**REMOTE SENSING FOR OIL PALM FOLIAR NITROGEN**

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**OBJECTIVES**

The overall objective of the project is to develop a fast and cost effective tool for monitoring and detecting oil palm foliar nitrogen content using an RS technique. Specific objectives are as follows:

- to verify the suitability of using Landsat TM data for assessing foliar nitrogen content;
- to identify suitable vegetation indexes for detecting oil palm foliar nitrogen content; and
- to develop a model for quantifying nitrogen levels in oil palm leaves.

**BENEFITS**

This new technique will reduce the cost of assessing oil palm foliar nitrogen content. It will also provide fast foliar nitrogen content information compared to the present conventional method. The development of this technique will enhance the adoption of precision agriculture in oil palm plantation management which is presently not well received by the industry due to its high sampling requirements. The success of this study will help in developing similar techniques to assess other oil palm foliar nutrient contents using RS.
METHODOLOGY

This study was conducted at an MPOB fertilizer trial in Sungai Papan Estate, Kota Tinggi, Johor. The palms were planted in 1980 on Rengam series soil and the fertilizer trial was initiated in 1990. The site was subdivided into 84 plots (Figure 1).

A radiometrically corrected Landsat-5 TM 1991 satellite image (Figure 2), a digital map of the fertilizer trial plots and foliar analysis data obtained in 1991 were used in this study. Figure 3 shows the methodology flow chart for developing a foliar nitrogen assessment model using the RS technique. The satellite image was atmospherically corrected using satellite image processing software, Erdas Imagine Version 8.3.1. The satellite image was then geometrically corrected using the topographic map of Pengerang area (Series L7030 Sheet 4651) and then a sub-scene was obtained that included only the study site and the plantation. The digital numbers (DN) for each plot were determined by overlaying the map of the study plots on the geometrically corrected satellite image. Later, the satellite image information was used to compute the reflectance from the DN.

The predetermined foliar nitrogen content of each plot was used to identify and test suitable vegetation indexes to extract foliar nitrogen content information from the satellite image. Three vegetation indexes tested were normalized difference vegetation index (NDVI), soil adjusted vegetation index (SAVI) and atmospherically resistant vegetation index (ARVI). The indexes manipulate the blue, red and near infrared wavelengths of oil palm reflectance to extract the nitrogen content information. From regression analysis, only SAVI gave a positive correlation with foliar nitrogen content (Figure 4). Accuracy assessment of the relationship between SAVI and foliar nitrogen and error of the algorithm indicated that the relationship was best described by a linear equation with an accuracy of 91% and error of 4% respectively. The equation used to correlate foliar nitrogen content with SAVI is shown in Figure 4. The formulation to derive SAVI is as follows:

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SAVI = \frac{(NIR - R)}{(NIR + R + L)} \times (1 + L)
\]

Notes: NIR = near infrared wavelength.
R = red wavelength.
L = constant to minimize soil effect.

APPLICATION OF RESULTS

The equation established is site specific. New equations are needed for application of the technique to other areas. SAVI may have an advantage over
the other indexes because it can also correlate well with foliage density and can minimize the influence of external factors such as solar and viewing geometry, soil background and atmospheric effects.

CONCLUSION

The RS technique can be used to extract fast information on field data at lower cost with minimum labour requirement. The technique developed to assess the foliar nitrogen content is still at the preliminary stage and more work needs to be carried out to make it more accurate, reliable and sensitive to the small changes in the foliar nitrogen content. Information on the relationship between the biophysical characteristics of the palm and the foliar nutrient content will be very useful for the development of this technique. The availability of higher resolution satellite image will further enhance the development of the technique.

REFERENCES


