Homologous Events and Water Stress in Oil Palm

The accelerating demand for vegetable oils, for both food and non-food uses, is the key driver for growers to aim for higher yields. Oil palm growers learn from their own experience and adopt best management practices recommended by experts to achieve high yields. Yet, oil palm yield still fluctuates year to year. Factors for this fluctuation include weather conditions, soil characteristics and topography. In tropical regions where oil palm is cultivated, rainfall (which influences drought, waterlogging and flooding) is the main weather factor that affects oil palm yields. Other weather variables like temperature, humidity and sunlight vary little over time in the tropics.

Oil palm yield formation takes a long time. Bunch development starts with initiation of the inflorescence, followed by sex determination, pollination and final filling of the fruits, a process taking some three years (Breure, 2003). Therefore, excessive (surplus water) or insufficient rainfall (water deficit) in the three-year period prior and up to the time of harvest can affect fresh fruit bunch (FFB) production.

The International Plant Nutrition Institute's Southeast Asia Program (IPNI SEAP) developed a concept known as *Homologous Events* (HE) to classify interactions of rainfall, soil type and topography so that the resulting HE classes can be linked to commercial or experimental results of oil palm. A newly developed software, HE_Analyzer[1], was used to classify each calendar year as normal (N), dry (D), wet (W) or extreme (E) where both a dry period and a wet period occurs in the same year. Oil palm yield in any year can then be related to HE classes of that year and up to two years before.

The concept of HE in analyzing annual variations in oil palm yield was successfully tested by IPNI SEAP using commercial production data for the period 2007-2013 from a 6,000 ha plantation in Central Kalimantan, Indonesia (Cock *et al.*, 2016).

Results (Table 1) showed that yields were significantly reduced by 6.1 t FFB $ha^{1}yr^{-1}$ following a dry year two years before (HE-2D). Similarly, yields were significantly reduced by 5.5 t FFB $ha^{-1}yr^{-1}$ following a wet year two years before (HE-2W). An extreme year two years before (HE-2E) caused a significant yield reduction of 8.5 t FFB $ha^{-1}yr^{-1}$.

Table 1: Yield for dry (HE-2D), wet (HE-2W) and extreme (i.e., dry + wet) (HE-2E) events two years before the year of harvest compared with a normal year (HE-2N). Harvest data from 2009-2013, weather data from 2007-2013.

HE Class 2 years prior to harvest year	Probability of the relationship between HE class and FFB yield[1]	FFB Yield change (t $ha^{-1}yr^{-1}$) due to HE class[2]
Dry year (HE-2D)	≥99%	-6.1
Wet year (HE-2W)	≥95%	-5.5
Extreme year (HE-2E)	≥99%	-8.5

1 – Probability of the observed relationship between HE class two years before and FFB yield in harvest year; 2 – Change compared to FFB yield following a normal year two years before (HE-2N).

This confirmed existing knowledge that dry years affected oil palm yields up to two years into the future, and provided first evidence that wet years also had a similar effect, and that a combination of both water deficit and excess water had the most severe effect in yield reduction. By being able to better understand how their farm practices combined with weather and other farm conditions in a good (or bad) way to produce exceptionally high (or low) yield, oil palm growers will be better able to optimize their operations.

References:

Breure, K. 2003. The search for yield in oil palm: Basic principles. In T. Fairhurst and R. Härdter (Eds.), Oil Palm: Management for Large and Sustainable Yields. pp. 59-98. Potash & Phosphate Institute (PPI), Potash & Phosphate Institute of Canada (PPIC) and International Potash Institute (IPI).

Cock, J., S.P. Kam, S. Cook, C. Donough, Y.L. Lim, A. Jines-Leon, C.H. Lim, S. Primananda, B.T. Yen, S.N. Mohanaraj, Y.M.S. Samosir and T. Oberthür. 2016. Learning from commercial crop performance: Oil palm yield response to management under well-defined growing conditions. Agricultural Systems 149:99-111.

[1] *HE_Analyzer is available upon request from the IPNI Southeast Asia Office (http://seap.ipni.net/).*