Specific leaflet mineral concentrations for high-yielding oil palm (*Elaeis guineensis* Jacq.) progenies and their implications for K/Mg management

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Introduction

- In oil palm, similar fertilization regimes can result in leaflet potassium and magnesium concentrations varying significantly from one progeny to another.
- This hinders development of standardized fertilizer recommendations as they are usually calculated to reach optimum mineral concentrations for specific cultivars.

Pic. 1. Mature oil palm plantation *(Ra. HA)*

Pic. 2. Oil palm tree fertilization (manually) in trial *(Ra. OD)*

Pic. 3. Oil palm trees fertilization (mechanically) in commercial plantation *(Ra. OLH)*

Aim

Provide oil palm growers with more productive planting material in combination with more adequate, progeny-targeted and lower fertilizer doses.

Materials and method

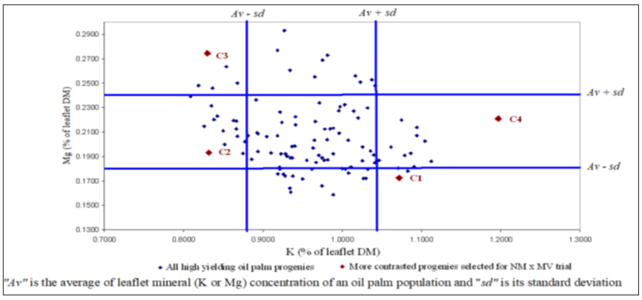
- The experiment consisted of a K3Mg3 factorial split plot design, set up in 2011, where fertilizer (respectively K x Mg) was considered as the main factor combined with 4 oil palm progenies in subplots and 6 repetitions.
- Fertiliser (KCl + $MgSO_4$) was applied annually during 9 years (2011 - 2019) whereas measurements (leaf analysis and fresh fruit bunch number and weights) were carried out over 6 years (2013 - 2019).
- Fertiliser rates were 0, 1.5 and 3.0 kg $palm^{-1}$ $year^{-1}$ of KCl for K0, K1 and K2, respectively and 0, 0.75 and 1.5 kg $palm^{-1}$ $year^{-1}$ of kieserite for Mg0, Mg1 and Mg2, respectively.
- To examine genotype, fertilizer and genotype x fertilizer interaction effects, 3 way ANOVAs were performed with factors "genotypes", "K" and "Mg".

Table 1. Genetic characteristics, varieties, and genetic origins of the parents of the different oil palm progenies

Progenies	Dura (Female Parent)	Dura Origin	Pisifera (Male Parent)	Pisifera Origin	Genetic origin
C1	PO 2630D	DA 10D x DA 3 D	PO 2766P	LM 10 T AF	D x L
C2	PO 3174 D	DA 115 D AF	PO 2973 P	LM 5 T x LM 10 T	D x L
C3	PO 3174 D	DA 115 D AF	PO 4747 P	LM 5 T AF	D x L
C4	PO 4953 D	Unknown	PO 4260 P	LM 238 T x LM 511 P	D x Y

The last letter after the PO number (e.g., PO 2630 D or PO 2766 P or LM 10 T) indicates the main varietal group: P = Pisifera, D = Dura, and T = Tenera. Progenies C1, C2, C3 and C4 are all Tenera crosses (they all come from crosses between a Dura and a Pisifera variety). Data in the Dura and Pisifera columns show the genetic material from which female inflorescences and male inflorescences (pollen) were used to obtain the progenies. AF refers to self-pollinated trees (e.g. LM 10 T AF = LM 10 T x LM 10 T). D x L: Deli x La Mé, D x Y: Deli x Yangambi

Fig.1. Leaflet K and Mg contents of 116 high-yielding oil palm progenies tested in a genetic block experiment in Aek Loba Timur (Indonesia) showing the four most contrasting progenies based on their mineral contents, subsequently used to set up the mineral nutrition (MN) x genetic material (GM) trial in Nigeria.



"Av" is the average of leaflet mineral (K or Mg) concentration of an oil palm population and *"sd"* is its standard deviation

Highlights

- Oil palm progenies exhibited antagonistic relationships between K and Mg.
- Oil palm progenies had different fertilizer x yield response curves and therefore different optimum leaflet mineral concentrations.
- As a result, different oil palm progenies have different specific mineral requirements.

More information

Dassou SO, Adjanohoun A, Vanhove W, Impens R, Aholoukpè H, Bonneau X, Flori A, Cochard B, Sinsin AB, Van Damme P, Ollivier J. 2022. Oil palm (*Elaeis guineensis* Jacq.) genetic differences in mineral nutrition: specific leaflet mineral concentrations in high-yielding oil palm progenies and their implications for managing K and Mg nutrition. *Plant and soil*, 475: 279 - 292. (https://doi.org/10.1007/s11104-022-05367-8).

Results

Fig. 2. Average oil palm progeny leaflet nutrient (K and Mg) concentrations over the 2016-2018 period (5 to 7 YAP) at different KCl (A) and $MgSO_4$ (B) application rates, and the effect of KCl on leaflet Mg concentrations (C) and of $MgSO_4$ on leaflet K concentrations (D)

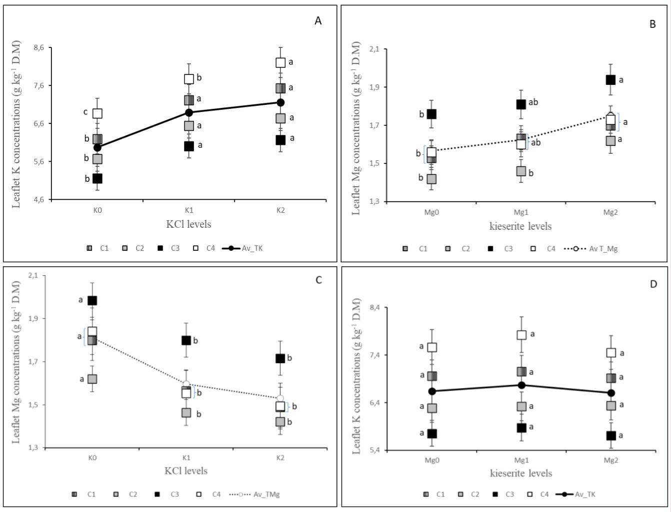


Fig.3. Average annual fresh fruit bunch yields (kg) per palm of the different oil palm progenies from 5 to 8 YAP (four consecutive harvesting years) according to 3 KCl application rates

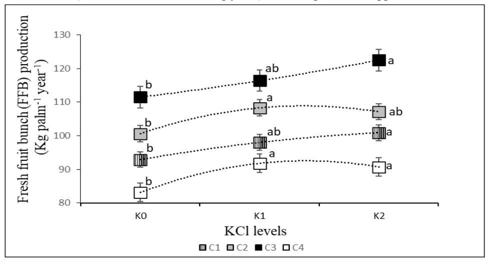
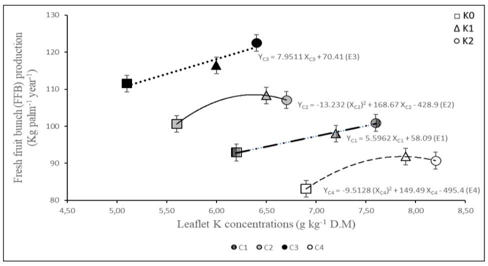


Fig. 4. Average annual fresh fruit bunch yields (kg) per palm of the different oil palm progenies from 5 to 8 YAP (four consecutive harvesting years) according to their leaflet K concentrations between 5 to 7 YAP



Pic. 4. Adult oil palm tree exhibiting Fresh Fruit Bunches (FFB) in the frond axils

Conclusion

C3 (DA 115 D AF x LM 5 T AF) oil palms appear to be an excellent planting material for the West African environment because they give the best yield with the lowest leaflet K concentration. Our study found specific optimum leaflet K and Mg concentrations for different oil palm progenies in a specific environment. It paves the way for defining K and Mg fertilizer application rates adapted to specific requirements of each type of oil palm planting material.

Tropentag, September 14 – 16, 2022, Czech Republic

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