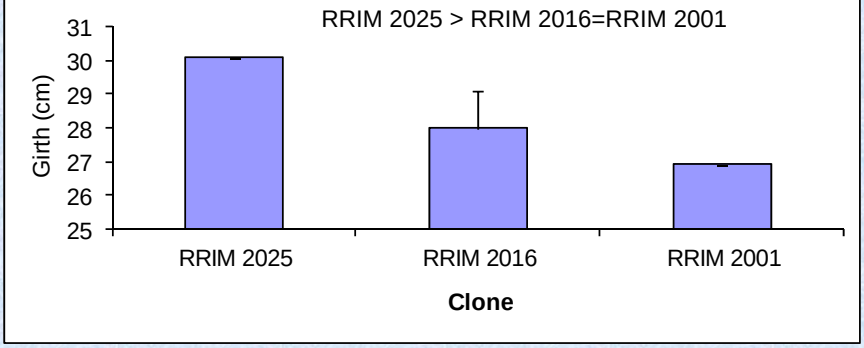
. Effect of planting density and clone on growth of rubber

Density	Clone	Mean girth (cm)				
		Months after planting				
		24	36	48	63	151
500	2025	15.7	28.6	38.7	48.6	69.4
500	2016	16.2	28.8	38.5	47.2	58.7
500	2001	16.1	27.2	37	46.3	59.1
700	2025	19.1	32	41	50.1	64.2
700	2016	13.5	26.4	36.1	45.2	58.2
700	2001	16.3	28.2	39	46.1	55.9
1000	2025	17.8	29.3	39.5	46.2	58.5
1000	2016	16.1	28.4	38.4	45.1	54.8
1000	2001	15.4	25.1	33.8	41.1	52.0
SEM (Density*clone)		0.5	0.7	0.9	1.1	4.3
				Probability		
Density (D)		0.4212	0.047	0.0864	0.0001	0.0244
Clone (C)		0.0001	0.0001	0.0001	0.0001	0.0064
(D*C)		0.0001	0.0001	0.0005	0.1402	0.8287

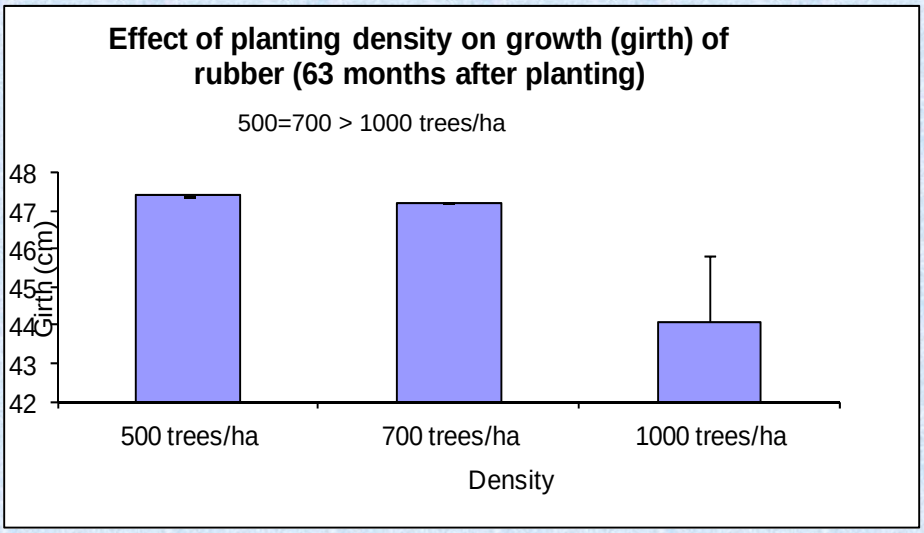


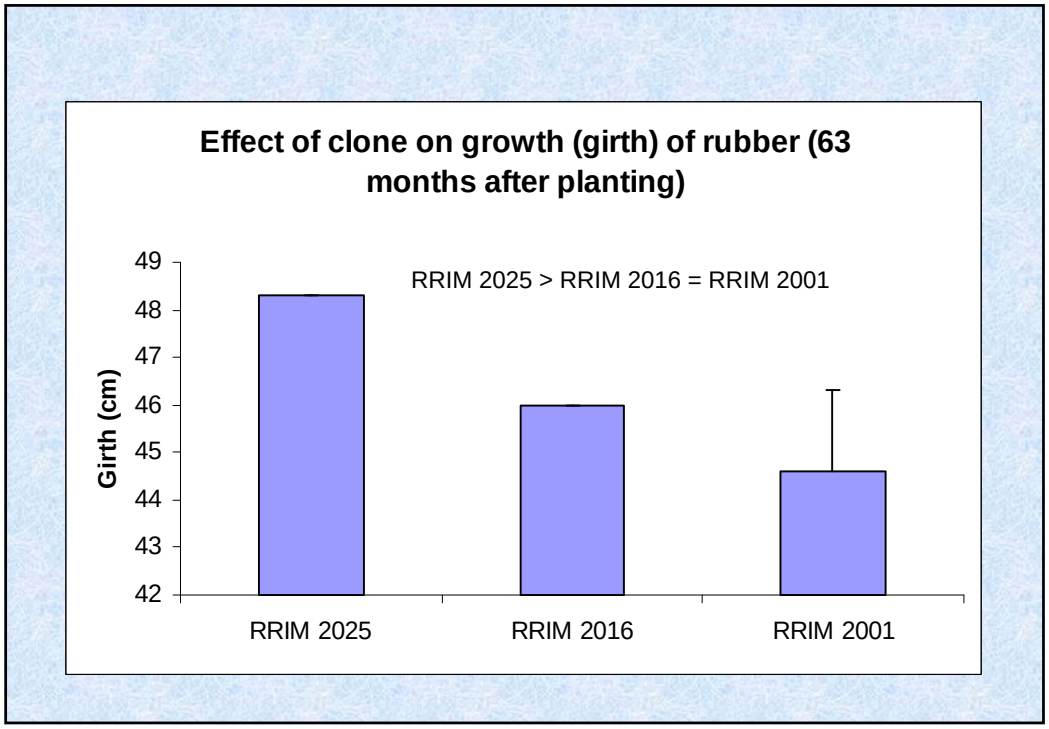
Bar indicates LSD

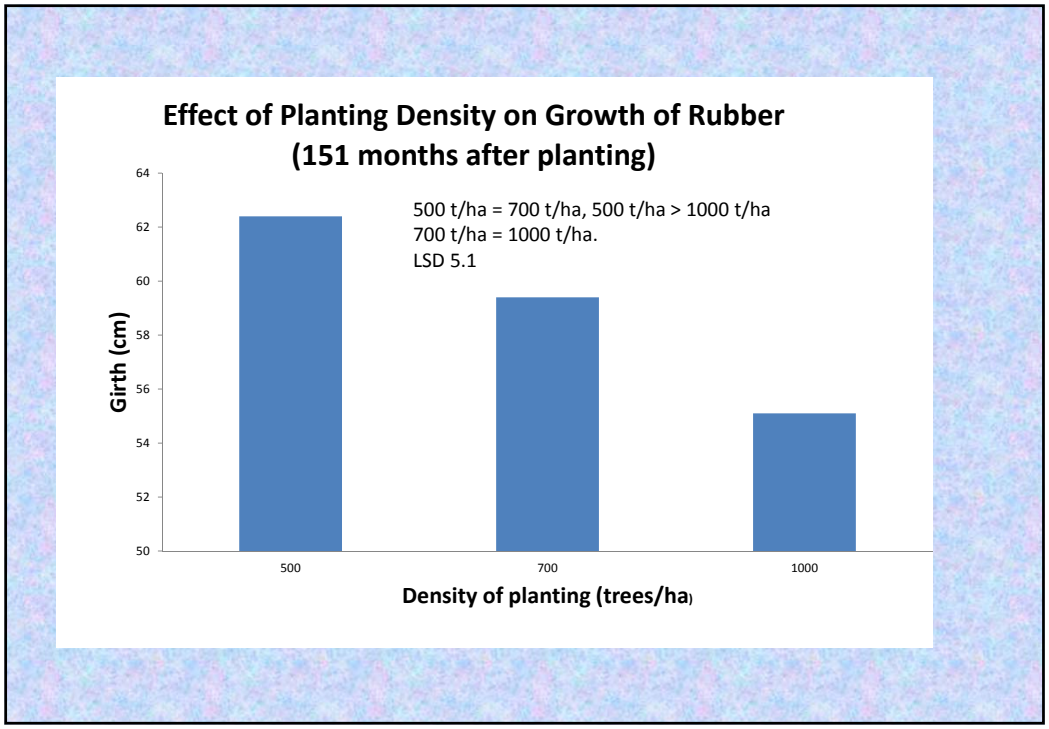
Table 3. Effect of clone on growth (girth) of rubber (36 months after planting)

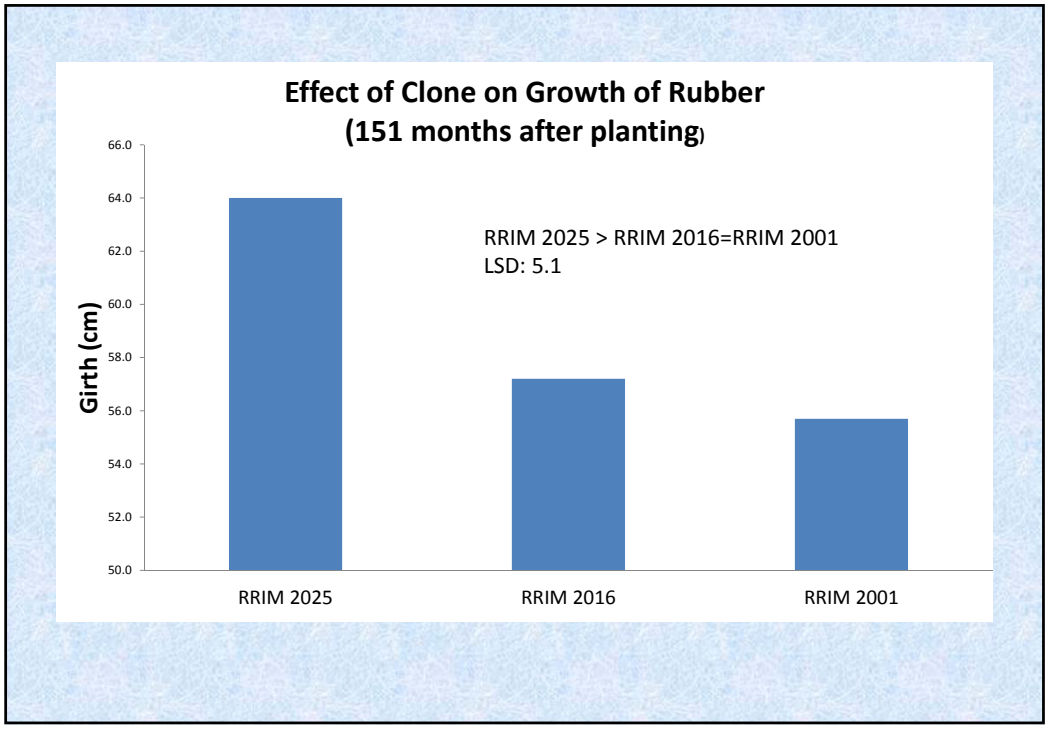


Effect of planting density on growth (girth) of rubber (63 months after planting)




Effect of clone on growth (girth) of rubber (63 months after planting)
RRIM 2025 > RRIM 2016 = RRIM 2001
Girth (cm)
49
48
47
46
45
44
43
42
RRIM 2025
RRIM 2016
RRIM 2001


Effect of Planting Density on Growth of Rubber (151 months after planting)
500 t/ha = 700 t/ha, 500 t/ha > 1000 t/ha
700 t/ha = 1000 t/ha.
LSD 5.1
Girth (cm)
64
62
60
58
56
54
52
50
500
700
1000
Density of planting (trees/ha)


Effect of Clone on Growth of Rubber
(151 months after planting)
Girth (cm)
66.0
64.0
62.0
60.0
58.0
56.0
54.0
52.0
50.0
RRIM 2025 > RRIM 2016=RRIM 2001
LSD: 5.1
RRIM 2025
RRIM 2016
RRIM 2001


RRIM 2025
Density: 1000 trees/ha

RRIM 2025
Density: 500 trees/ha

Effect of Density and Clone on Percentage of Tappability (> 40 cm, 63 months after planting)

Density	Clone	% of Tappability
500	RRIM 2025	77.8
500	RRIM 2016	63.2
500	RRIM 2001	68.7
700	RRIM 2025	62.1
700	RRIM 2016	57.9
700	RRIM 2001	67.2
1000	RRIM 2025	55.6
1000	RRIM 2016	61.1
1000	RRIM 2001	55.5
SEM		8.0
Variable:		Probability
Density		0.1846
Clone		0.7857
Density*Clone		0.6960

Effect of Density and Clone on % of Tappability

Density (trees/ha)	% of Tappability
500	69.9
700	62.4
1000	57.4
LSD	13.7
Clone	**% of Tappability**
RRIM 2025	65.2
RRIM 2016	63.8
RRIM 2001	60.7
LSD	13.7

Effect of planting density and clone on yield of rubber (1/2S d3 + SEN)

Density	Clone	Mean yield (g/t/t)			
		1	2	3	Mean
500	RRIM 2001	46.1	63.2	44.8	51.4
500	RRIM 2016	48.0	66.5	49.6	54.7
500	RRIM 2025	51.1	65.0	56.4	57.5
700	RRIM 2001	42.1	61.1	42.8	48.7
700	RRIM 2016	41.2	60.3	44.3	48.6
700	RRIM 2025	52.8	71.3	51.1	58.4
1000	RRIM 2001	38.4	56.7	42.4	45.8
1000	RRIM 2016	34.7	50.0	36.6	40.4
1000	RRIM 2025	40.5	52.0	38	43.5
SEM (Density*Clone)		2.8	3.9	9.4	11.4
Variable:		Probability			
Density		0.0001	0.0002	0.0923	0.0007
Clone		0.006	0.5008	0.4917	0.2211
Density*Clone		0.4226	0.2659	0.7193	0.4692

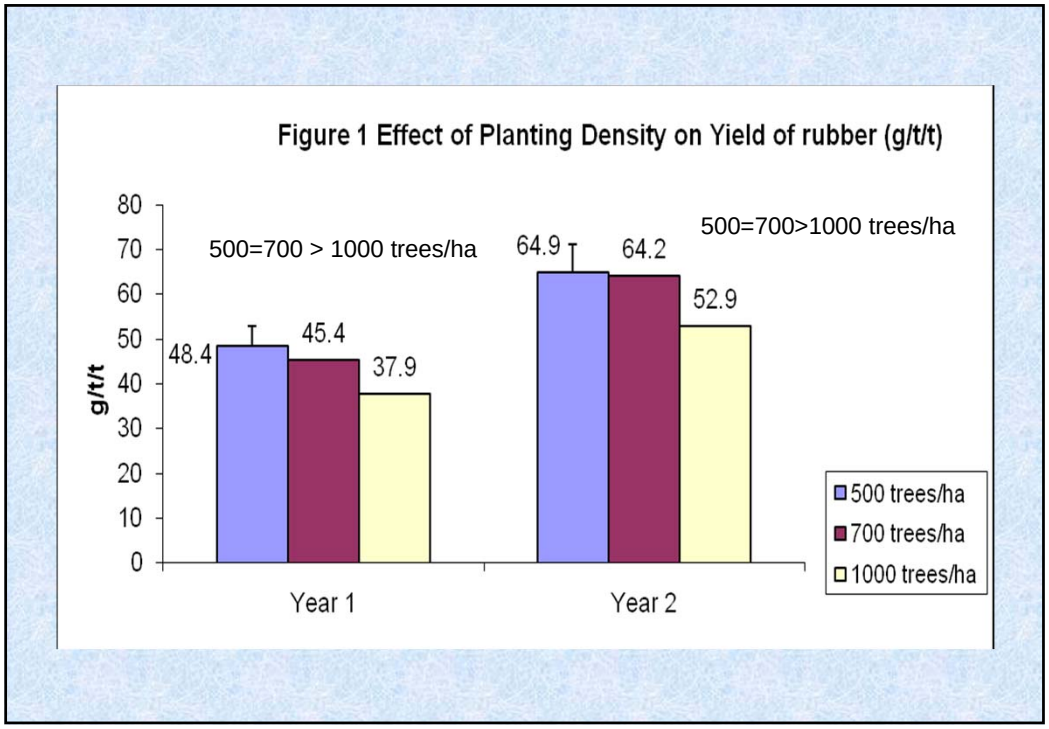
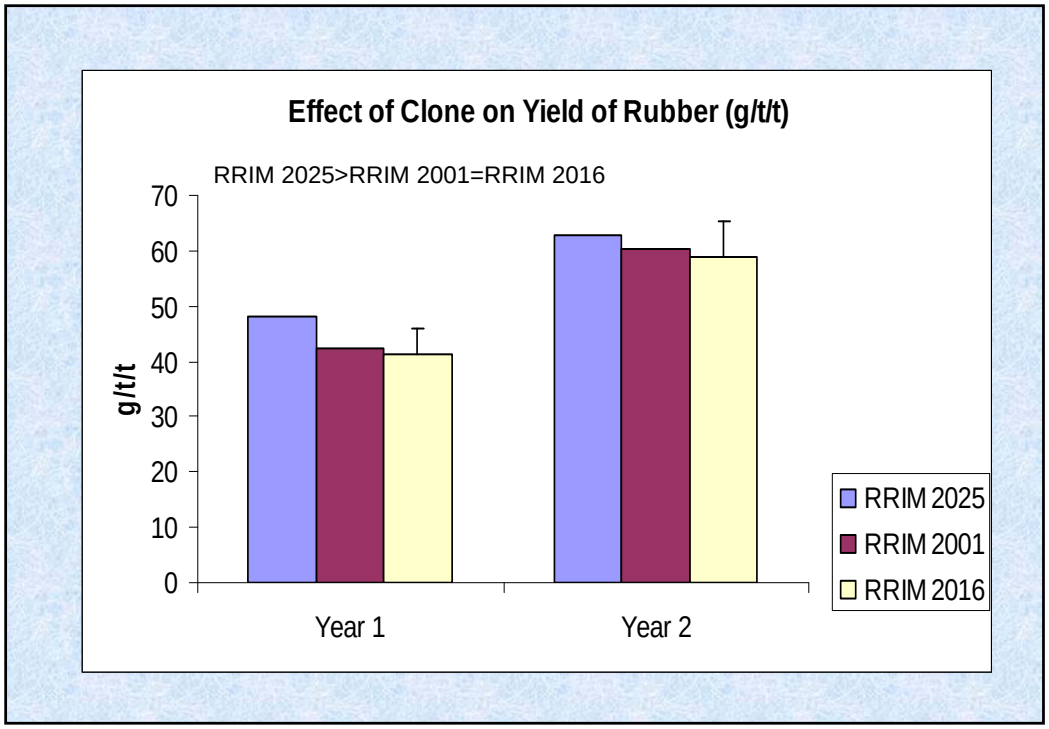
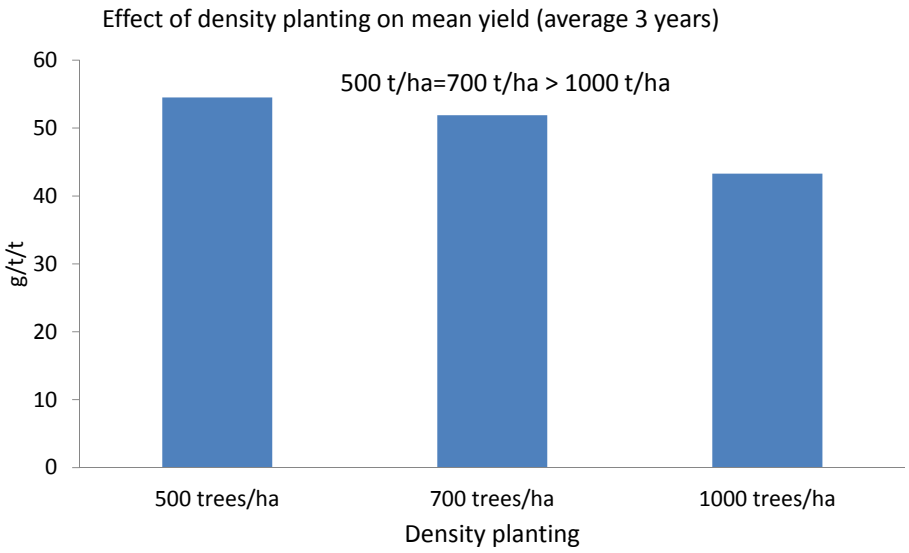
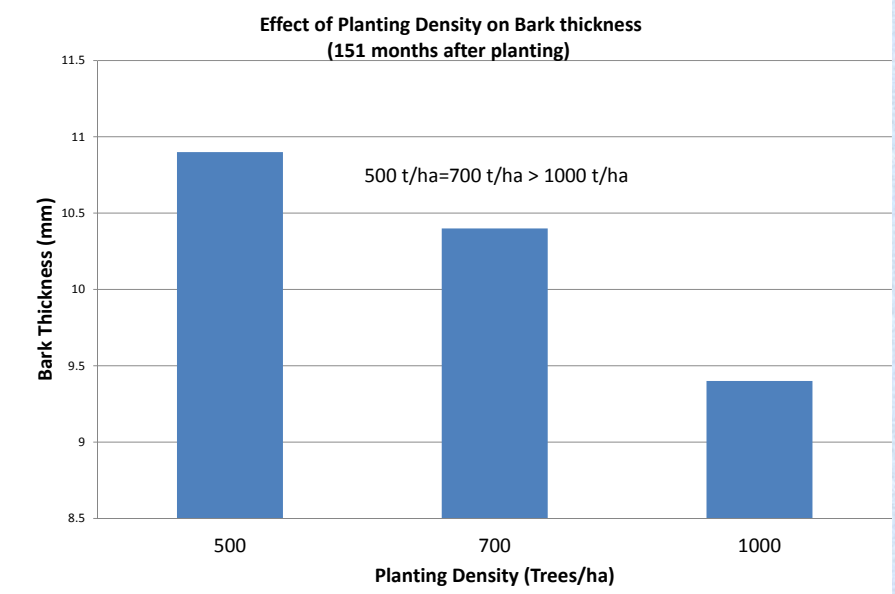


Figure 1 Effect of Planting Density on Yield of rubber (g/t/t)
500=700 > 1000 trees/ha
500=700>1000 trees/ha
g/t/t
80
70
60
50
40
30
20
10
0
48.4
45.4
37.9
64.9
64.2
52.9
Year 1
Year 2
500 trees/ha
700 trees/ha
1000 trees/ha


Effect of Clone on Yield of Rubber (g/t/t)
RRIM 2025>RRIM 2001=RRIM 2016
g/t/t
70
60
50
40
30
20
10
0
Year 1
Year 2
RRIM 2025
RRIM 2001
RRIM 2016

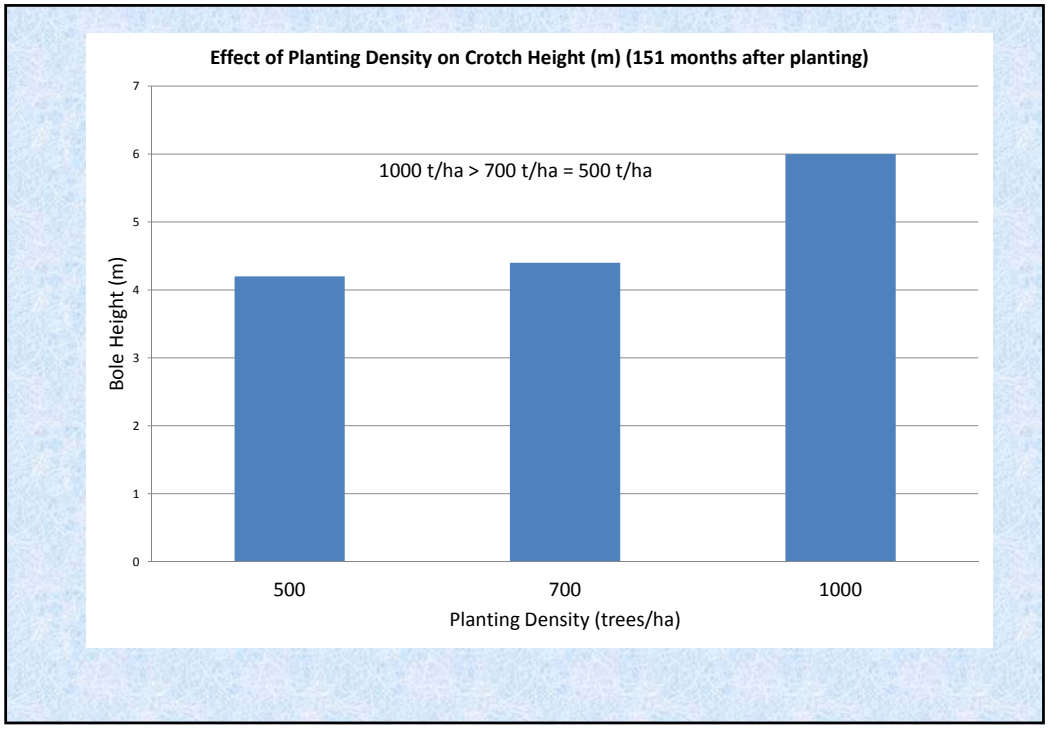


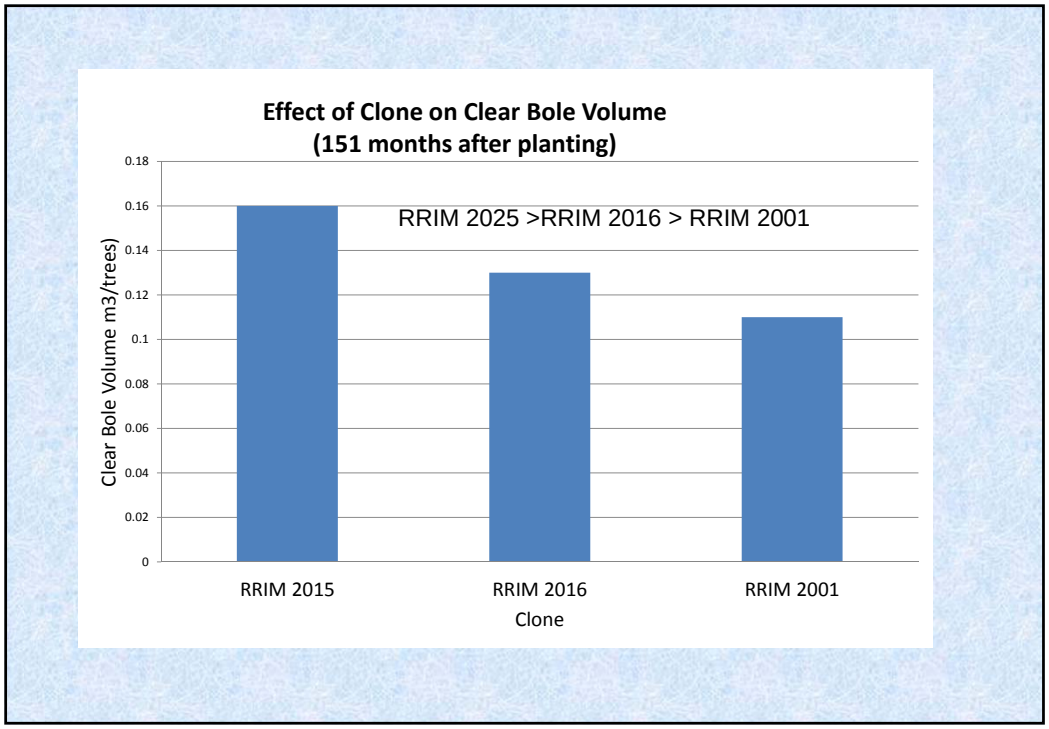
Yield projection based on density of planting									
Density (trees/ha)	No. of tappability trees	Yield projection							
		Year 1		Year 2		Year 3		Mean	
		Mean g/t/t	(kg/ha)	Mean g/t/t	(kg/ha)	Mean g/t/t	kg/ha	g/t/t	kg/ha/yr
500	350 (69.9%)	48.4	1626	64.9	2181	54.3	1824	55.9	1878
700	437 (62.4%)	45.3	1900	64.2	2693	47.6	1996	52.4	2198
1000	574 (57.4%)	37.8	2083	52.9	2915	39.9	2198	43.5	2397
Based on 1/2S d3 + SEN (8 x/month)									



Effect of planting density and clone on girth, crotch-height and clear bole volume (151 months after planting)

Density	Clone	Girth (cm)	Crotch-height (m)	Clear Bole volume (m^3/tree)
500	2025	69.4	4.7	0.17
500	2016	58.7	3.9	0.11
500	2001	59.1	4.1	0.11
700	2025	64.2	4.2	0.14
700	2016	58.2	4.0	0.10
700	2001	55.9	5.1	0.10
1000	2025	58.5	5.8	0.16
1000	2016	54.8	6.9	0.16
1000	2001	52.0	4.9	0.12
SEM (Density*Clone)		4.336	0.026	0.0259
Variable:			Probability	
Density (D)		0.0244	0.0004	0.0737
Clone (C)		0.0064	0.5616	0.0057
(D*C)		0.8287	0.0588	0.4399


Effect of Planting Density on Crotch Height (m) (151 months after planting)
1000 t/ha > 700 t/ha = 500 t/ha
Bole Height (m)
0
1
2
3
4
5
6
7
500
700
1000
Planting Density (trees/ha)


Effect of Clone on Clear Bole Volume
(151 months after planting)
RRIM 2025 >RRIM 2016 > RRIM 2001
Clear Bole Volume m3/trees)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
RRIM 2015
RRIM 2016
RRIM 2001
Clone

Conclusion

- Rubber trees established with 500 trees/ha and 700 trees/ha had higher growth (girth) compared to the density of 1000 trees/ha.
- Clone RRIM 2025 showed higher growth (girth) compared to the clone RRIM 2016 and RRIM 2001.
- Density of 500 and 700 trees/ha produced higher yield/tree/tapping (g/t/t) compared to the density of 1000 trees/ha.
- Clone RRIM 2025 produced higher g/t/t compared to the clone RRIM 2001 and RRIM 2016.
- Higher density of 1000 trees/ha produced higher land productivity (kg/ha) compared to 700 and 500 trees/ha.