PROJECT:	**Evaluating the Use of the SPAD-502 Meter to Manage Nitrogen in Mango Trees (Kensington Pride) in the Northern Territory**
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Location:	Darwin and Katherine

Objectives:

To explore the use of the SPAD-502 Minolta chlorophyll meter to assess leaf nitrogen (N) in Kensington Pride (KP) mango trees.

To determine the effect of N applications (urea and KNO3) during the flowering season.

Introduction:

Mangoes (*Mangifera indica*) are the main horticultural crop in northern Australia. The industry is mainly focused on the main commercial cultivar, KP, which suffers from erratic flowering, excessive vigour and low productivity. Excessive tree growth causes a reduction in flowering activity. Very importantly, excessive N fertilisation is associated with fruit quality issues like green skin on ripe mangoes.

The lack of clear and proven guidelines for N management has encouraged growers to reduce N inputs to avoid fruit quality disorders. Therefore, a tool that would allow growers to estimate leaf N levels in an expeditious way would be advantageous. The chlorophyll meter - Soil Plant Analysis Diagnostic (SPAD) - provides a quick and non-destructive method for estimating leaf chlorophyll content, which is directly related to N status of leaves. The correlation between SPAD values and N status in leaves has not been explored in mangoes.

Method:

Two trials were conducted on growers' properties during the 2004 mango-growing season. One trial was in Darwin and the other one was in Katherine. A SPAD meter was used to measure the chlorophyll content of leaves. The chlorophyll level was measured as a SPAD unit. The average of SPAD levels was measured by the chlorophyll meter.

Leaf samples were collected in July 2004, October 2004 and April 2005 from mango trees. On each sampling date and at each location, leaves were collected from the sunny northwest 'sunny' side and southeast 'shaded' side of the trees for the SPAD readings and tissue analysis. The SPAD level of leaves was measured and groups of leaves with SPAD values within one unit were treated as a single sample.

Individual flushes and leaves within a terminal were monitored for changes in SPAD readings from July to November 2004. Urea (2%) and KNO_3 were applied to trees several times during the trial period. The dynamics of SPAD values during the fruit-growing season were monitored from tagged terminals spread across six groups of trees. The groups consisted of 'green' trees which had green leaves; 'yellow' trees which had yellowish leaves; 'shaded side' trees whose leaves were collected from the south-eastern side; urea treated trees; and KNO3 treated and control trees in Darwin and Katherine. Terminals were randomly selected and tagged. Each terminal had at least three flushes. On each tagged flush, a mature leaf was selected as a reference leaf from which SPAD readings were taken. About five measurements were taken from each flush. The N application included foliar sprays of urea or a solution of KNO_3 applied to the soil.

Foliar N

Twenty trees were selected at each site. Ten terminals per tree were selected and tagged. For urea sprays 100 terminals were used. An equivalent number of terminals was sprayed with water and used as a control. A solution of 2% urea was sprayed on selected terminals to run-off level.

Soil N

At each site, 20 trees were selected, 10 of which received soil N and the other 10 were used as a control group (no N). Three terminals per tree were selected and tagged. These terminals were monitored to get the average SPAD levels. The rates of KNO_3 were 250 – 300 g/tree/application. In Darwin, 175 kg of KNO_3 was applied over a period of seven weeks. In Katherine, 1.4 kg of KNO_3 was applied over a period of 13 weeks.

Effect of N applications on fruit quality characteristics

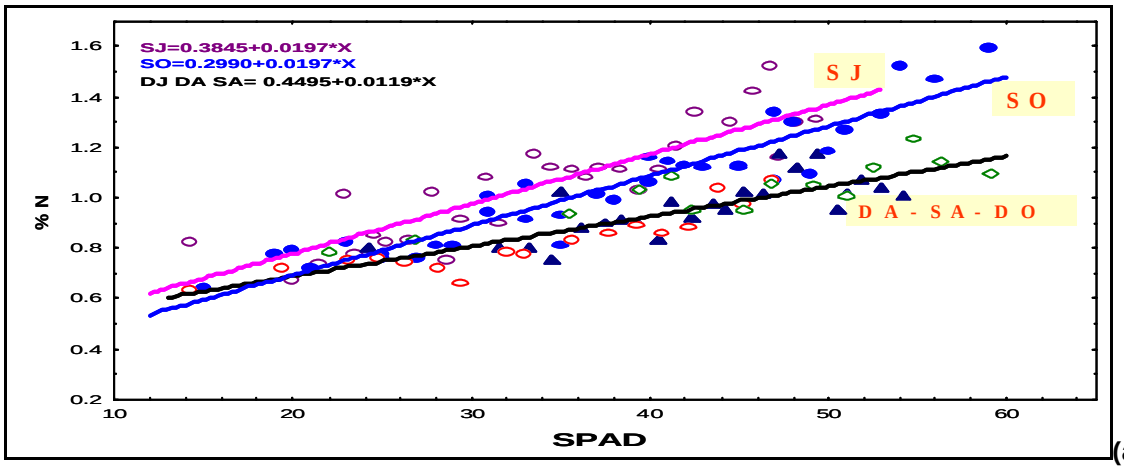
All fruit from tagged terminals was collected about a week before harvest and assessed for quality. Fruit quality included dry matter content, weight, total soluble solids and N.

Statistical analysis

The relationship between SPAD values and N concentration was analysed using the GLM procedure of Genstat 6.0. Regression analysis with Groups Routine was used to test similarities in the intercept and slopes of the regression lines. The effect of N applications on fruit size and fruit quality characteristics was analysed using analysis of variance.

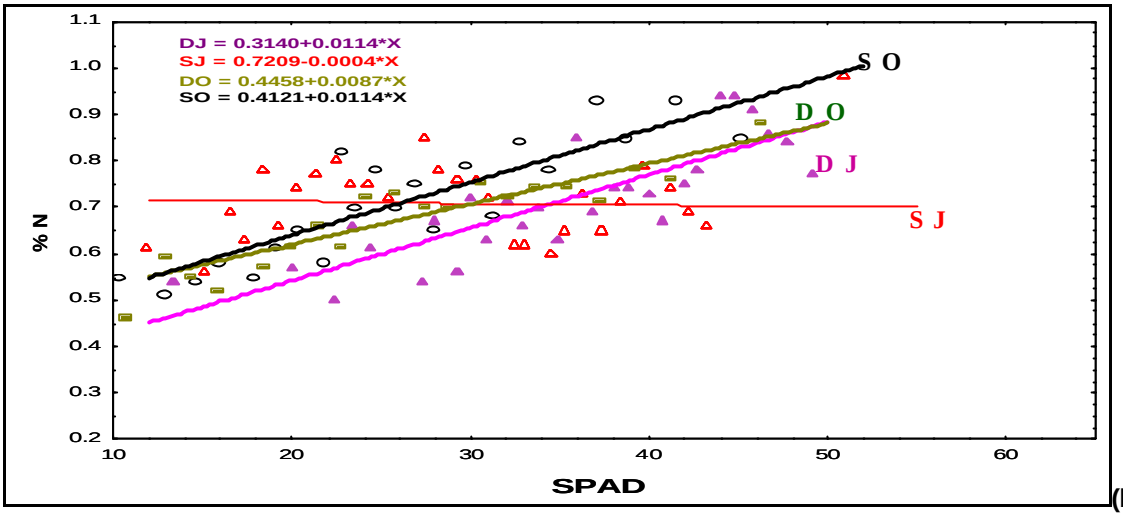
Results:

On all sampling dates and in both tree aspects SPAD levels were linearly related to leaf N content (Figure 1), except in samples from the 'sunny' side collected in July from the Katherine orchard.



(a)

SJ – Sunny July, SO – Sunny October, DJ – Shaded (Dark) July, DA – Dark April,
SA – Sunny April, DO – Dark October.



(b)

Figure 1. Relationship between leaf SPAD values and leaf N (%) in mango leaves collected in (a) Darwin and (b) Katherine at different times of the year and from different tree aspects

Effect of N applications on SPAD values

Throughout the time of study, flush SPAD values were highly correlated to SPAD values measured on the reference leaf.

Urea application

The effect of urea applications on SPAD values was analysed on several groups of trees.

'Green' trees in Darwin

SPAD values of both treatments started to diverge at about 44 days after treatment. After a few weeks, SPAD values of both control and urea terminals showed a sharp trend to increase (Figure 2 a).

'Yellow' trees in Darwin

SPAD values of urea treated terminals increased sharply 44 days after treatment and those of the control remained more or less stable. In both treatments, there was a trend to increase SPAD values at about 60 days after treatment (Figure 2 b).

'Green' trees in Darwin - shaded aspect

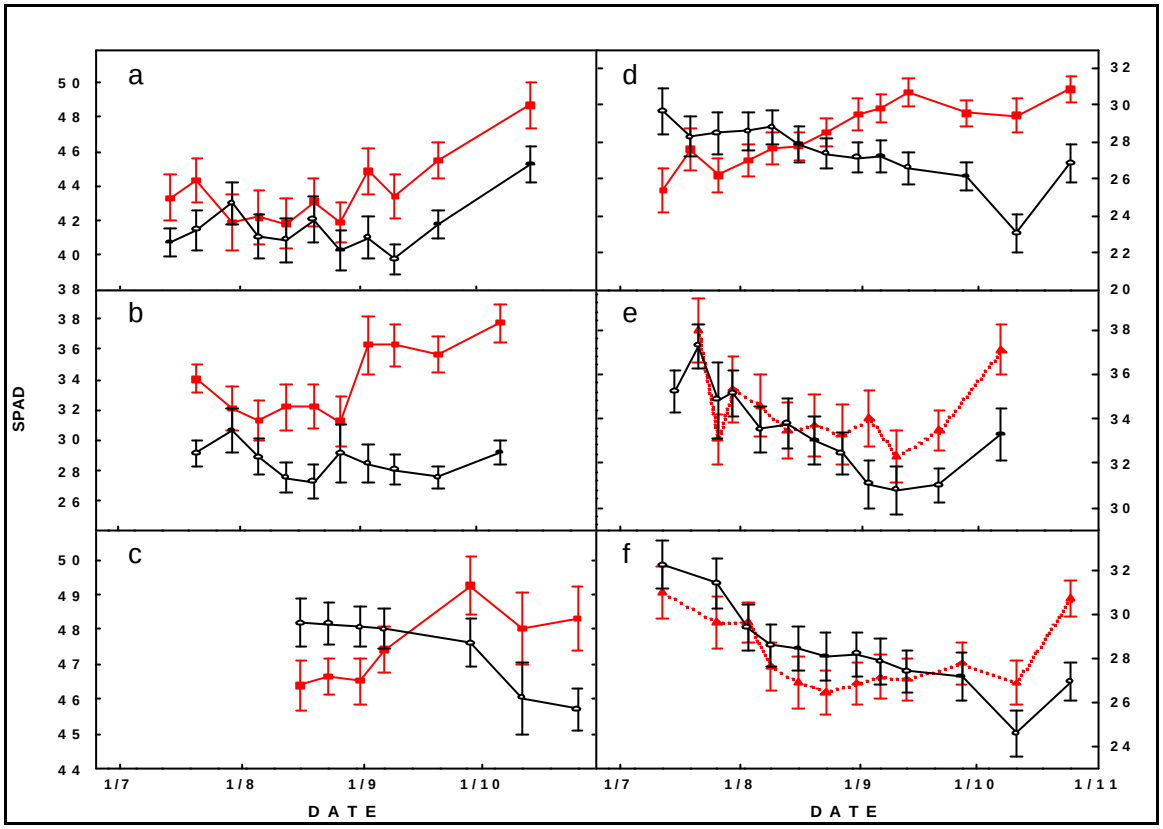
The trees responded to foliar urea applications (Figure 2 c).

In Katherine

Trees responded to foliar urea applications. However, there were no statistically significant treatment effects evident (Figure 2 d).

KNO_3 application in Darwin and Katherine

Results from these trials indicate that chlorophyll content of leaves did not increase until the second last and last assessment dates in Darwin and Katherine, respectively. There were no statistically significant treatment effects evident in these trials (Figures 2 e and f).



Solid symbols (red), N treated terminals and blank symbols (black), water treated terminals.

Figure 2. Changes in SPAD values observed in leaves of the first flush treated with urea (a, b, c, d) or KNO_3 (e, f)

Each graph represents a group of trees: (a) 'green' trees in Darwin; (b) 'yellow' trees in Darwin; (c) shaded side green trees in Darwin; (d) in Katherine, urea; (e), in Darwin, KNO_3 and control trees; (f), in Katherine, KNO_3 and control trees.

Effect of N application on fruit quality characteristics

Fruit characteristics were evaluated for each group of trees which received either urea or KNO_3 in Katherine and Darwin orchards. In Darwin, the dry matter content in fruit was significantly higher in the urea treated terminals compared with the water treated terminals (Table 1). The total soluble solid content in fruit was significantly higher in the urea treated terminals compared with the water treated terminals. In Darwin, the N content in fruit was significantly higher in the urea treated terminals compared with the water treated terminals (Table 1). Applications of KNO_3 or urea as foliar sprays had not significant effect on the fruit size.

Table 1. Fruit characteristics of urea, KNO_3 and water treated terminals

Farm	Treatment	% DM	F wt (g)	TSS (%)	N (%)
Katherine	Urea	13.5 ±0.9	390 ±107	12.5 ±0.7	0.31 ±0.00
	Water	13.2 ±0.6	347 ±63	11.6 ±0.5	0.31 ±0.01
Katherine	KNO3	12.6 ±0.8	425 ±106	11.7 ±0.5	0.35 ±0.01
	Water	12.9 ±0.6	441 ±73	11.8 ±0.8	0.36 ±0.02
Darwin	Urea	13.3 ±0.2	392 ±90	14.3 ±0.5	0.59 ±0.06
	Water	12.2 ±0.3	396 ±74	13.2 ±1.4	0.35 ±0.02
Darwin	KNO3	12.5 ±0.1	392 ±73	13.7 ±1.5	0.41 ±0.00
	Water	13.0 ±0.4	399 ±53	13.9 ±1.2	0.40 ±0.01

Values represent the average and standard deviation (?).

Conclusion:

The SPAD-502 meter could be a useful tool to monitor leaf N levels that will help to increase overall tree health and long-term cumulative fruit yield. Further investigation is warranted.