Chapter 4

Assessment of Appropriate Tangerine-Leaf Sampling Position for Nutrient Analysis

Introduction

Plant analysis is an assessment of nutrient level in plant (Kumlung *et al*., 2003). The outcome of analysis was compared with a critical or standard range. The carefully interpreted result could indicate nutrients status in the orchard (Kenworthy, 1973). Although soil testing is useful to improve soil for efficient use of nutrients (Chang *et al*., 1996; Leece, 1976a and 1976b), both plant and soil analysis will be helpful to fertilizer management of plant (Righetti *et al*., 1990).

Plant samples collected for nutrients analysis had to be defined (Poovarodom *et al*., 1998). Generally, leaf tissue is used for testing because it is the crucial center of plant metabolism. Therefore, leaf is sensitive to deficiency of nutrients (Kumlung *et al*., 2003). In addition, destructive sampling of leaf generally affects the fruit production less than other plant tissue. Most nutrient concentrations of sampled leaves should be stable with time (Poovarodom *et. al*., 1998). Supakamnerd (2006) introduced that the best sample leaf of tangerine cv. Shogun is one which is fully expanded and it should be taken before the new shoot emerges. Whereas, in Taiwan, the leaves which were picked to develop the standard value are the 3rd or 4th leaves of 5 to 6 month-old non fruiting terminals and spring flush (Chang *et al*., 1996). In USA, the leaf samples are taken from the middle stem where the leaves are 4-6 months old (Smith, 1966; Embleton *et al*., 1973). Sainampueng trees in Chiang Mai flowers and produces fruit all year round. The new shoots emerge every 2-3 months. Therefore, it is difficult to find the 4-6 month-old leaf from the branches which have no flowers and fruits. The objective of this study is to examine the appropriate leaf position for sampling and for nutrient analysis.

Materials and Methods

The experiment was conducted at a private orchard located at Mae Soon Noi subdistrict, Fang district of Chiang Mai province during May – October 2005. Five-

year-old tangerine cv. Sainampueng trees were selected for the study. The completely randomized design was used with 6 treatments with 90 day-old leaves in the 1st, 2nd, 3rd, 4th, 5th and 6th leaf position from shoot apex (Figure 4.1). Each treatment consisted of 5 replicates and each tree represented one replicate.

The fifty recently matured tangerine leaves (90 days) around the tree canopy were collected on May 21, 2005. All leaf samples were washed and dried in hot air oven at 72 °C for 3 days. Then the leaves were crushed and passed through a 0.5-mm sieve. Total nitrogen (N) was determined using the Kjeldahl digestion method. The other nutrients, plant samples were digested by wet digestion method using nitric-perchloric acid (5:2). Extracts from mixed acid digestion procedures were analyzed for phosphorus (P; colorimetry method, spectrophotometer), boron (B; azomethine-H method, spectrophotometer), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn) by atomic absorption spectrophotometry (AAS) (Suwannawong, 2001).

Soil samples were collected at 0-15 and 15-30 cm deep under the canopy of the tangerine trees from which leaves were collected. The soils were sampled from 4 directions for each tree on the same day as leaf sampling. All soil samples taken at the same depth were mixed, air-dried, ground and passed through a 2-mm sieve. The sieved soils were determined for pH (1:1, soil:water, pH meter), available P (Bray II, spectrophotometer), exchangeable K, Ca and Mg (1 $\overline{N}$ NH_4OAc, pH 7, AAS), extractable Fe, Mn, Cu and Zn (DTPA, AAS) and available B ($CaCl_2$ 0.01 M, spectrophotometer) (Puranapong, 2005). For organic matter (OM), the 2-mm sived passed through a 0.5 mm sieve and determined using the Walkley-Black dichromate method.

The data were statistically analyzed by using ANOVA. A least significant difference (LSD) was applied to test the effects of treatments when the F-test was statistically significant at $p \leq 0.05$.

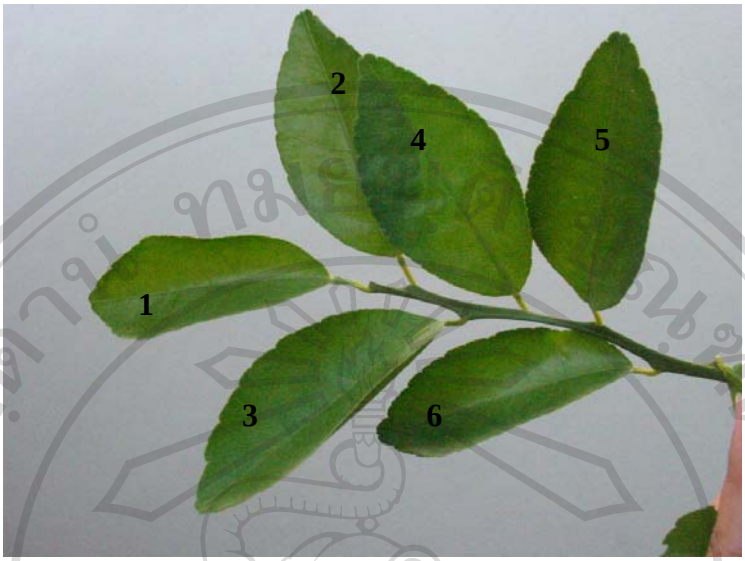

Figure 4.1 Leaf position of tangerine cv. Sainampueng for nutrient concentration analysis.

Results and Discussion

1. Effect of leaf position on nutrients concentration in leaf

As shown in Table 4.1, the concentration of N, P, K and B were basipetally increased while Ca, Fe, Mn and Zn concentration decreased. In contrast with Mg and Cu, their concentrations in leaves at various positions were different and uncertain. It is probably because of the foliar application of water-soluble Mg compound at the first week of May and the Cu constituted pesticides.

The principle of leaf sampling is to select any position when the most nutrient concentrations were not significantly influenced by the position of leaves on twigs (Poovarodom *et. al*., 1998). The concentration of N and K were quite stable at the 1st to 5th leaf position of the shoot. The concentration of P and Mg were quite stable at position 1 to 4. The concentration of Ca at position 3 and 4 were a little lower than position 1 and 2. The concentration of other micronutrient elements was rather inconsistent, because of the foliar application and spraying of some pesticides. However, it was generally found that all micronutrient elements at position 3 to 6 were less varied than the leaves at position 1 to 2. The appropriate position for leaf sampling was accepted at 3rd leaf position because the nutrient concentrations were

quite stable. Leaf analysis guides from USA advice that leaf samples should be taken before the spring flush. The leaves age of tangerine cv. Sainampueng for leaf analysis which was taken before flushing leaves (60 to 90 day-old leaves), showing in the highly the nutrient concentration.

The comparison between leaf nutrient concentration at position 3 from shoot apex and the adequate concentration in Florida was shown in Table 4.1. It was found that most of nutrients concentrations agreed with the standard values except K, Ca and Zn. The K concentration was higher than the standard value because of the luxury consumption from high K concentration in soil (Table 4.2) (Osotsapar, 2000). The high Ca and Cu might came from the foliar application of water-soluble calcium compound and copper constituted of pesticides.

Sulfur (S) was mainly considered especial in this experiment because most fertilizer formulae must already be included with sulfured or sulfate function, and it shows much wide range; thus it is not needed to analysis S as the nutrient.

2. The relationship between nutrient concentration in soil and nutrient concentration in leaf

In the present experiment there was a lower level of the coefficient of determination (R^2) with 0.0124-0.3474 (Figure 4.2). The relationship had not been found between the concentration of nutrients in soil (see Table 1 in Appendix B) and leaf (Table 4.1) in experiment. It was showed that the concentration of nutrients in soil had over sufficient nutrient for plant growth and the addition of fertilizer does not increase the growth of the plant (Barker and Pillbeam, 2007).

From the mentioned experiment, the indifferent relationship was due to the tangerine fruits age from a 4 size fruited tree. Definitely, fruits may mainly absorb nutrients as much as possible.

Conclusions and Recommendations

The appropriate position for leaf sampling was the 3rd leaf from shoot apex for nutrients values in plant. The relationship between nutrient concentration in soil and leaf did not detected in this study.

Table 4.1 Nutrient concentration in 90-day-old tangerine cv. Sainampueng leaf at different leaf position.

Leaf position	Concentration of macronutrient element (%)[1/]					Concentration of micronutrient element (ppm)[1/]				
	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu	B
1	2.53 b	0.154 cd	2.06 b	6.01 a	0.36 a	122.1 a	62.6 ab	130.7 a	26.3 c	30.0 c
2	2.59 ab	0.152 d	2.08 b	5.89 a	0.35 a	100.3 b	63.0 ab	120.1 a	24.0 d	43.3 b
3	2.80 ab	0.155 bcd	2.16 ab	5.28 b	0.35 a	75.8 de	63.6 a	84.8 b	24.3 d	63.3 a
4	2.81 ab	0.160 abc	2.15 b	5.38 b	0.37 a	81.0 d	61.0 b	93.3 b	30.2 b	61.8 a
5	2.76 ab	0.163 a	2.29 ab	4.71 c	0.34 ab	87.6 c	55.1 c	89.9 b	32.5 a	64.8 a
6	2.93 a	0.161 ab	2.47 a	4.57 c	0.31 b	73.6 e	47.4 d	62.0 c	30.9 b	63.7 a
$LSD_{0.05}$	0.36	0.006	0.31	0.36	0.03	6.56	2.12	12.17	1.59	8.11
% CV	8.71	3.24	10.91	5.15	5.75	5.58	2.76	9.63	4.34	11.40
Adequate concentration										
Florida[2/]	2.5-2.7	0.12-0.16	1.2-1.7	3.0-4.9	0.3-0.49	60-120	25-100	25-100	5-16	36-100
Taiwan[3/]	2.9-3.1	0.12-0.18	1.4-1.7	2.5-4.5	0.26-0.5	60-120	25-200	25-100	5-16	25-150

[1/]Means followed by different letters within columns are significantly different at the 5 % level by LSD

[2/]source: Alva and Tucker (1999)

[3/]source: Chang *et al*. (1992)

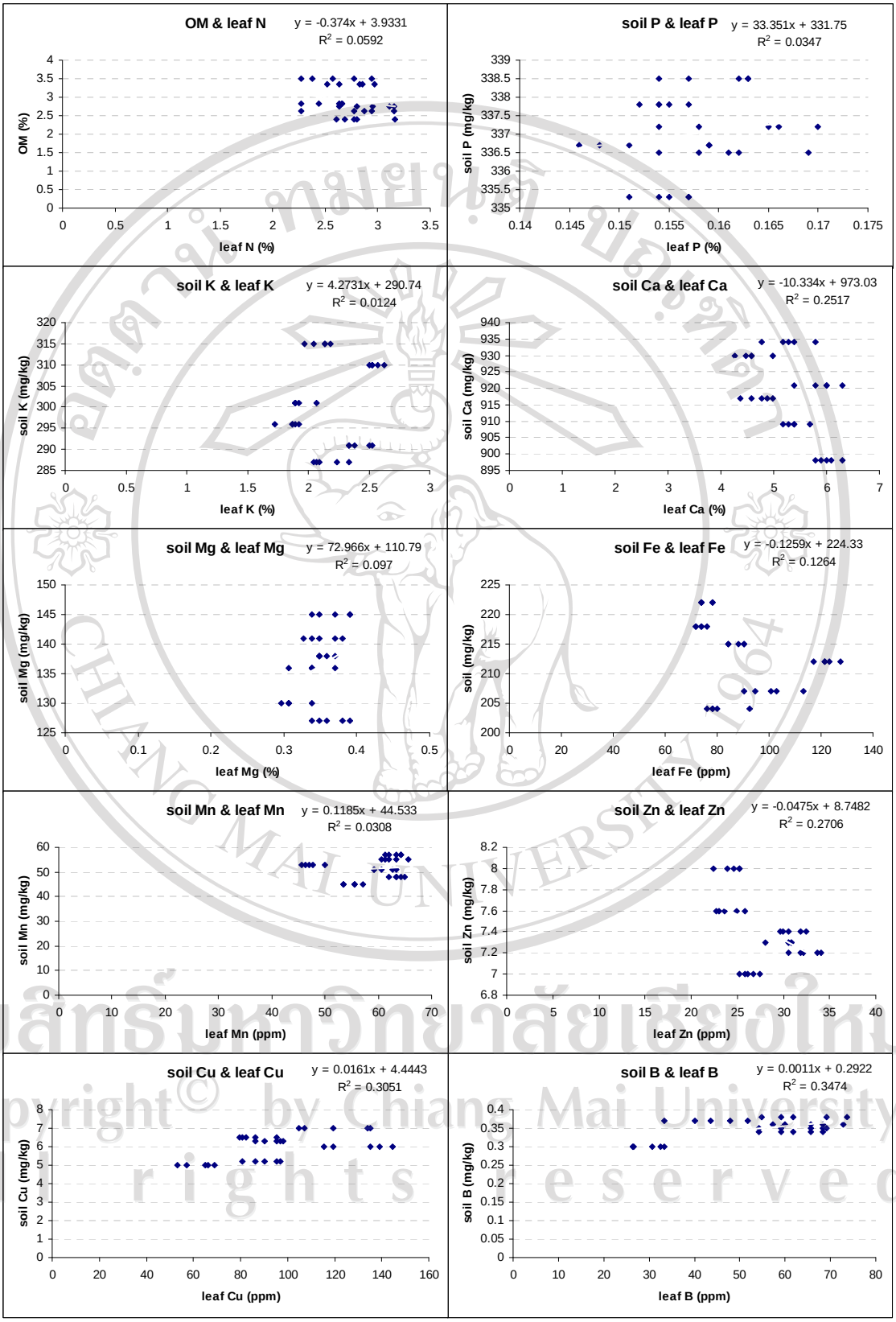

Figure 4.2 Relationship between nutrient concentration in soil and concentration of element in leaf.