

# Economic considerations in modern farming : Plant densities

Edrean Ernst



# Introduction

- Establishment of new orchards = choices :
  - Cultivar
  - Rootstock
  - Plant density and spacing
  - Irrigation system
  - Ridging (new)
  - Netting (future?)
  - Trellis (future?)



# Modern farming approach

- Newer cultivars and rootstocks with higher potential (yield, quality, size, etc...)
- Drip irrigation and advanced scheduling
- Ridges a must – depending on soil
- Higher plant densities



# Concerns with higher plant densities

- Extra expense in terms of :
  - Irrigation system
  - Trees
- Yield implication of higher densities
  - Overcrowding
  - Law of diminishing returns
  - Limited production potential of small tree vs large tree



# High density study - Methodology

- Use 7m x 3.5m (408 trees/ha) as base/benchmark
- Compare various higher densities
  - 800 trees/ha
  - 1250 trees/ha
  - 1600 trees/ha
- Determine if and when additional outlay cost of higher density breaks even with benchmark
- Determine effect of higher density on long term yield and income in comparison with benchmark



# Assumptions

Tree price	<b>R 85.00</b>	per tree
Fruit price	<b>R 10.00</b>	per kg
Average fruit weight	<b>250</b>	gram
Interest rate	<b>10%</b>	per year
Year 1 production	<b>5</b>	fruit per tree
Year 2 production	<b>30</b>	fruit per tree

# Benchmark 408 trees/ha (7m x 3.5m)

Trees per ha	408							
Year	0	1	2	3	4	5	6	7
<b>Variable cost</b>	<b>R 44,680.00</b>							
Irrigation system	R 10,000.00							
Total tree cost	R 34,680.00							
<b>Income</b>								
Fruit per tree		5	26	123	166	207	208	214
Production		510.00	2601.90	12544.30	16916.30	21069.50	21240.20	21875.30
Income		R 5,100.00	R 26,019.00	R 125,443.00	R 169,163.00	R 210,695.00	R 212,402.00	R 218,753.00

# 800 trees/ha (eg. 5m x 2.5m)

Trees per ha	800		Needed for B/E						
Year	0	1	2	3	3	4	5	6	7
<b>Variable cost</b>	<b>R 83,630.00</b>								
Irrigation system	R 15,630.00								
Total tree cost	R 68,000.00								
<b>Additional vs. 408 trees/ha</b>	<b>R 38,950.00</b>								
Irrigation system	R 5,630.00								
Total tree cost	R 33,320.00								
<b>Income</b>									
Fruit per tree		5	30		123	166	166	166	166
Production		1000.00	6000.00		24596.67	33169.22	33169.22	33169.22	33169.22
Income		R 10,000.00	R 60,000.00		R 245,966.67	R 331,692.16	R 331,692.16	R 331,692.16	R 331,692.16
<b>Additional income vs. 408 trees/ha</b>									
Fruit per tree		0	4	-56	0	0	-41	-42	-49
Production		490.00	3398.10	853.44	12052.37	16252.92	12099.72	11929.02	11293.92
Income		R 4,900.00	R 33,981.00	R 8,534.35	R 120,523.67	R 162,529.16	R 120,997.16	R 119,290.16	R 112,939.16
<b>Net Present Value</b>		<b>R -34,495.45</b>	<b>R -6,411.98</b>	<b>R 0.00</b>					

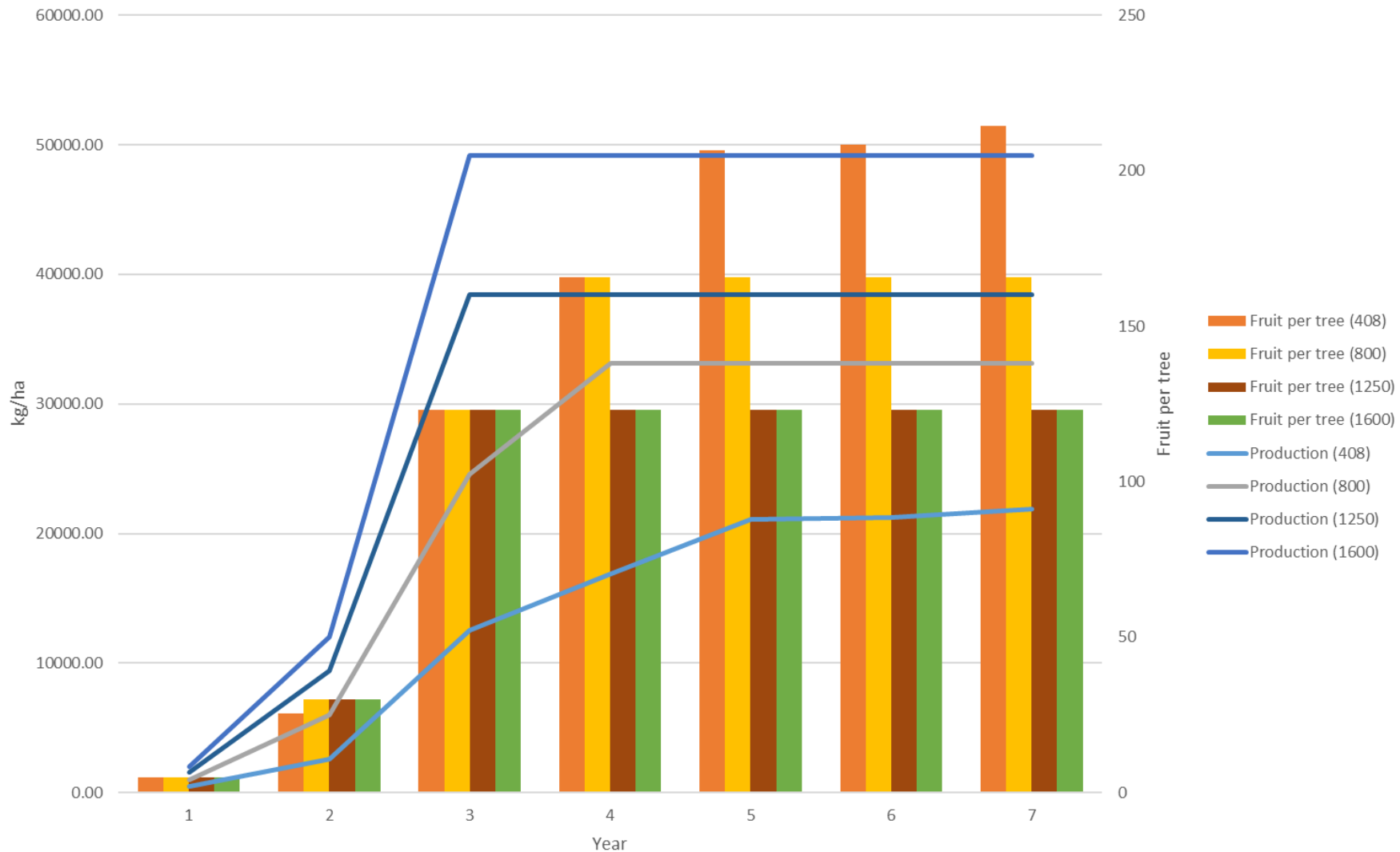
# 1250 trees/ha (eg. 4m x 2m)

Trees per ha	1250		Needed for B/E						
Year	0	1	2	3	3	4	5	6	7
<b>Micro irrigation</b>									
<b>Variable cost</b>	<b>R 134,027.78</b>								
Irrigation system	R 27,777.78								
Total tree cost	R 106,250.00								
<b>Additional vs. 408 trees/ha</b>	<b>R 89,347.78</b>								
Irrigation system	R 17,777.78								
Total tree cost	R 71,570.00								
<b>Income</b>									
Fruit per tree		5	30		123	123	123	123	123
Production		1562.50	9375.00		38432.29	38432.29	38432.29	38432.29	38432.29
Income		R 15,625.00	R 93,750.00		R 384,322.92	R 384,322.92	R 384,322.92	R 384,322.92	R 384,322.92
<b>Additional income vs. 408 trees/ha</b>									
Fruit per tree		0	4	-73	0	-43	-84	-85	-91
Production		1052.5	6773.1	3168.25	25887.99	21515.99	17362.79	17192.09	16556.99
Income		R 10,525.00	R 67,731.00	R 31,682.54	R 258,879.92	R 215,159.92	R 173,627.92	R 171,920.92	R 165,569.92
<b>Net Present Value</b>		<b>R -79,779.60</b>	<b>R -23,803.56</b>	<b>R 0.00</b>					

# 1600 trees/ha (eg. 2.5m x 2.5m)

Trees per ha	1600		Needed for B/E						
Year	0	1	2	3	3	4	5	6	7
<b>Variable cost</b>	<b>R 163,777.78</b>								
Irrigation system	R 27,777.78								
Total tree cost	R 136,000.00								
<b>Additional vs. 408 trees/ha</b>	<b>R 119,097.78</b>								
Irrigation system	R 17,777.78								
Total tree cost	R 101,320.00								
<b>Income</b>									
Fruit per tree		5	30		123	123	123	123	123
Production		2000	12000		49193.33	49193.33	49193.33	49193.33	49193.33
Income		R 20,000.00	R 120,000.00		R 491,933.33	R 491,933.33	R 491,933.33	R 491,933.33	R 491,933.33
<b>Additional income vs. 408 trees/ha</b>									
Fruit per tree		0	4	-82	0	-43	-84	-85	-91
Production		1490.00	9398.10	3711.10	36649.03	32277.03	28123.83	27953.13	27318.03
Income		R 14,900.00	R 93,981.00	R 37,111.04	R 366,490.33	R 322,770.33	R 281,238.33	R 279,531.33	R 273,180.33
<b>Net Present Value</b>		<b>R -105,552.32</b>	<b>R -27,882.08</b>	<b>R 0.00</b>					

Plant density production comparison



Maluma<sup>2016</sup> DAY  
Principles and practices for modern farming



Trees per ha	1250	Needed for B/E							
Year	0	1	2	3	3	4	5	6	7
<b>Micro irrigation</b>									
<b>Variable cost</b>	<b>R 134,027.78</b>								
Irrigation system	R 27,777.78								
Total tree cost	R 106,250.00								
<b>Additional vs. 408 trees/ha</b>	<b>R 89,347.78</b>								
Irrigation system	R 17,777.78								
Total tree cost	R 71,570.00								
<b>Income</b>									
Fruit per tree		5	30		123	123	123	123	123
Production		1562.50	9375.00		38432.29	38432.29	38432.29	38432.29	38432.29
Income		R 15,625.00	R 93,750.00		R 384,322.92	R 384,322.92	R 384,322.92	R 384,322.92	R 384,322.92
<b>Additional income vs. 408 trees/ha</b>									
Fruit per tree		0	4	-73	0	-43	-84	-85	-91
Production		1052.5	6773.1	3168.25	25887.99	21515.99	17362.79	17192.09	16556.99
Income		R 10,525.00	R 67,731.00	R 31,682.54	R 258,879.92	R 215,159.92	R 173,627.92	R 171,920.92	R 165,569.92
<b>Net Present Value</b>		<b>R -79,779.60</b>	<b>R -23,803.56</b>	<b>R 0.00</b>					

<b>Drip irrigation</b>									
<b>Variable cost</b>	<b>R 160,416.67</b>								
Irrigation system	R 54,166.67								
Total tree cost	R 106,250.00								
<b>Additional vs. 408 trees/ha</b>	<b>R 115,736.67</b>								
Irrigation system	R 44,166.67								
Total tree cost	R 71,570.00								
<b>Income</b>									
Fruit per tree		5	30		123	123	123	123	123
Production		1562.50	9375.00		38432.29	38432.29	38432.29	38432.29	38432.29
Income		R 15,625.00	R 93,750.00		R 384,322.92	R 384,322.92	R 384,322.92	R 384,322.92	R 384,322.92
<b>Additional income vs. 408 trees/ha</b>									
Fruit per tree		0	4	-61	0	-43	-84	-85	-91
Production		1052.5	6773.1	6680.62	25887.99	21515.99	17362.79	17192.09	16556.99
Income		R 10,525.00	R 67,731.00	R 66,806.15	R 258,879.92	R 215,159.92	R 173,627.92	R 171,920.92	R 165,569.92
<b>Net Present Value</b>		<b>R -106,168.48</b>	<b>R -50,192.45</b>	<b>R 0.00</b>					

nd  
are

# Conclusion

- Increased cost associated with higher density planting can be offset by year 3 when using precocious cultivars such as Maluma.
- Although yield per tree stabilises earlier with higher densities, significantly higher yields should be consistently obtained.
- Higher density plantings can make expensive capital expenditure more affordable. *In other words, easier to justify the cost.*
- Densities higher than 1600 can potentially produce even higher yields and returns. Future research should aim to determine the point of diminishing returns.

