Comparison between Rachis and Leaflet to control potassium nutrition of oil palm – Influence of genetic origins

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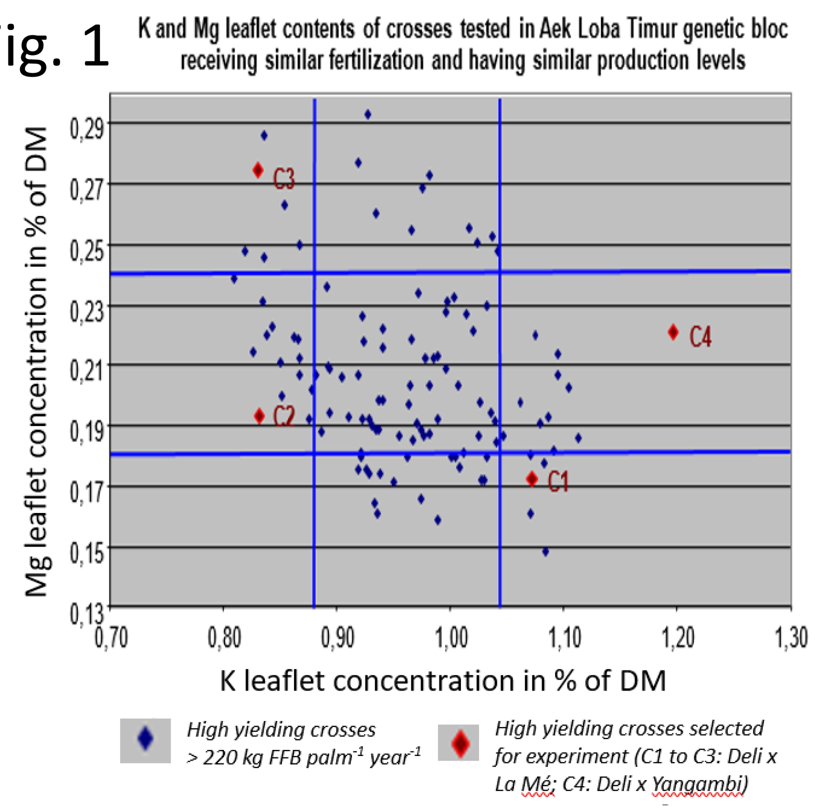
Introduction

Adapting oil palm fertilization relies on reference experiments and annual nutrient contents analysis. The leaflet is the most common organ used for nutrient diagnosis
However, leaflet nutrient contents (especially K and Mg) are subject to fluctuations depending on genetic origin, as previously observed in Indonesia (Fig.1).
CIRAD has therefore undertaken experimental research to determine the critical reference thresholds for standard types of crosses and to propose fertilization decision tools that are less sensitive to genetic origin.

Fig. 1



1- Materials and methods

Leaflet (left) and rachis (right) sample preparation

Vegetative and reproductive organs measured for mineral-mass

◆ The experiment is a factorial split-plot, 3 levels of Potassium chloride (KCl), 3 levels of Magnesium Sulfate (Kieserite) tested on 4 oil palm crosses. The crosses were selected according to their very contrasted leaflet concentrations in K and in Mg (Fig. 1). The experiment with 6 replicates was established in 2011 in Nigeria (33ha – 1944 useful palms).

◆ The treatments started one year after planting. K*Mg fertilization schedule was stabilized 5 years after planting with rates of 0, 1.5 and 3kg of KCl and 0, 0.75 and 1.5kg of Kieserite per palm and per year.

◆ Bunch number and bunch weight were recorded on each palm. Leaflet and Rachis analysis was done annually on composite sample from each subplot of every second replicates to draw response curves of nutrient content according to production.

◆ Evaluation of mineral-masses (uptakes) in the different organs (leaflets, rachis, petioles, trunk, bunches components, old leaf bases, roots) allowed to assess K agrophysiological efficiency (APE) at 8 years after planting.

2- Results

◆ KCl significantly increased the production of all the crosses although different according to crosses (C3,C1>C2,C4). In contrast, the effect of kieserite was not significant on production.

◆ Regarding leaflet K content, the concentration differed between crosses (C4,C1>C2>C3). KCl treatment effect was significant too, F value=149 was two times higher compared to crosses effect.

◆ Optimal K critical reference depended on crosses: it was around 0,75% and 0,86% for C2 and C4 (1.5 kg of KCl applied) but was not reached for C1 and C3 crosses (Fig. 2a).

Fig. 2a

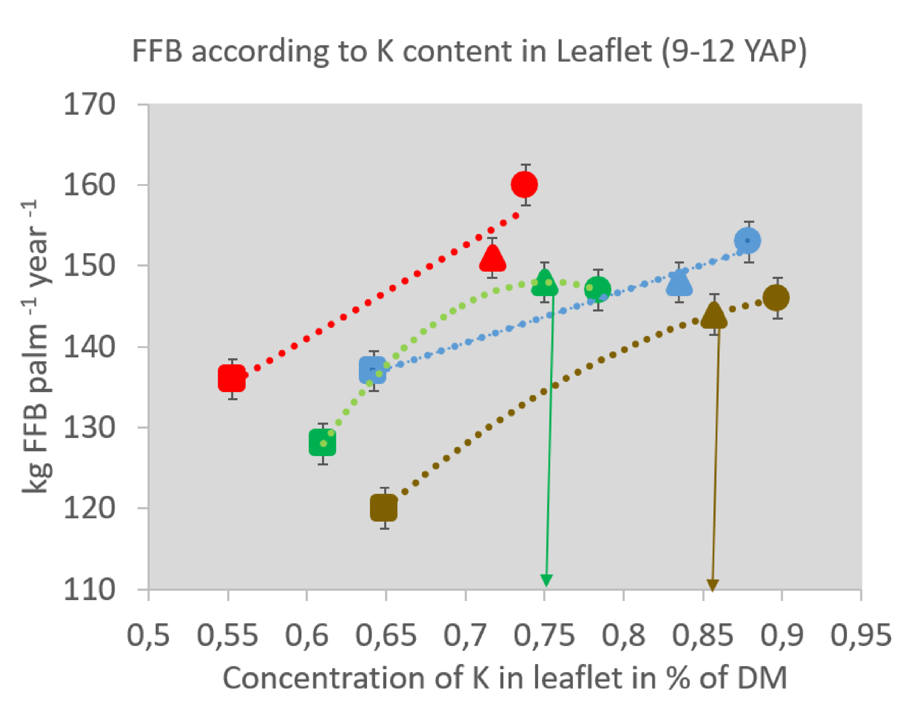
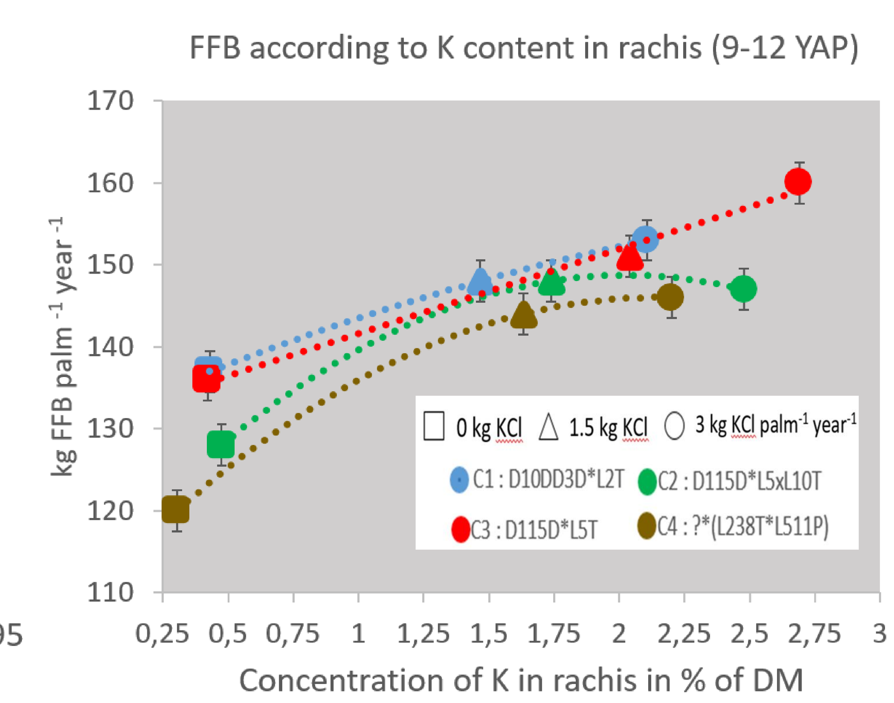


Fig. 2b

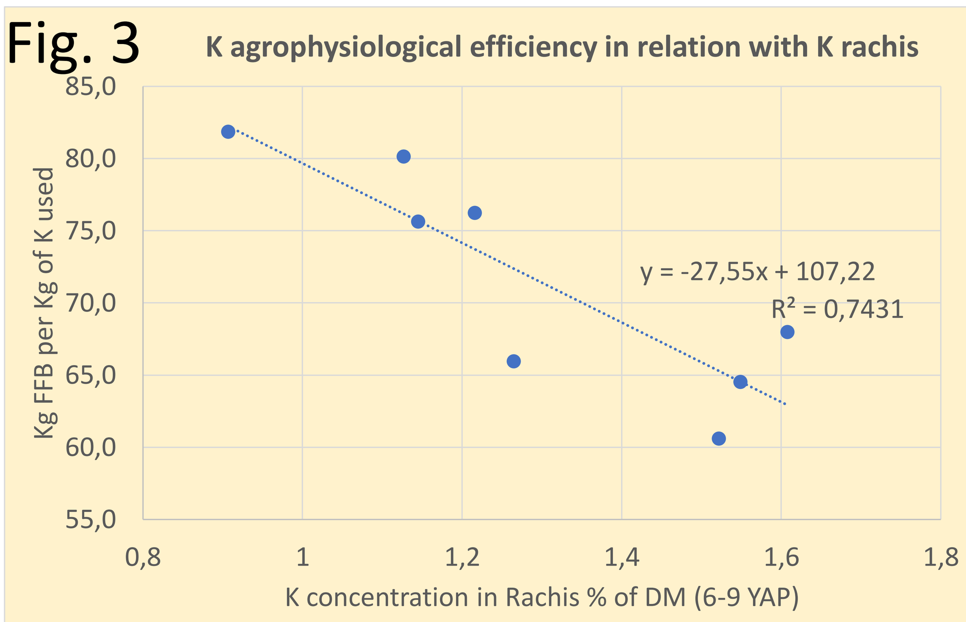


◆ A very good correlation between rachis K content and KCl treatments (F value = 983) and crosses (F value= 39) was found. Rachis contents of C2 and C4 (1.5 kg KCl) are similar at around 1,6% - 1,7% (Fig. 2b).

◆ The APE, calculated as the ratio between the increase in FFB from K0 to Ki and the increase in nutrient uptake, is on average 70 kg FFB/kg K.

◆ A significant decreasing linear relation (R^2=74% ; $p<0,01$) was found between K APE (efficiency) and rachis content independently of the crosses (Fig. 3). The relation is not significant for leaflet content (p=0,445). The K APE is 60kg FFB/kg K at a rachis content of about 1.6% which has to be interpreted in line with the economic context.

Fig. 3



3- Discussions

K leaflet contents followed the same ranking in Nigeria as in Indonesia. The less favorable pedo-climatic condition in Nigeria explained the differences in production, but cross C3 appeared well adapted to African conditions. The effect of the KCl treatments was significant on the production of the 4 progenies and on the K contents on both leaflet and rachis, but F value was 6 times higher for the rachis than the leaflet. The progeny effect was more accentuated on the leaflet with a F value double than the one on rachis. The rachis is less influenced by genetic origins than the leaflet analysis to steer potassium nutrition of oil palm. It gives a better prediction in the K use efficiency and appears to be a relevant tool for plantations that use several planting material, however rachis contents thresholds in K need to be refined.

Reference
Dassou SO (2023). Interaction between oil palm (*Elaeis guineensis* Jacq) progenies and K and Mg mineral nutrition. Ph.D. Thesis, Ghent University, 9000 Ghent, Belgium. 329pp.

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