Some Nutritional Disorders in Oil Palm

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Prevention of Oil Palm Disorders with Legume Cover Crops

Except for peat soils, the proper approach to oil palm development begins with the establishment of leguminous cover plants (LCP), immediately following land clearing (**Photo 1**). The LCPs help prevent soil erosion and surface run-off, improve soil structure and palm root development, increase the response to mineral fertilizer in later years, and reduce the danger of micronutrient deficiencies (**Photo 2**). They also help prevent outbreaks of *Oryctes* beetles, which nest in exposed decomposing vegetation. Both phosphorus (P) and potassium (K) fertilizers are needed to maximize the LCP's symbiotic nitrogen (N) fixation potential of approximately 200 kg N/ha/yr and are applied to most soils at 115 to 300 kg P_2O_5/ha and 35 to 60 kg K_2O/ha. Young palms are severely set back where grasses are allowed to dominate the inter-row vegetation (**Photo 3**), particularly on poor soils where the correction of nutrient deficiencies is difficult and costly.

Nitrogen Deficiency – Nitrogen deficiency is frequently observed on young palms grown in areas with non-LCP inter-row vegetation (**Photo**

Photo 1. (At top left) Properly established legume cover plants.
Photo 2. (At top right) During the time frame planting to maturity a full cover crop of *Pueraria phaseoloides* provides 150 to 200 kg N/ha/year and prevents soil erosion.
Photo 3. (At bottom left) Young palms planted without legume cover plants.
Photo 4. (At bottom right) Nitrogen deficiency in palms planted without legume cover plants.

4). Severe N deficiency is rarely seen on old palms. Nitrogen deficiency is expressed in uniformly pale, yellow green leaflets and a sharply reduced growth rate. Midrib tissues become bright yellow. Unlike magnesium (Mg) deficiency, the symptoms are equally pronounced on both upper and lower rank pinnae. Nitrogen deficiency may also be caused by poor drainage.

Phosphorus Deficiency – Phosphorus deficiency does not produce leaf symptoms in oil palm. However, the trunks of affected palms are narrow and tapered (**Photo 5**). The presence of Straits rhododendron (*Melastoma malabathricum*) (**Photo 6**), the tropical bracken fern *Dicranopteris linearis* (**Photo 7**) and alang-alang (*Imperata cylindrica*) (**Photo 8**) all indicate low soil fertility and past soil degradation (**Photo 9**).

Potassium Deficiency – Potassium is the nutrient required by oil palm in largest amounts, and deficiency symptoms develop on most soils unless K fertilizer is applied. Continued K deficiency leads to a progressive decline in yield and plant health. A number of different symptoms indicate K deficiency or an imbalance of K with other elements. The most typical and widespread form of K deficiency is known as "confluent orange spotting" (**Photo 10**). The first signs of K deficiency are pale green spots on the pinnae of older fronds. In a more advanced stage, the rectangular spots become orange-yellow and transmit light when held up to the sky. Later, the tips of leaf pinnae start to dry up. In very severe cases, entire older fronds may dry up. Some palms show symptoms similar to K deficiency known as "genetic orange spotting"

Photo 5. (At top left) The trunk of P deficient palms is small and stunted.
Photo 6. (At top right) *Melastoma malabathricum* indicates low soil pH and soil infertility.
Photo 7. (At bottom left) Inter-row dominated by the tropical bracken fern *Dicranopteris linearis*.
Photo 8. (At bottom right) Phosphorus-deficient alang-alang leaves.

Photo 9. (At top left) Alang-alang leaves show P deficiency on eroded soil.
Photo 10. (At top right) Typical orange spotting symptoms indicate K deficiency.
Photo 11. (At bottom left) Genetic orange spotting in a young mature palm.
Photo 12. (At bottom right) Potassium-deficient cover crop leaf (*Pueraria phaseoloides*) in oil palm.

caused by an inherited defect (**Photo 11**). Potassium deficiency symptoms are also easy to identify in legume cover plants (**Photo 12**).

"White stripe" is a condition related to K deficiency. "White stripe" is a complex physiological disorder, frequently observed on young, vigorously growing palms. An imbalance among N, K, and boron (B) is believed to be involved in most cases. In such cases where affected pinnae are long and soft, an N/K imbalance appears to be the main cause. White stripe symptoms may also be found in combination with confluent orange spotting symptoms. In such cases the symptoms are due to an N/K imbalance and low B status of the leaf. The pinnae shown in **Photo 13** contained N, K and B concentrations of 2.92 percent, 0.78 percent, and 5 mg/kg, respectively.

Boron Deficiency – Boron deficiency is expressed in a range of leaf symptoms. However, in all cases the distal end of leaflets at the tip of the frond are most affected. Pinnae are misshapen, stiff and brittle. "Hook leaf" is one typical symptom of B deficiency (**Photo 14**).

Magnesium Deficiency – Severe Mg deficiency results in the development of bright orange color in older fronds (**Photo 15**). The orange discoloration is very pronounced on the upper rank pinnae exposed to sunlight, whilst lower rank and shaded pinnae remain green (**Photo 16**). Leaf veins also stay green for a longer period. Older fronds dry up and die under conditions of severe Mg deficiency. Planters should be able to distinguish between Mg and K deficiency and a healthy leaf (**Photo 17**).

Manganese Deficiency – Manganese (Mn) deficiency is not common, but has been reported on soils with high exchangeable Mg status and

Photo 13. (At top left) "White stripe" symptoms are widely observed in fast-growing, young (up to 6 years) palms where there is an imbalance among N, K and B.
Photo 14. (At top right) Close-up of hooked leaves indicating B deficiency in oil palm.
Photo 15. (At bottom left) Severe Mg deficiency in a young oil palm.
Photo 16. (At bottom right) Close-up of an oil palm leaf showing Mg deficiency. Shaded lower pinnae remain green, but exposed upper rank pinnae turn orange-yellow.

insufficiently compacted peat soils where palms are suffering from drought. Manganese deficiency shows as a yellowing of interveinal areas (**Photo 18**). In contrast to Mg deficiency, the symptoms are found on young rather than on older fronds. The symptoms are equally pronounced on upper (sun exposed) and lower (shaded) rank pinnae. Manganese deficiency can occur on peat and very sandy soils and is sometimes associated with high leaf Mg status.

Zinc Deficiency – Zinc (Zn) deficiency is not common in oil palm but may be induced under high soil P status and occurs on ultrabasic and ultramafic soils with high soil pH. It is also believed to be a factor involved in the "Peat Yellows" condition found on peat soils. Zinc deficiency has also been reported on shallow peat soils overlying sand, particularly where large amounts of soluble P fertilizer have been applied. It appears as small, narrow white streaks on lower and mid-crown fronds (**Photo 19**). A different condition that produces blotchy leaf symptoms has also been identified tentatively as Zn deficiency.

Iron Deficiency – Iron (Fe) deficiency is very rare in oil palm and occurs where soil pH is very high (i.e., more than 7.5). The deficiency has been observed where palms are grown over coral outcrops or on spots where white ant hills have been levelled. It is easily identified, as symptoms appear first on the youngest fronds, which appear droopy and show diffuse blotchy yellowing and white freckles (**Photo 20**).

Copper Deficiency – Copper (Cu) deficiency is common on deep peat soils and occurs also on very sandy soils. It appears initially as whitish-yellow mottling of younger fronds. As the deficiency intensifies, yellow, mottled, interveinal stripes appear and rusty, brown spots develop on

Photo 17. (At top left) Magnesium (bottom in photo) and K (center in photo) deficient oil palm leaves compared with normal leaf.
Photo 18. (At top right) Manganese deficiency in oil palms is very rare.
Photo 19. (At bottom left) Zinc deficiency in oil palm.
Photo 20. (At bottom right) Iron deficiency in oil palm fronds.

the distal end of leaflets. Affected fronds and leaflets are stunted and leaflets dry up (**Photo 21**).

On sandy soils, palms recover rapidly after a basal application of 50 g $CuSO_4$ (**Photo 22**). On peat soils, lasting correction of Cu deficiency is difficult, as applied $CuSO_4$ is rendered unavailable. A promising method to correct Cu deficiency on peat soil, developed by the authors, is to mix $CuSO_4$ with clay soil and to form tennis-ball sized "copper mudballs" that are placed around the palm and that provide a slow-release source of available Cu.

Crown Disease – Crown disease is probably caused by a genetic disorder that tends to affect young palms (**Photo 23**). In most planting material, palms recover completely from crown disease. Nitrogen fertilizer should not be applied to palms affected by crown disease since this increases the chance of opportunistic pathogenic invasion of affected tissue.

Little Leaf – This syndrome has not been fully explained but has often been confused with B deficiency. The growing point is damaged, sometimes by *Oryctes* beetle. Small, distorted leaves that resemble B deficiency are then produced (**Photo 24**). This is often followed by secondary pathogenic infections in the spear that may lead to spear rot and palm death. **BCI**

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Photo 21. (At top left) Use of peat soil for poly-bag filling may result in severe Cu deficiency of the seedlings. For oil palm nurseries, only mineral soil should be used.
Photo 22. (At top right) Young oil palm recovering from Cu deficiency after an application of $CuSO_4$.
Photo 23. (At bottom left) Crown disease in oil palm.
Photo 24. (At bottom right) Little leaf syndrome.

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