



Experimental design & fertiliser rates

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Experimental design

- Tailor-made Reduced Factorial with four fertiliser levels:
 - 0%, 50%, 100% and 150% of calculated offtake
- The design fits onto one hectare and is replicated twice.
- There is space for two secondary nutrient omission treatments with four replicates each.

Nutrient offtake & loss

- We made an nutrient requirement model in Excel using nutrient data and allometric relations from literature and from own research
- We checked the model outcomes with other models and with recommendations from Yara and adapted it.
- Extreme soils (very rich or poor) are not yet taken into account.

Screenshot of offtake model (parameter worksheet)

Parameter	Unit	Model input
Tree age		4
Target yield	Bean DM/ha/yr	1000 2000
Allometric relations		
Total biomass increase year 1	kg DM/ha/yr	1500
Total biomass increase year 2	kg DM/ha/yr	3000
Total biomass increase year 3	kg DM/ha/yr	5000
Total biomass increase year 4	kg DM/ha/yr	5000
Total biomass increase year 5	kg DM/ha/yr	3000
Total biomass increase year 6-10	kg DM/ha/yr	2000
Total biomass increase year 11 and up	kg DM/ha/yr	1000
Additional leaves year 1	Leaves-to-total	0.4
Additional leaves year 2-5	Leaves-to-total	0.2
Additional leaves year 6-10	Leaves-to-total	0.1
Additional leaves year 11 and up	Leaves-to-total	0
Wood-to-total year 1	Wood-to-total	0.6
Wood-to-total year 2-5	Wood-to-total	0.8
Wood-to-total year 6-10	Wood-to-total	0.9
Wood-to-total year 11 and up	Wood-to-total	1
Roots-to-wood	Ratio	0.2
Stbr-to-wood	Ratio	0.8
Beans-to-pod	kg DB/kg DP	0.4

CocoaSoils experimental design. Levels are coded as follows: 1 = 0%, 2 = 50%, 3 = 100%, 4 = 150% of modelled offtake rate.

Treatment	N	P	K	Treatment	N	P	K
1	1	1	1	16	2	3	2
2	2	1	1	17	2	4	2
3	3	1	1	18	2	2	1
4	4	1	1	19	2	2	3
5	1	2	1	20	2	2	4
6	1	3	1	21	1	4	4
7	1	4	1	22	2	4	4
8	1	1	2	23	3	4	4
9	1	1	3	24	4	4	4
10	1	1	4	25	4	1	4
11	1	2	2	26	4	2	4
12	2	2	2	27	4	3	4
13	3	2	2	28	4	4	1
14	4	2	2	29	4	4	2
15	2	1	2	30	4	4	3

Fertiliser rates

- Will be updated annually based on predicted yields.
- Can be adapted to specific environments (if necessary).
- Numbers below were generated in first calculations.

Estimated yields and estimated offtake rates (kg/ha/year)

Year 1

Nutrient \ Yield	0
N	28
P ₂ O ₅	18
K ₂ O	37

Year 2

Nutrient \ Yield	0
N	42
P ₂ O ₅	32
K ₂ O	72

Year 6

Nutrient \ Yield	0	500	1000	2000	3000
N	23	48	73	122	171
P ₂ O ₅	20	38	57	77	97
K ₂ O	47	94	140	210	280

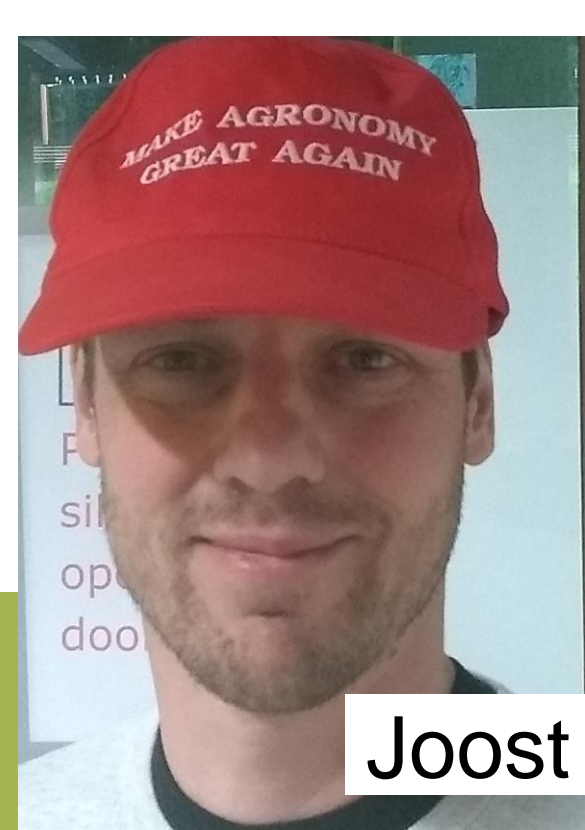
Acknowledgements

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References

- Information shared by Yara on nutrient requirements
- Van Vliet and Giller, 2017; Calvo-Romero, 2018; Fisher, 2019

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