Outline

- Introduction

- Research question and objectives.

- Methods and Materials

- Results and discussion

- Conclusion

- References

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Introduction

- **Site preparation:** Any process that involves the treatment of vegetation, residues, and soil preparation before planting

- Soil Preparation: tillage methods can either be intensive or moderate

Intensive methods of soil preparation

- Last 4 decades

Moderate soil preparation methods

- Last decade (pitting – preferred method)

56%

10%

34%

(Ramantswana, 2019)

Drivers of mechanised soil prep

For some large cooperate companies mechanised soil preparation has been a major investment drive due to:

- Ergonomics, health and safety improvements

- Productivity improvement and cost reduction

- Pit quality and consistency improvements

- Social challenges

(McEwan and Steenkamp 2014)

Research question

- What effect does pit preparation techniques and slash management have on pit quality, seedling survival, initial growth and operational productivity?

Research objectives

- To determine the impact of manual, motor manual and fully mechanised pitting on productivity (pits/hour and pit density (pits/ha) at re-establishment.

- To understand the effect of manual, motor manual and fully mechanised pitting implements on pit quality (tilth, size and volume).

- To determine the influence of slash management (burn or unburn), pit quality (as influenced by pitting method) and planting method (water or dry planting) on eucalypt survival, growth and uniformity in South Africa.
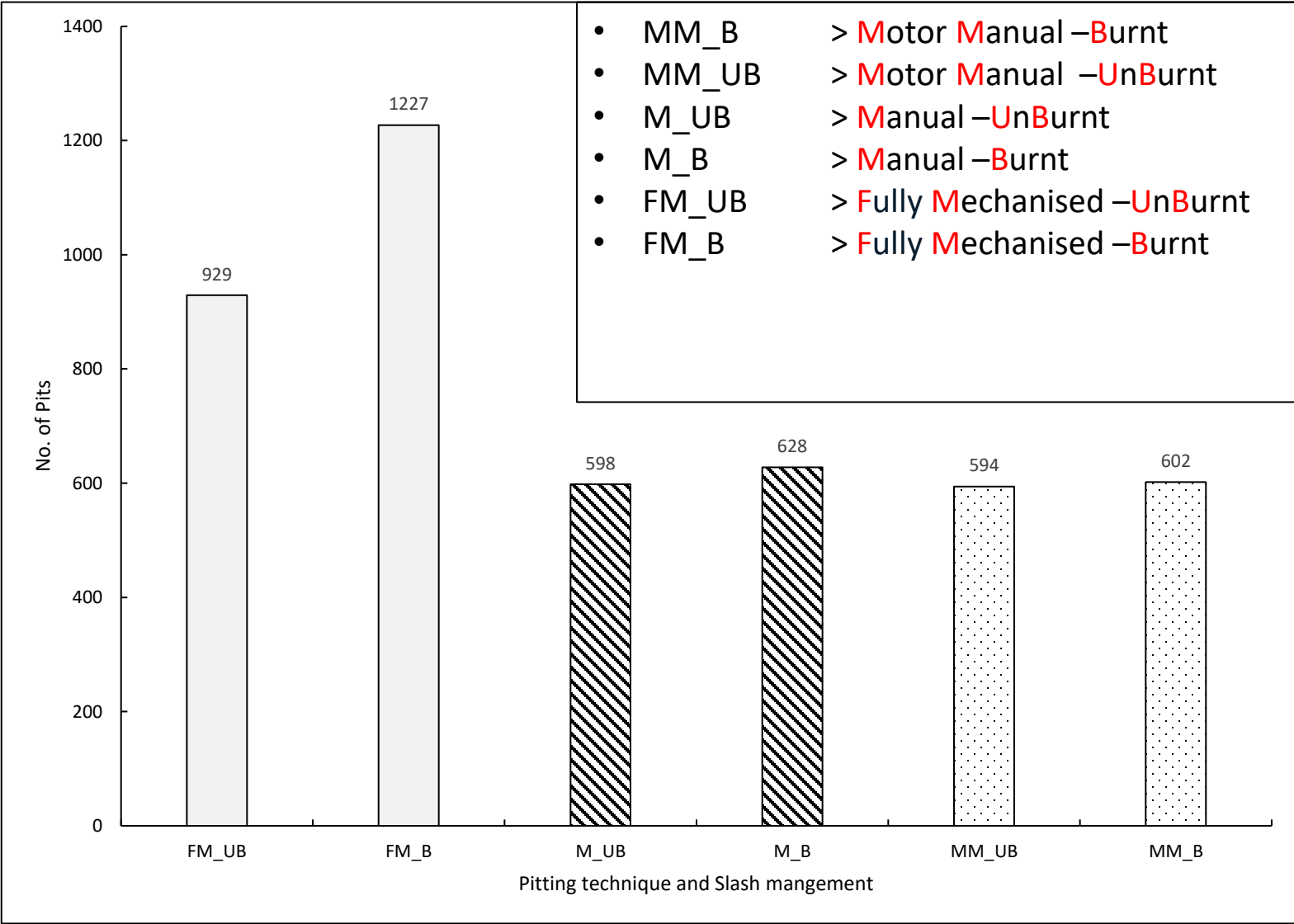
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Methods and materials

o Objective 1:
- Time study measurements (identified relevant elements)
- Trimble (handheld computer) – capture time for each element on every cycle.
- Espacement

o Objective 2:
- Pit quality (dimensions, volume and tilth) -sampled 10 pits per pitting method and slash management method.

o Objective 3:
- Trial - growth assessments (monitored for 0 - 12 months)
- 2xSlash management, 3xpitting method and 2xplanting method.

o Data Analysis
- Descriptive statistics
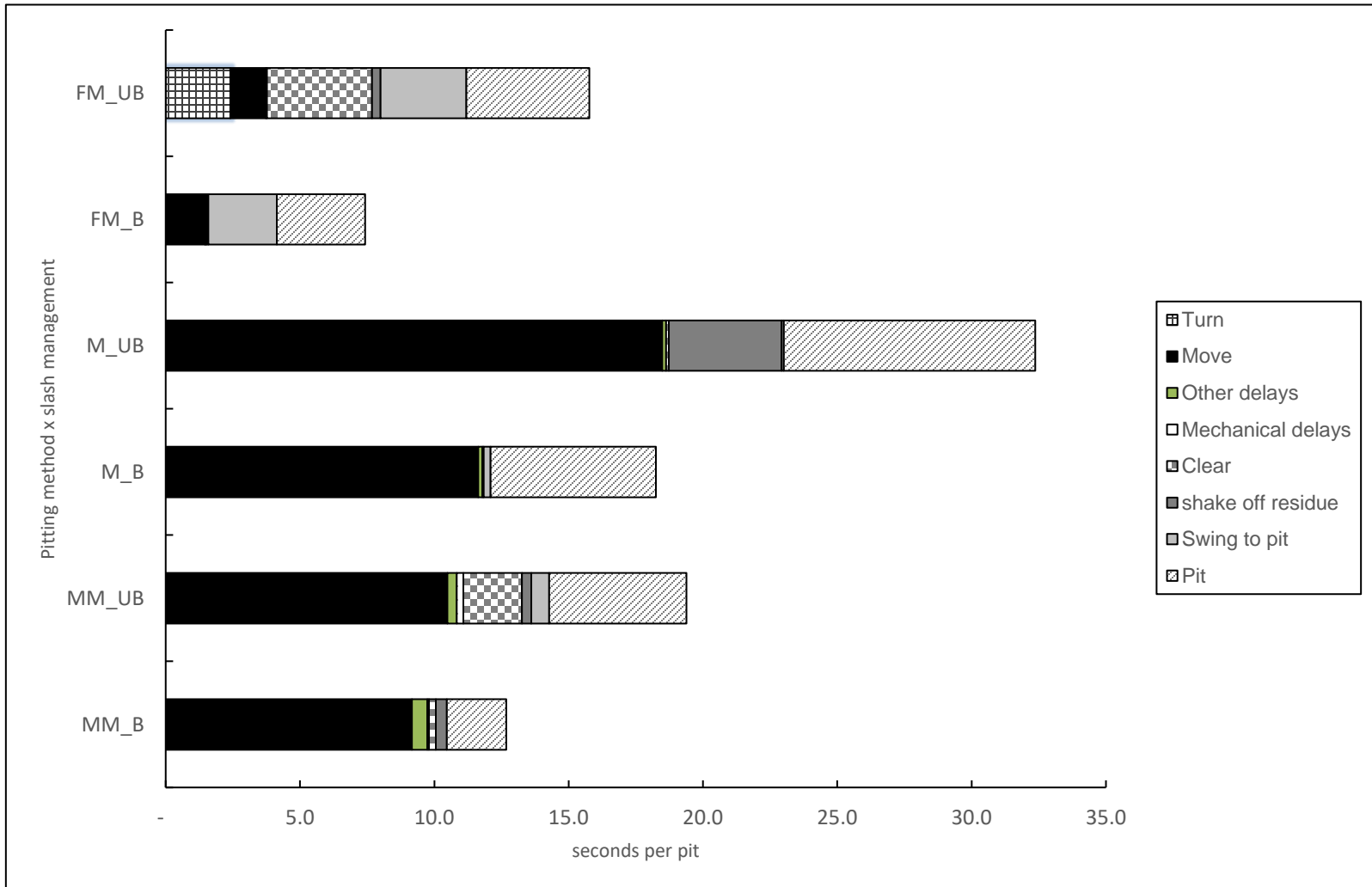- Guidance on the other relevant methods to used for further data analysis.
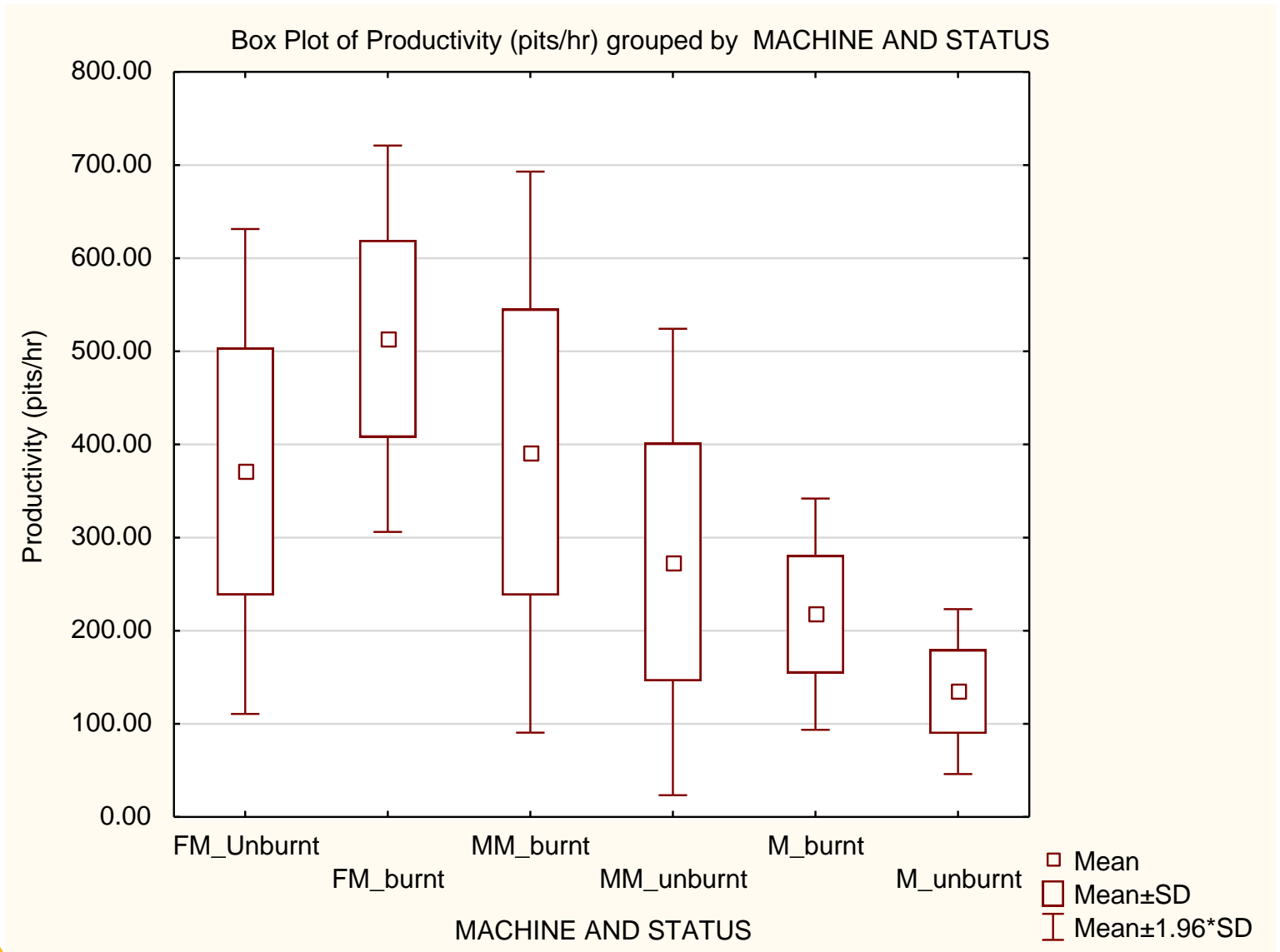
Results and discussion: Productivity Studies

Sample size

Work time distribution- sec/pit

Chart: Horizontal stacked bar chart showing seconds per pit (x-axis, 0 to 35.0) by pitting method x slash management (y-axis: FM_UB, FM_B, M_UB, M_B, MM_UB, MM_B).

Legend:
- Turn
- Move
- Other delays
- Mechanical delays
- Clear
- shake off residue
- Swing to pit
- Pit

Productivity summary statistics

Box Plot of Productivity (pits/hr) grouped by MACHINE AND STATUS
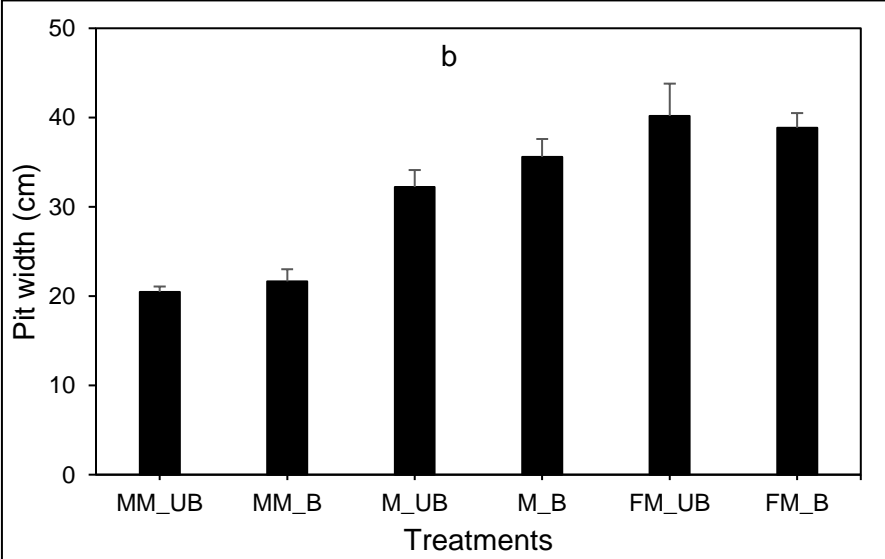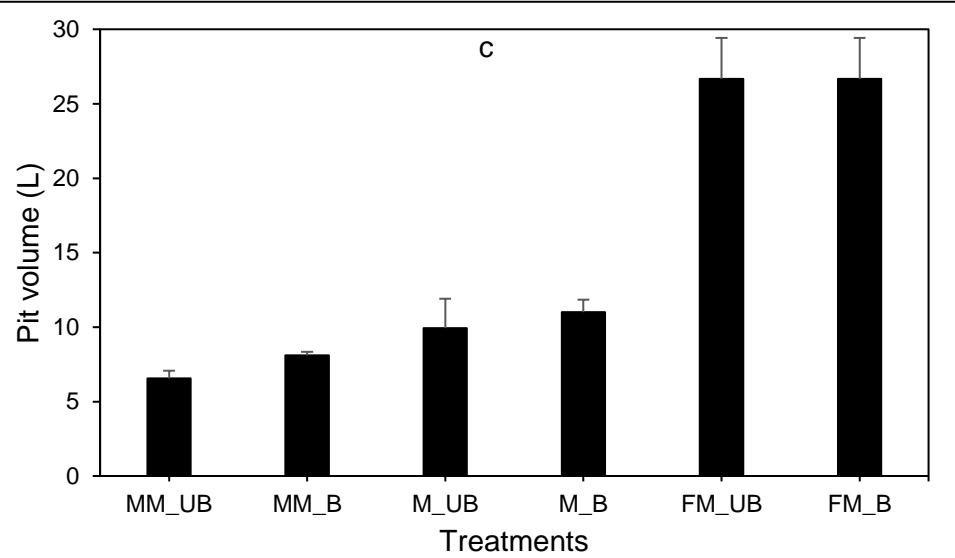
Pit density comparisons
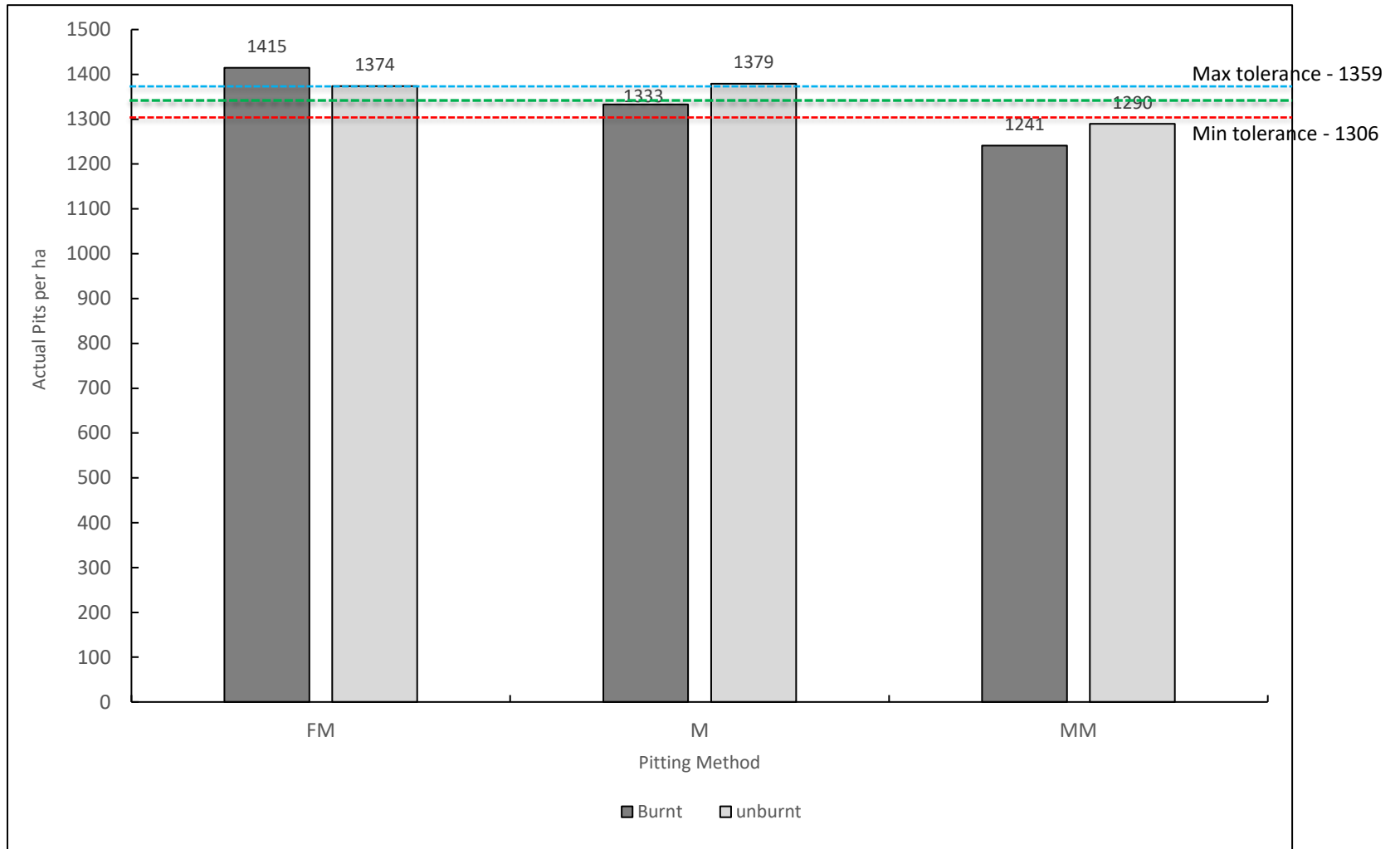
Pit quality results and discussion
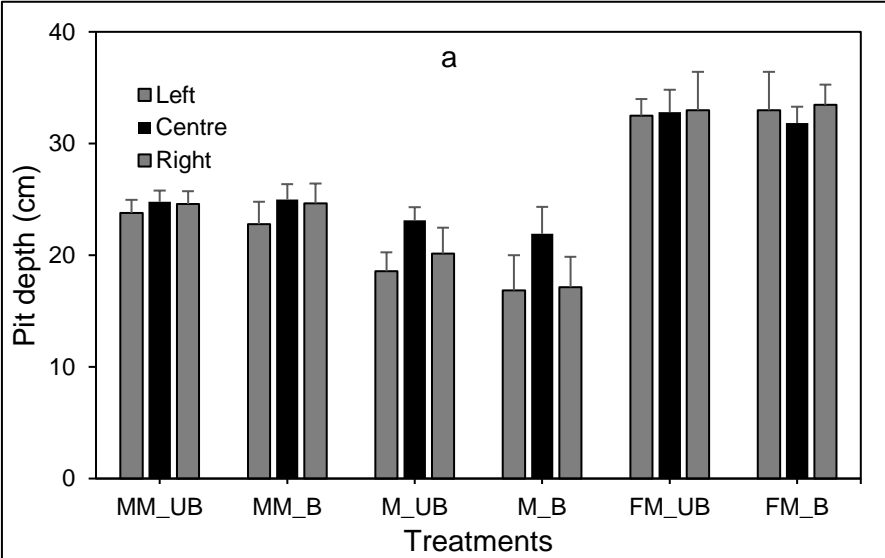
- MM_B   > Motor Manual –Burnt
- MM_UB   > Motor Manual –UnBurnt
- M_UB   > Manual –UnBurnt
- M_B   > Manual –Burnt
- FM_UB   > Fully Mechanised –UnBurnt
- FM_B   > Fully Mechanised –Burnt

Soil tilth

≤ 2 mm

≥ 10 mm

Growth response results and discussion.

○ Indicators:
- Height
- GLD
- Biomass index
- Corrected Biomass index
- Stocking

ANOVA Summary (0-3months).

Source of variation	d.f.	0 Days After planting					3 months after planting				
		Ht_1 (cm)	Gld_1 (cm)	$Stock_1$ (sph)	Bl_1	Bl_{c1}	Ht_2 (cm)	Gld_2 (cm)	$Stock_2$	Bl_2	Bl_{c2}
Rep Stratum	3	2.111	0.00097	-	0.055	-	1.491	0.004	3433.2	1.8447	3.006
Rep.Slash_Mgt Stratum											
Slash_Mgt	1	70.235**	0.0000^{ns}	-	0.307*	-	71.391**	0.0001^{ns}	25719^{ns}	0.659^{ns}	1.277^{ns}
Residual	3	0.895	0.0000	-	0.011	-	5.012	0.0013	12841	0.805	0.433
Rep.Slash_Mgt.Pitting stratum											
Pitting	2	3.751*	0.0002^{ns}	-	0.031^{ns}	-	5.821**	0.0002^{ns}	343^{ns}	0.220^{ns}	0.193^{ns}
Slash_Mgt.Pitting	2	1.279^{ns}	0.0006**	-	0.122*	-	3.461*	0.0006^{ns}	6516*	0.473^{ns}	0.297^{ns}
Residual	12	0.887	0.0001	-	0.020	-	1.206	0.0003	1410	0.182	0.173
Rep.Slash.Mgt. Pitting.Plant_Method stratum											
Plant Method	1	0.003^{ns}	0.0001^{ns}	-	0.006	-	6.375^{ns}	0.0002^{ns}	22405^{ns}	0.307^{ns}	0.734^{ns}
Slash_Mgt.Plant_Method	1	15.447*	0.0012^{ns}	-	0.278**	-	10.108^{ns}	0.0004^{ns}	1829^{ns}	0.436^{ns}	0.326^{ns}
Pitting.Plant_Method	2	1.881^{ns}	0.0000^{ns}	-	0.012^{ns}	-	1.76^{ns}	0.0002^{ns}	5944^{ns}	0.116^{ns}	0.227^{ns}
Slash.Mgt.Pitting.Plant_Method	2	4.853^{ns}	0.0001**	-	0.031^{ns}	-	5.579^{ns}	0.0002^{ns}	2172^{ns}	0.115^{ns}	0.096^{ns}
Residual Total	18	3.336	0.0000	-	0.030	-	4.66	0.0002	3772	0.155	0.153
Summary statistics											
Grand Mean		22.95	0.2213	1 333	1.223	-	30.32	0.3082	1282	3.081	2.972
Standard error of the difference of means		0.594	0.002	-	0.031	-	0.388	0.0004	0.000	0.114	0.114
Coefficient of variation (units) (%)		8.0	4.4	-	14.1	-	7.1	4.3	2.1	9.8	13.2
Shapiro-Wilk test for Normality (Treatments)		0.99^{ns}	0.98^{ns}	-	0.98^{ns}	-	$.97^{ns}$	0.98^{ns}	0.98^{ns}	0.97^{ns}	0.96^{ns}

Note: $^{\$}$ = F-prob <0.10
* = F-prob <0.05
** = F-prob <0.01
^{ns} = non-significance.

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ANOVA Summary (6-12months).

Source of variation	d.f.	6 months after planting					12 months after planting				
		Ht_3 (cm)	Gld_3 (cm)	$Stock_3$	Bl_3	Bl_{C3}	Ht_4 (cm)	Gld_4 (cm)	$Stock_4$	Bl_4	Bl_{C4}
Rep Stratum	3	265.437	0.193	14736	1732.89	1329.26	1836.4	0.295	10154	18172924	19213694
Rep.Slash_Mgt Stratum											
Slash_Mgt	1	75.000^{ns}	0.031	178353^*	70.04^{ns}	6.34^{ns}	6497.2^{ns}	0.107^{ns}	160382^*	14214044^{ns}	63430929^{ns}
Residual	3	69.019^{n}	0.037	6430^{n}	193.52	158.79	2006.1	0.716	7890	28 811 564	22779524
Rep.Slash_Mgt.Pitting stratum											
Pitting	2	100.05^*	0.523^{**}	5744	891.09	750.87	$4276.8^\$$	0.764^*	12176	40018249^*	31043123^*
Slash_Mgt.Pitting	2	33.897^{ns}	0.024^{ns}	13917^{ns}	388.81^{ns}	348.60^{ns}	377.8^{ns}	0.113^{ns}	19200^{ns}	5119176^{ns}	7257141^{ns}
Residual	12	23.59	0.015	6440	226.98	192.41	1279.2	0.209	12474	8472518	8473572
Rep.Slash.Mgt. Pitting.Plant_Method stratum											
Plant Method	1	62.576^{**}	0.007^{ns}	63129^*	24.62^{ns}	67.24^{ns}	366.3^{ns}	0.199^{ns}	39305^*	6865204^{ns}	24423469^*
Slash_Mgt.Plant_Method	1	0.945^{ns}	0.002^{ns}	257^{ns}	41.02^{ns}	27.78^{ns}	440.6^{ns}	0.003^{ns}	1366^{ns}	19897332^{ns}	2085933^{ns}
Pitting.Plant_Method	2	6.755^{ns}	0.0004^{ns}	6887^{ns}	1.4^{ns}	5.54^{ns}	473.0^{ns}	0.036^{ns}	913^{ns}	2542299^{ns}	2006157^{ns}
Slash.Mgt. Pitting.Plant_Method	2	17.84^*	0.009^{**}	7973^{ns}	52.15^{ns}	32.40^{ns}	307.8^{ns}	0.064^{ns}	9560^{ns}	2083637^{ns}	3192346^{ns}
Residual	18	6.684	0.003	5077	33.03	29.22	230.2	0.070	6973	3229354	4775791
Summary statistics											
Mean		45.55	0.5923	1201	21.74	19.5	409.6	6.243	1153	17276	14995
Standard error of the difference of means		0.000	0.0434	20.6	1.659	1.56	4.38	0.076	24.1	518.8	630.9
Coefficient of variation (units) (%)		5.7	9.4	5.9	26.4	27.7	3.7	4.2	7.2	10.4	14.6
Shapiro-Wilk test for Normality (Treatments)		0.99^{ns}	0.98^{ns}	0.99^{ns}	0.95	0.94^{s}	0.98^{ns}	0.99^{ns}	0.99^{ns}	0.99^{ns}	0.98^{ns}

Note: $^\$$ = F-prob <0.10
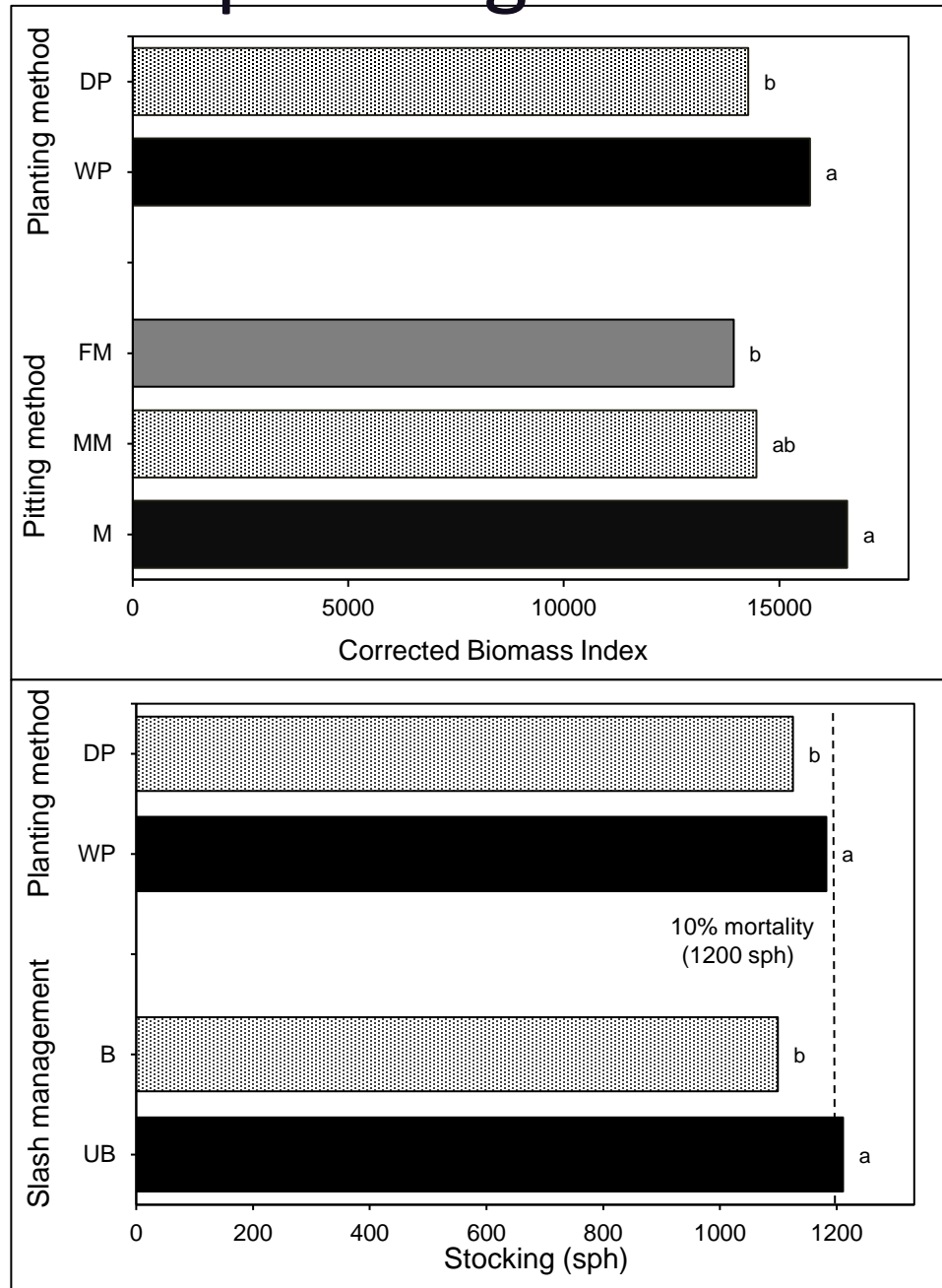 * = F-prob <0.05
   ** = F-prob <0.01
   ^{ns} = non-significance.

(Day 0) - Day of planting
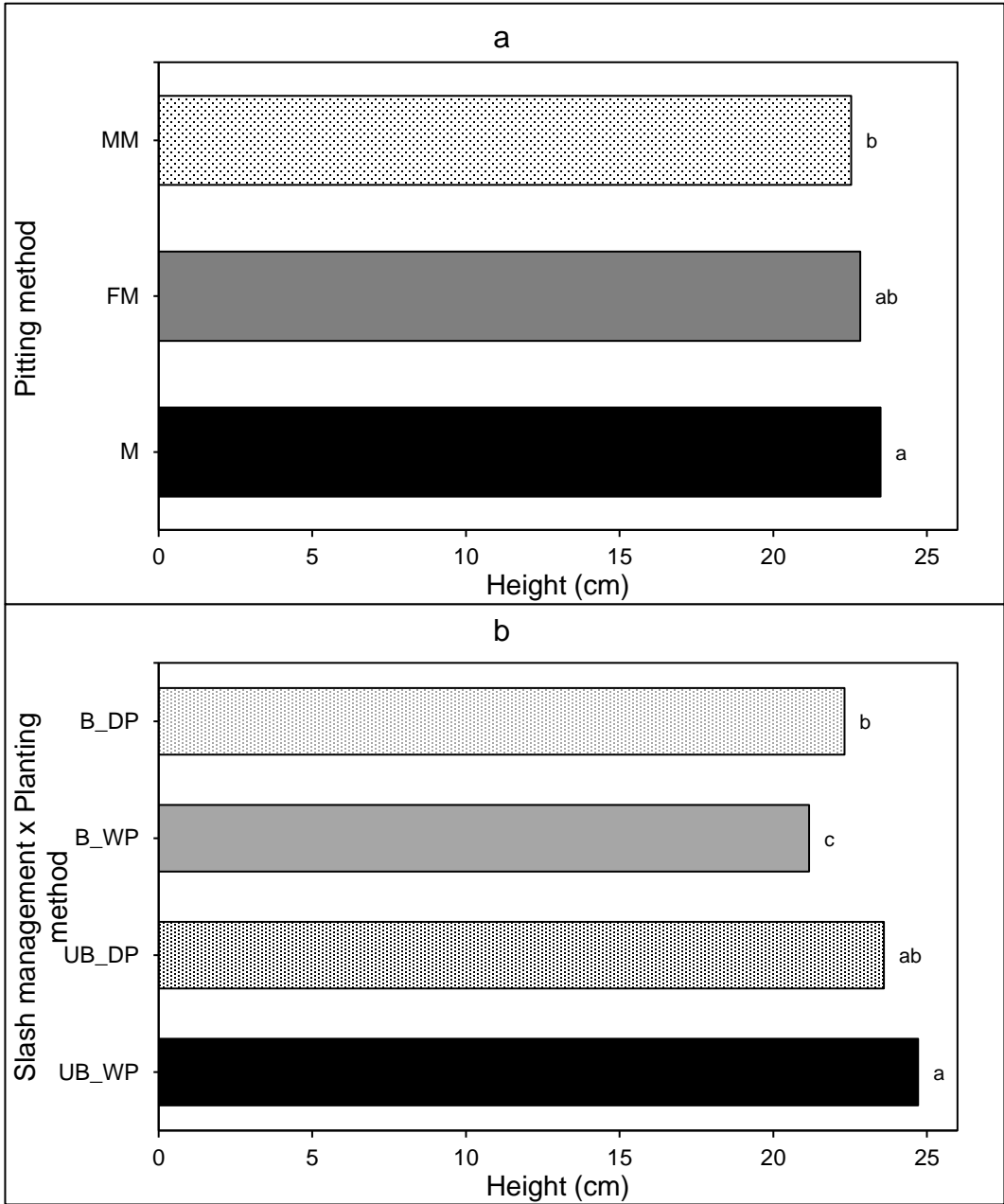
12 months after planting

Conclusion

- FM pitting was more productive than M and MM

- Pit density was high in FM pitting than M and MM methods

- FM pitting produced deep and wider pits than M and MM

- Pitting methods and interaction between plant method and slash management influenced height (day 0)

- Pitting and planting methods influenced Bic (12 months)

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Ngiyabonga

Thank you

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