Chapter 4

Results

1. Nutrient concentration in soil of lychee orchards at different representative sites and soil parent material

1.1 Soil pH

In both sandstone soil and limestone soil, pH was similar in all depths. In sandstone pH was 4.7 – 4.9 whereas, in limestone pH was 7.5 – 7.7 (Figure 4.1)

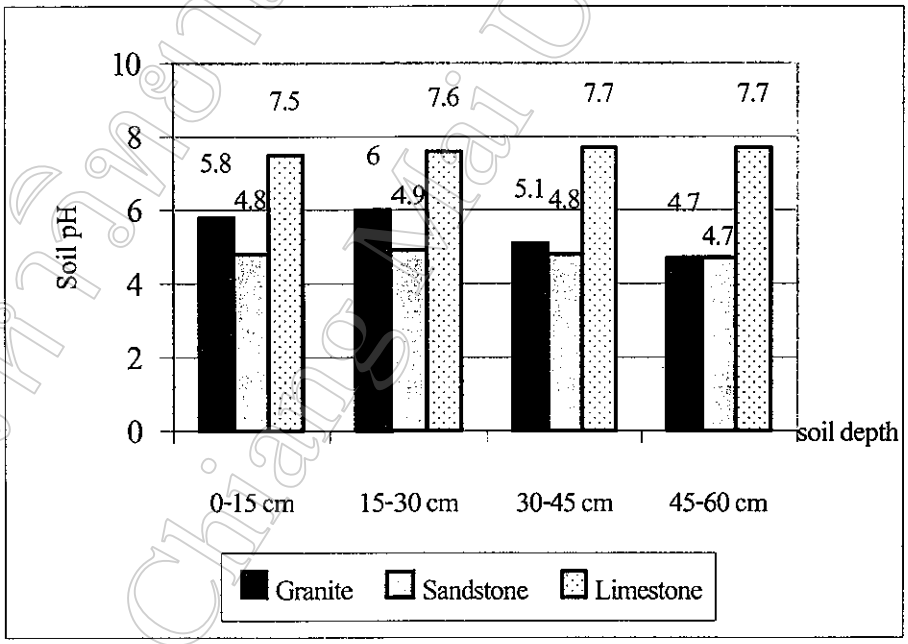


Figure 4.1 Soil pH at different soil depths of the three representative lychee orchards

1.2 Soil Nitrogen

Level of N in all soil types was slightly declining according to soil depth levels (Figure 4.2). Among all soil types, the greatest amount of N concentration was in limestone soil at 0 – 45 cm depth. However, N concentration of limestone soil was less than that of other four soil types.

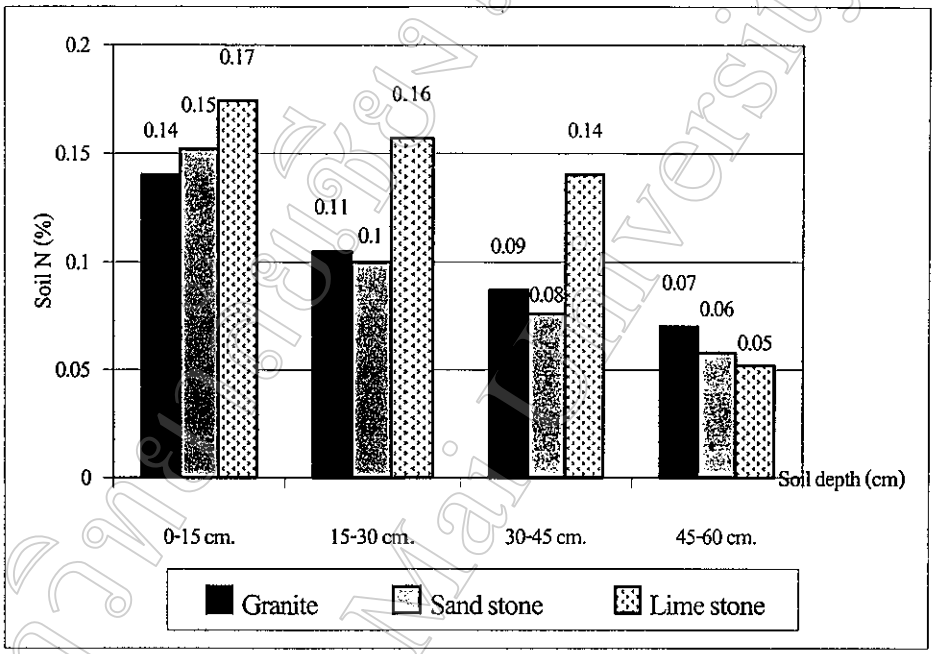


Figure 4.2 Nitrogen concentration at different soil depth of three different soil types

1.3 Soil Phosphorus

P concentrations in all soil type were very low (Figure 4.3). In granite and limestone soil types, P concentration decreased as soil depths increased. On the other hand, in sandstone soil type, P concentration was about 7.9 – 13.2 mg/kg DW at 0 – 30 cm soil depth. It was 14 mg/kg DW at 30 – 45 cm soil depth and then was 9.7 mg/kg DW at 45 – 60 cm soil depth. The greatest amount of P concentration in limestone soil type was at 0 – 15 cm soil depth. The lowest amount of P concentration, 1.3 mg/kg DW, was found in granite soil type at 30 – 45 cm soil depth.

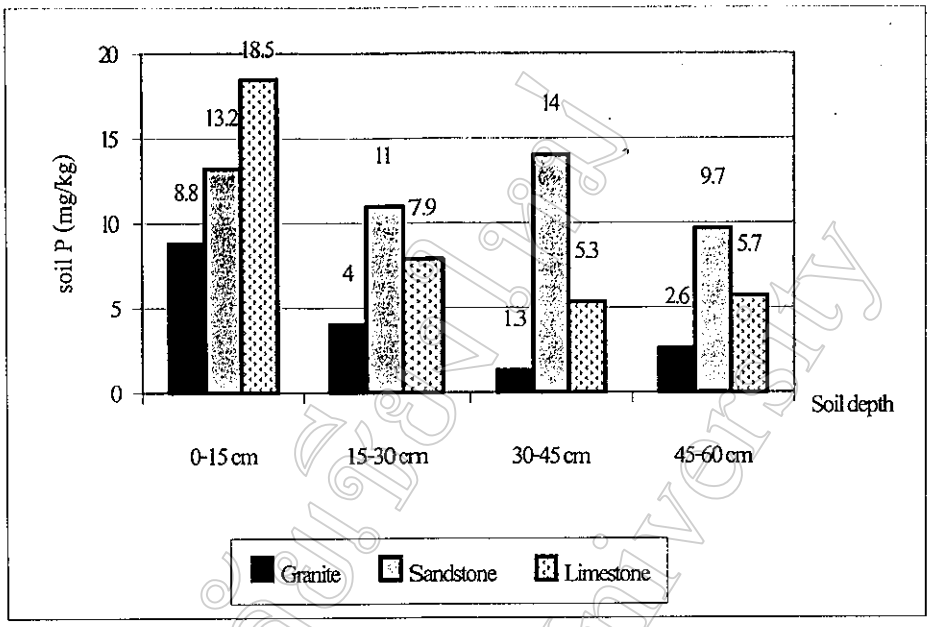


Figure 4.3 Phosphorus concentration at different soil depths of three different soil types

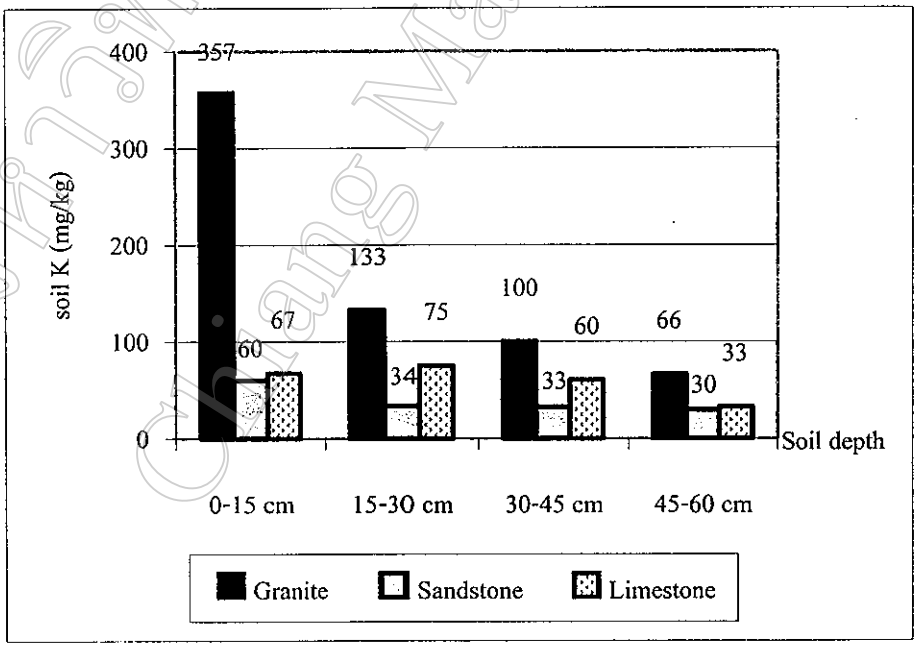


Figure 4.4 Potassium concentration at different soil depths of three different soil type

1.4 Soil Potassium

Granite soil type gave the greatest K concentration, 357 mg/kg DW, among others (Figure 4.4). However, K concentration was much lower at 15 – 60 cm soil depth, 66 – 133 mg/kg DW, than that of other depths. K concentration in sandstone and limestone soil types were very low, ranging from 30 – 60 mg/kg DW and 33 – 6 mg/kg DW, respectively.

1.5 Soil Calcium

The greatest concentration of Ca was found in limestone soil type, 4,600 – 5,500 mg/kg. Whereas in granite and sandstone was only 500 – 1,100 and 600 – 1,300 mg/kg DW, respectively (Figure 4.5)

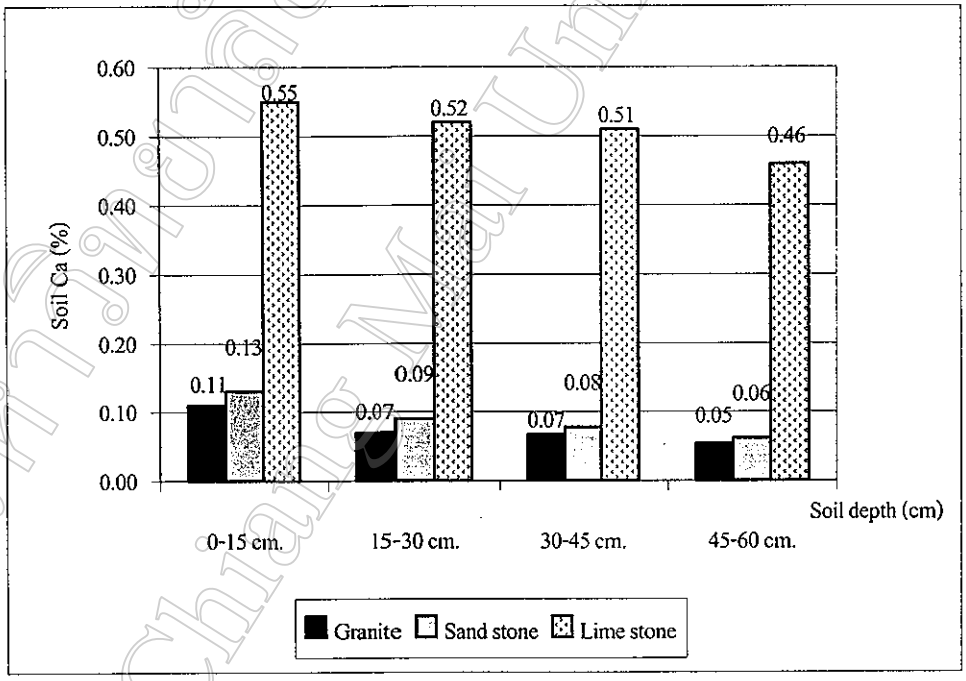


Figure 4.5 Calcium concentration at different soil depths of three different soil type

1.6 Soil Magnesium

Mg concentration in granite and limestone soil types were more than 100 mg/kg DW in all soil depths except for granite at 45 – 60 cm soil depth, it was 66 mg/kg DW (Figure 4.6). In sandstone soil type, Mg concentration was quite low, ranging from 45 – 77 mg/kg DW.

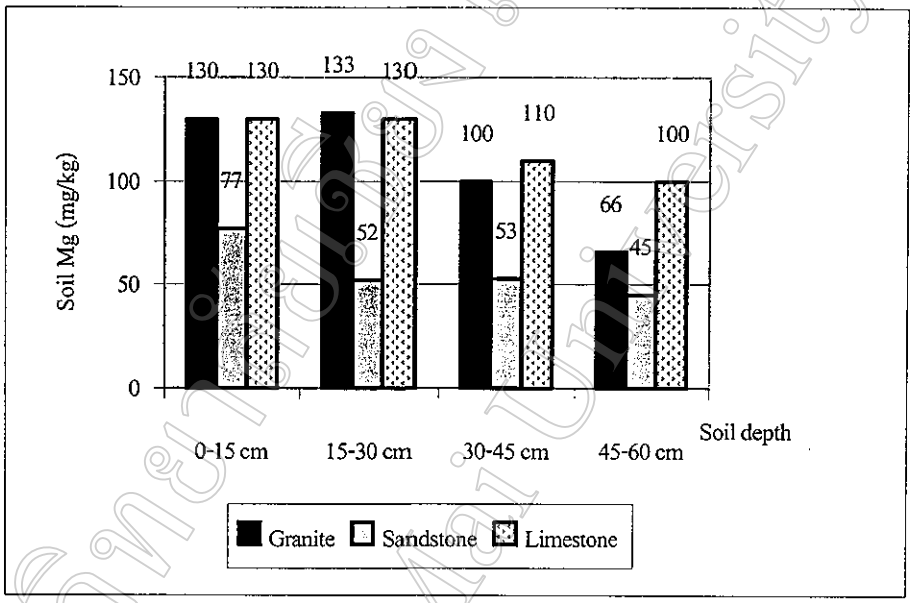


Figure 4.6 Magnesium concentration at different soil depths of three different soil types

1.7 Soil Manganese

The greatest concentration of Mn ,49 – 354 mg/kg DW, was found in sandstone soil type (Figure 4.7). Whereas in granite and limestone soil types, Mn concentrations were very low 20 – 59 and 11 – 16 mg/kg DW, respectively.

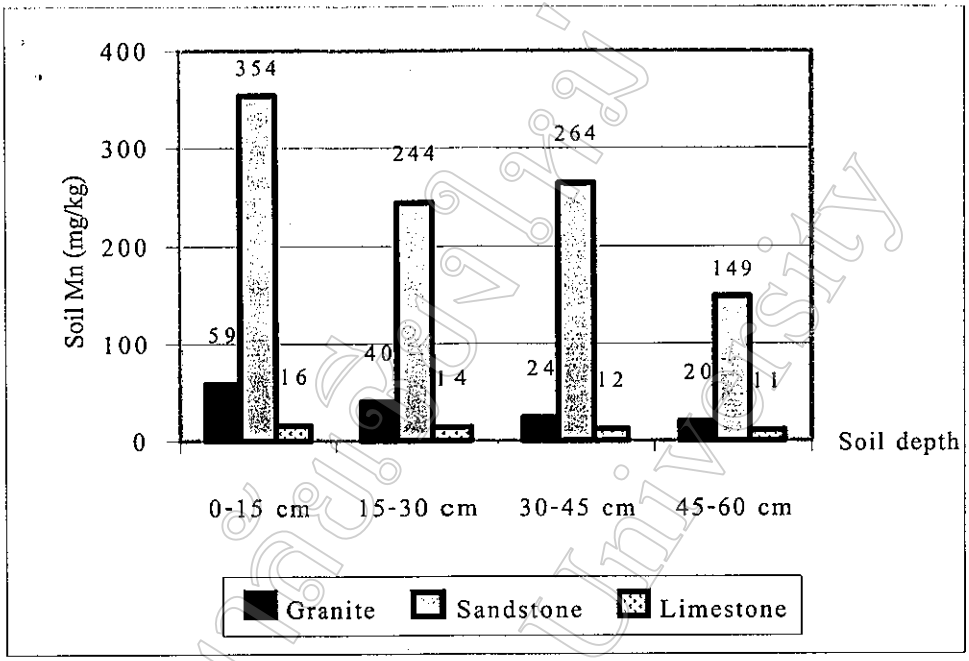


Figure 4.7 Soil Mn at different soil depths of the three representative lychee orchards

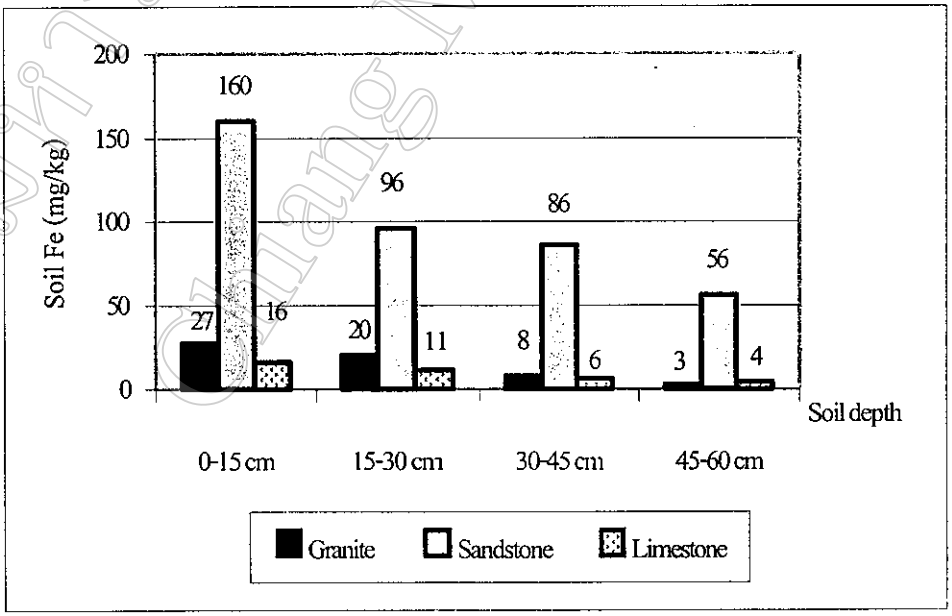


Figure 4.8 Soil Fe at different soil depths of the three representative lychee orchards

1.8 Soil Iron

The greatest concentration of iron, 56 – 160 mg/kg DW was found in sandstone soil type (Figure 4.8). Whereas in granite and limestone soil types, Fe concentration were low 3 – 27 and 4 – 16 mg/kg DW, respectively.

1.9 Soil Zinc

The greatest concentration of Zn, 11 mg/kg DW, was found in granite soil type at 0 – 15 soil depth, whereas at other soil depths, the concentration of Zn was very low, 0.1 – 0.8 mg/kg DW (Figure 4.9).

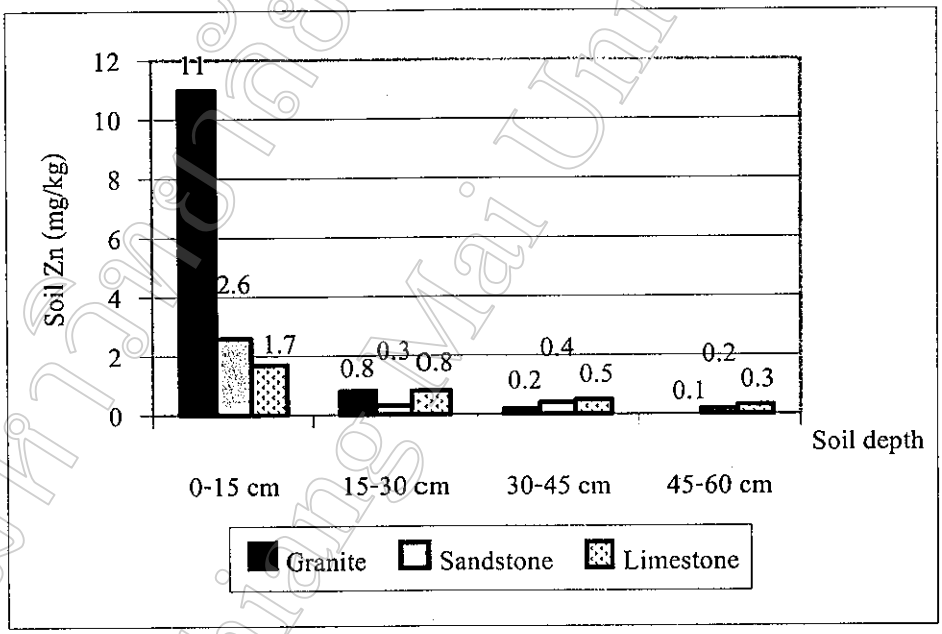


Figure 4.9 Soil Zn at different soil depths of the three representative lychee orchards

1.20 Soil Boron

Boron concentrations were very low in all soil types, 0.1 mg/kg DW (Figure 4.10). Only in sandstone at 0-15 cm soil depth and limestone at 15 – 30 cm, B concentrations of both were 0.2 mg/kg DW (Figure 4.10).

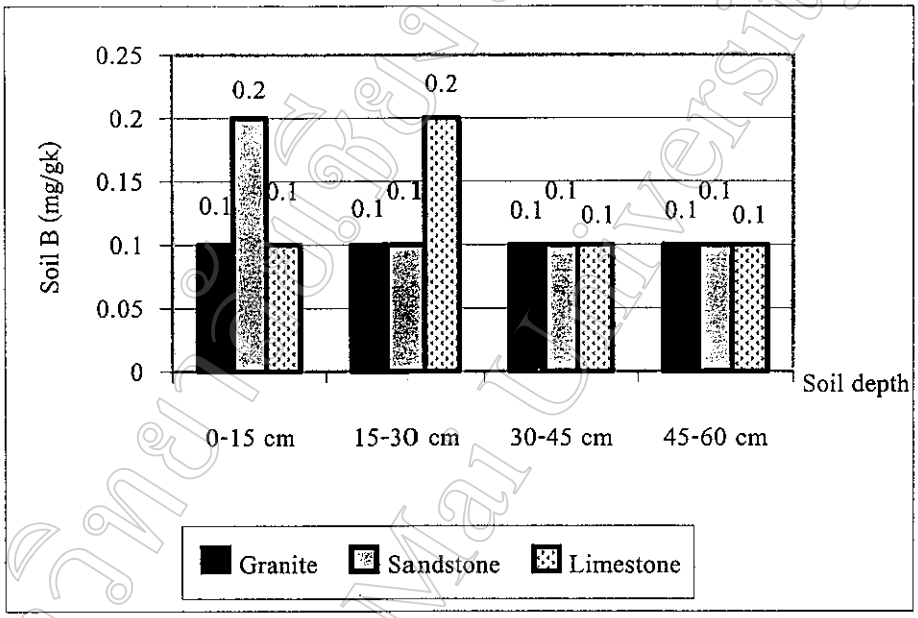


Figure 4.10 Soil B at different soil depths of the three representative lychee orchards

2. Nutrient concentration in lychee leaf

Lychee leaf analysis showed that concentration of nutrient varied depending on soil type (soil parent material). However, there was no significantly different in the amount of nutrient concentration of N, P, K, Mg, Zn and B in all soil types (Figure 4.11, 4.12). Only Ca, S, Mn and Fe were found that the nutrient concentrations were significantly different in particular soil types.

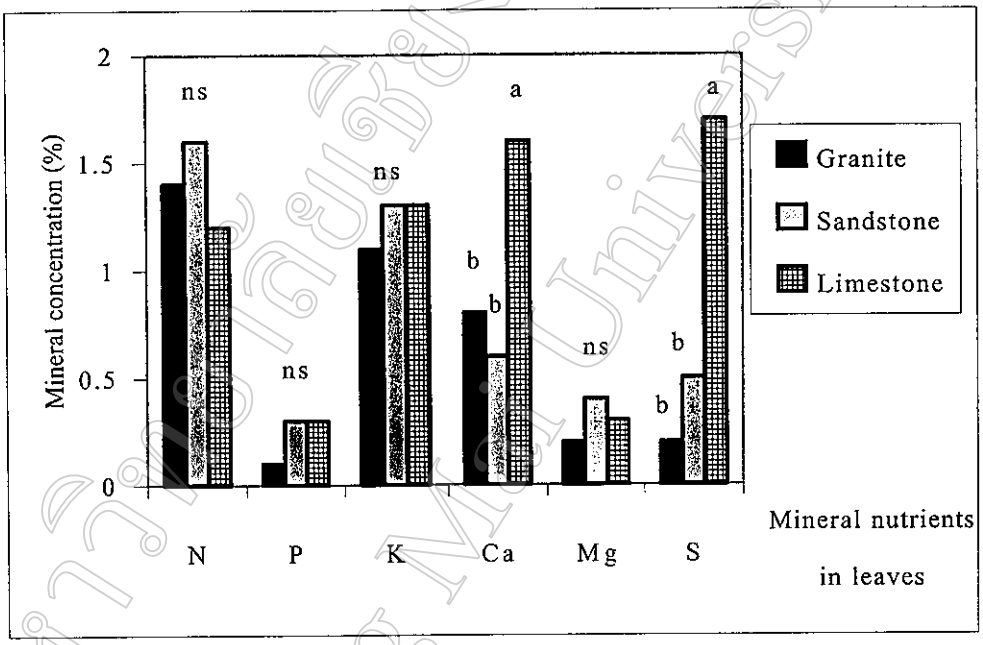


Figure 4.11 Macro- and micro-element concentration in lychee leaves at three different soil types

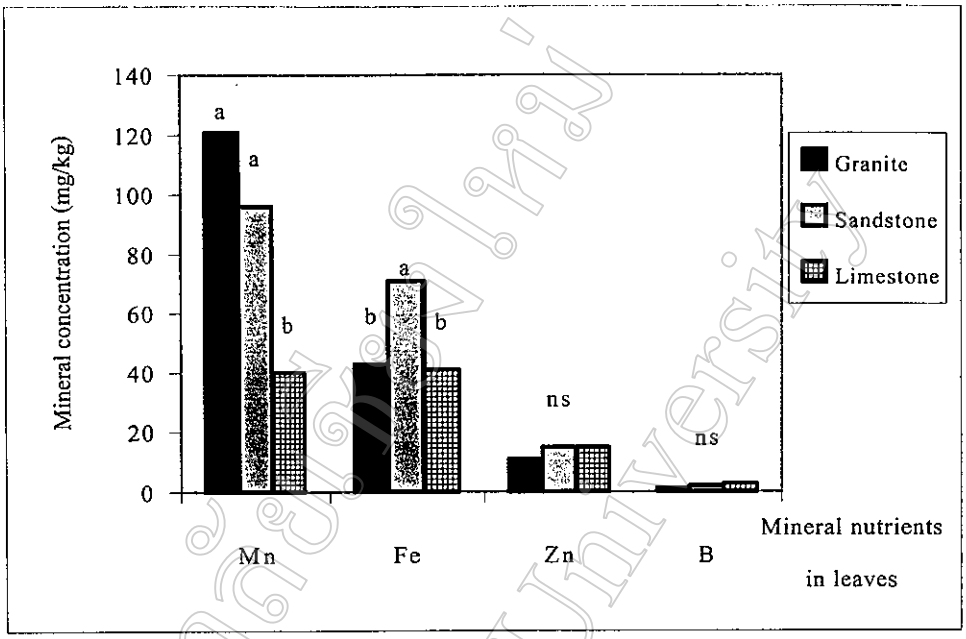


Figure 4.12 Trace elements, Mn, Fe, Zn and B concentration in lychee leaves at three different soil type

Ca concentration was greater in limestone than that of granite and sandstone soil type. This result was found to be similar to S concentration. On the other hand, Mn concentration was greater in granite and sandstone than that of limestone. Only Fe concentration was greater in sandstone than that of the other two soil types.

3. Comparison of the nutritional concentration in leaves at four cardinal points

Nutrient concentrations of leaves at different developmental stage (flowering, fruit set, mid-fruit development, late fruit development and fruit mature) and four cardinal points, north, south, east and west, were conducted.

The highest concentration of nutrient found in lychee leaves was nitrogen (Figure 4.13). The greatest amount of N was found at flowering stage and then it declined toward fruit maturation. Similar patterns of element concentration were also found in terms of P, Mg and B (Figure 4.13,4.14, 4.17 and 4.22).

However, some nutrient concentration trended to increase from flowering to fruit maturation. Those nutrients were K and Mn (Figure 4.15, 4.19).

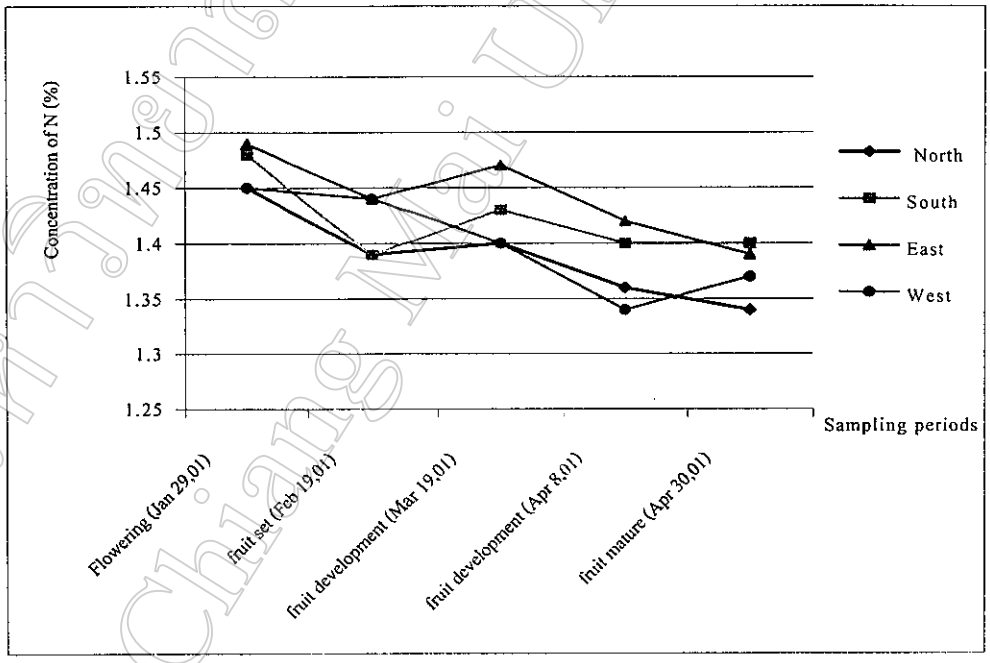


Figure 4.13 Nitrogen concentration of lychee leaves at different four cardinal points and sampling periods

3.2 Phosphorus content in lychee leaf

There was non significant effect of sampling points and sampling periods during fruit development on the level of phosphorus in lychee leaves. However, the data from analysis indicated that the level of P at four cardinal points was no significant difference as compared between flowering to fruit harvest. The pattern of P was slightly declined during the reproductive stage.

However, there was no different in level of P in each of sampled stage. Level of phosphorus ranged in 0.07 – 0.09%. The content of phosphorus presented in Figure 4.14.

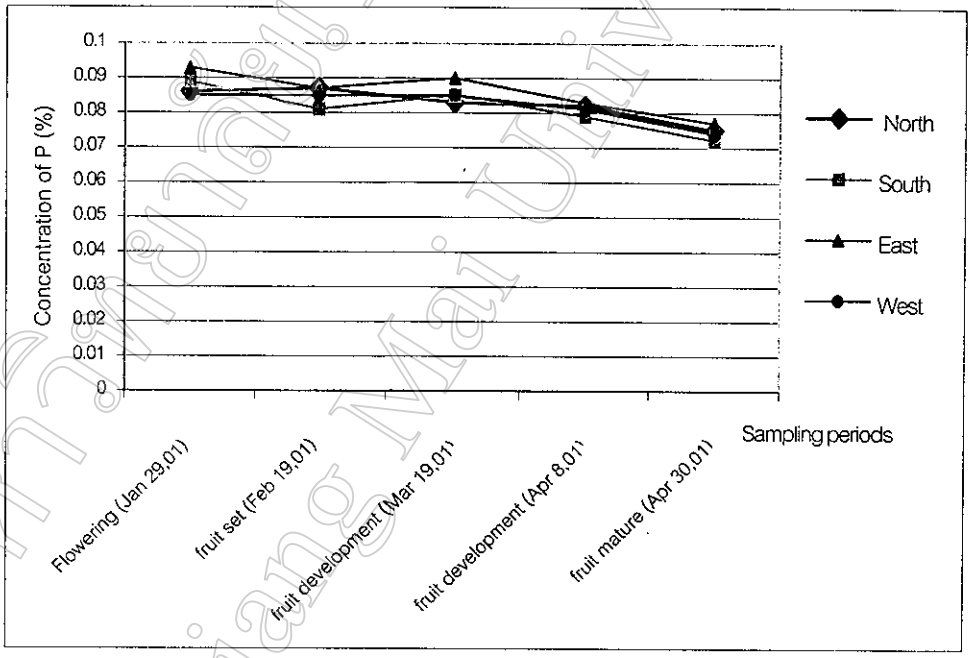


Figure 4.14 Phosphorus concentration of lychee leaves at different four cardinal points and sampling periods

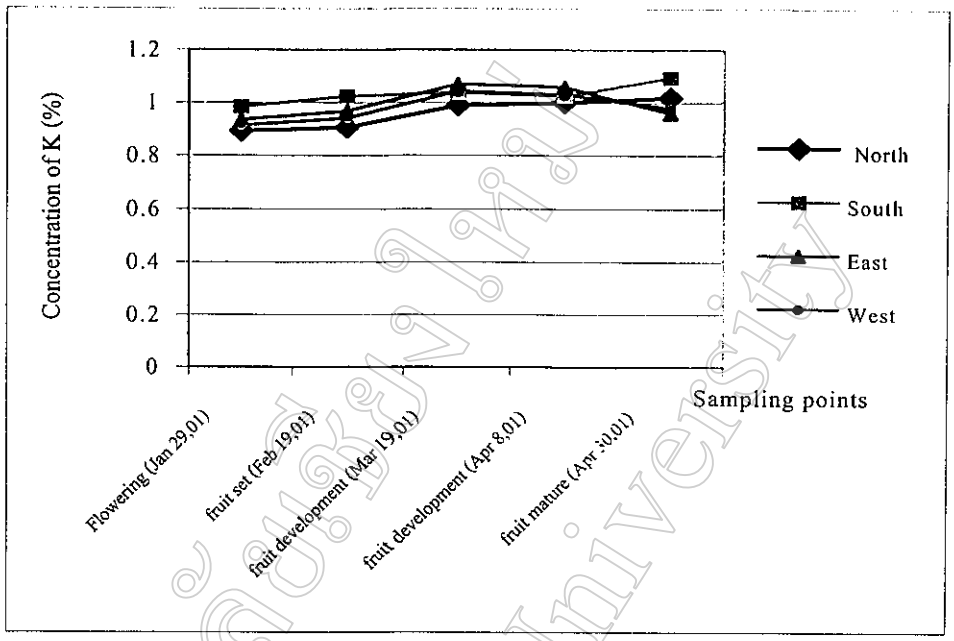


Figure 4.15 Concentration of lychee leaves K at different four cardinal points and sampling periods

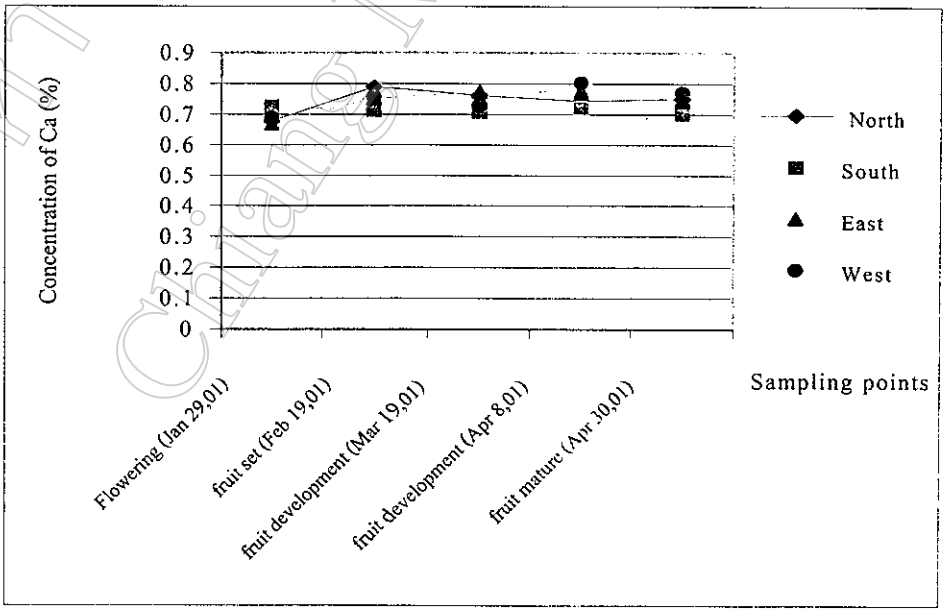


Figure 4.16 Concentration of lychee leaves Ca at different four cardinal points and sampling periods

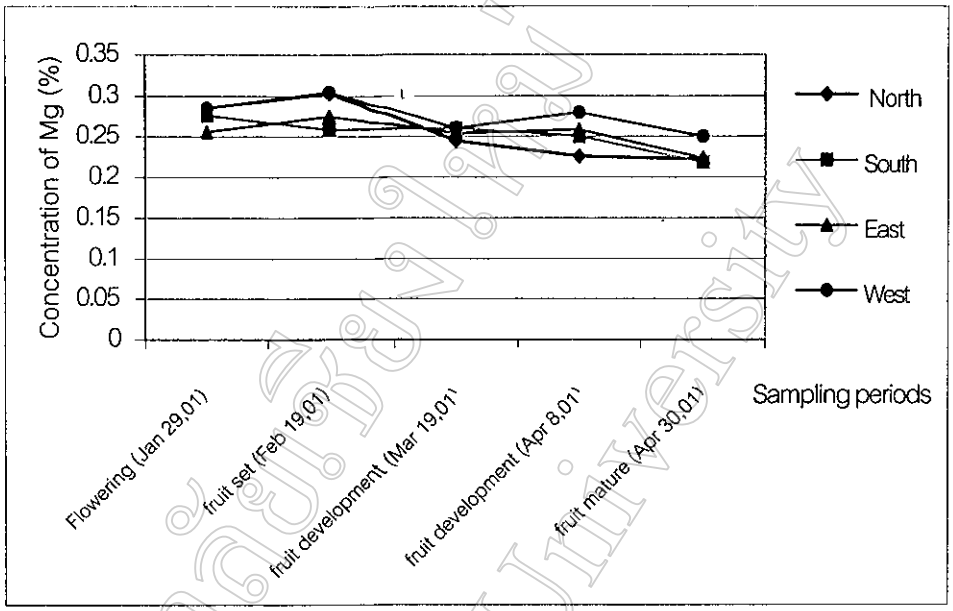


Figure 4.17 Concentration of lychee leaves Mg at different four cardinal points and sampling periods

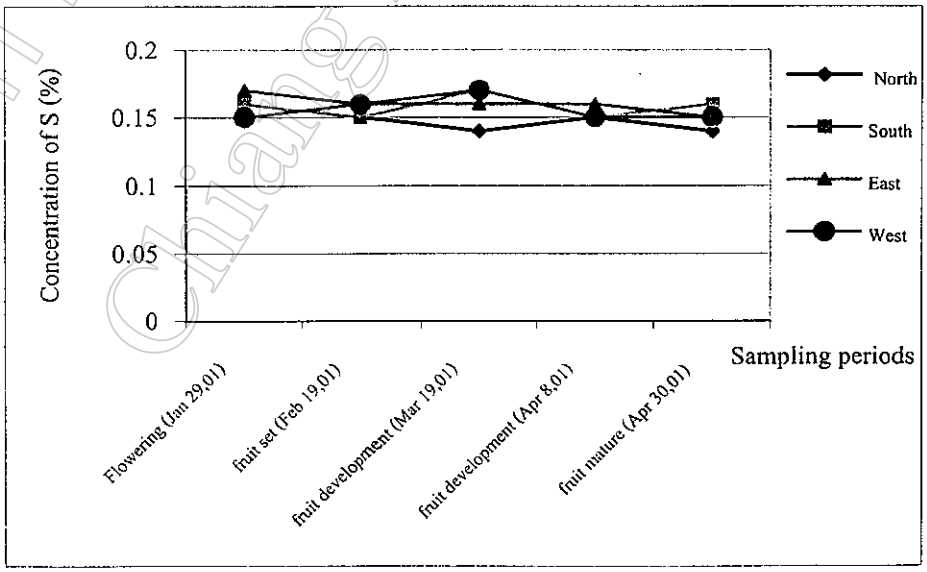


Figure 4.18 Concentration of lychee leaves S at different four cardinal points and sampling periods

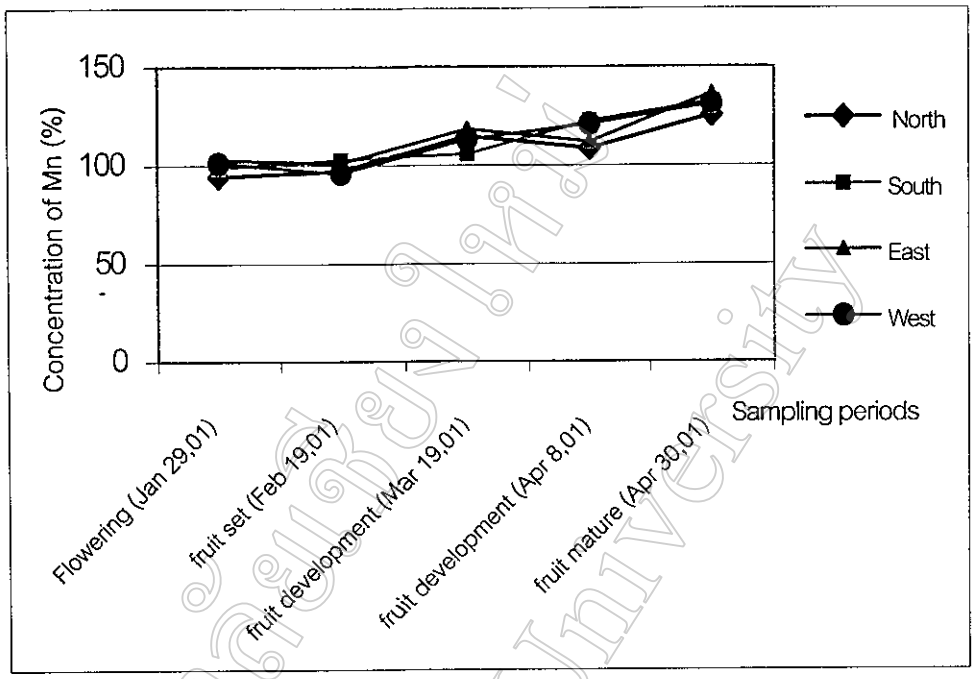


Figure 4.19 Concentration of lychee leaves Mn at different four cardinal points and sampling periods

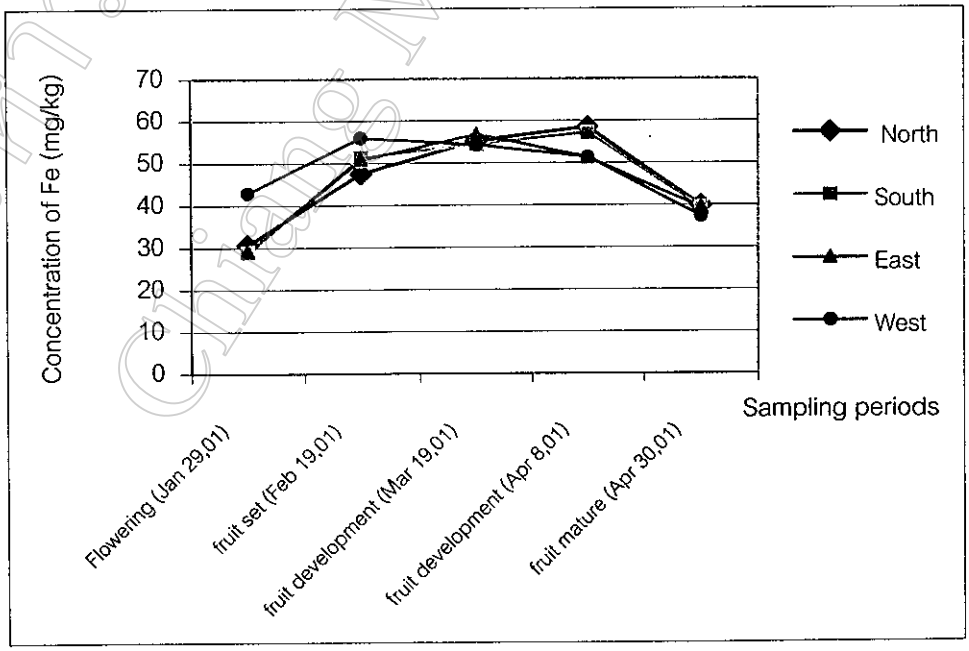


Figure 4.20 Concentration of lychee leaves Fe at different four cardinal points and sampling periods

Concentration of Zn fluctuated. It was 12 mg/kg DW at flowering stage, and then decreased to approximately 8 mg/kg DW at fruit set. However, concentration of Zn was 12 mg/kg at mid fruit development and then it was 6 mg/kg DW at late fruit development. At the final stage of fruit maturation, the concentration of Zn was 9 mg/kg DW (Figure 4.21).

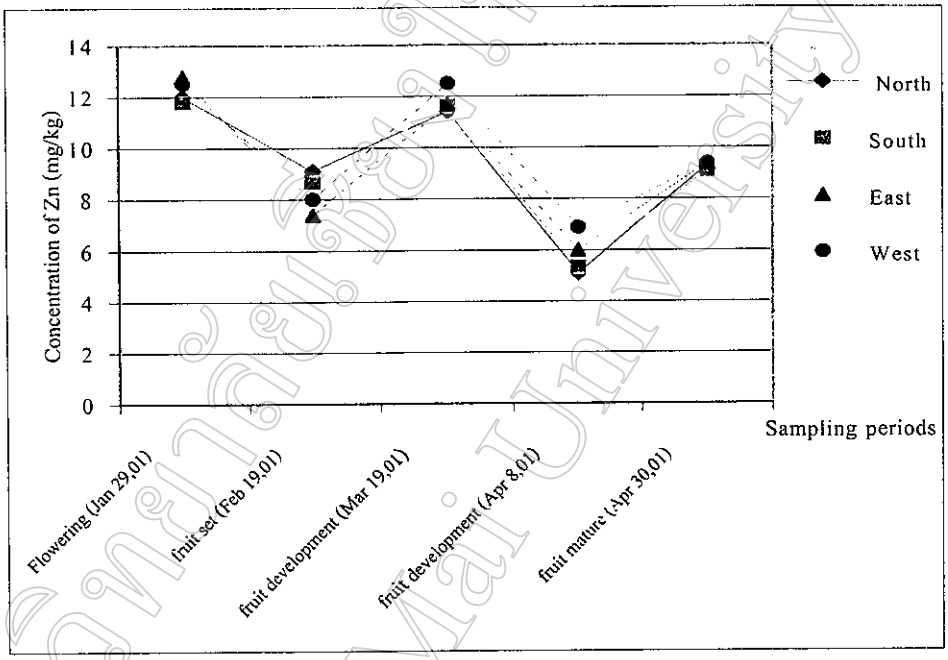


Figure 4.21 Concentration of lychee leaves Zn at different four cardinal points and sampling periods

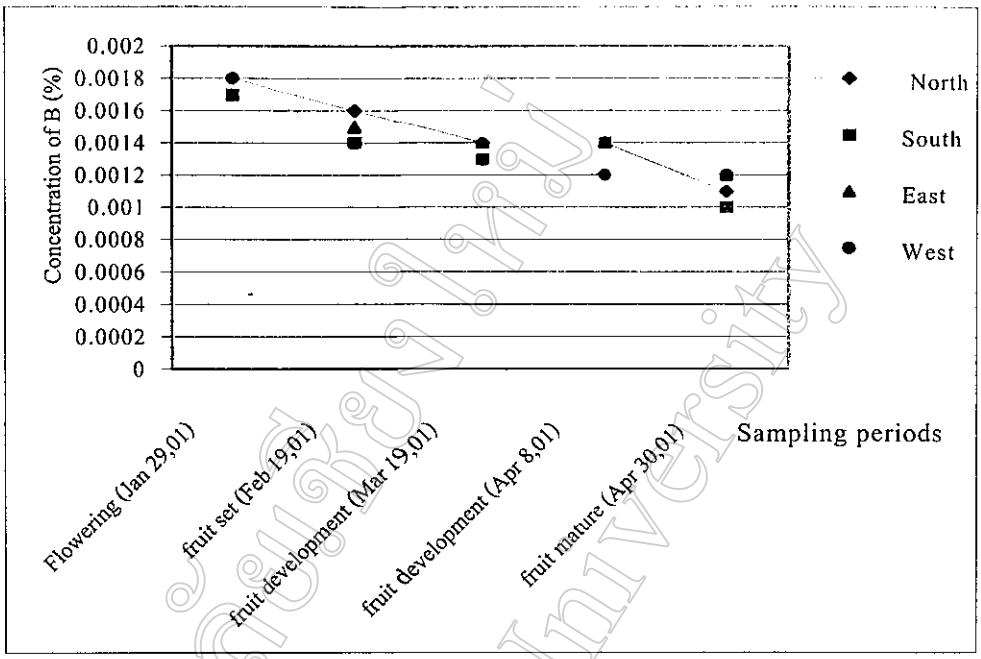


Figure 4.22 Concentration of lychee leaves B at different four cardinal points and sampling periods

4. Analysis of fruit quality at different four cardinal points

No significantly difference was found in terms of fruit color, size, weight, TSS and TA in all four different cardinal points.

4.1 Fruit color of lychee

The values L (brightness) were 78.66, 79.20, 79.18 and 78.19 in the north, south, east and west, respectively. In addition, the values a* and b* were similar status with value L. The values a* of lychee color were 8.66, 11.46, 9.65 and 10.51 and values b* were 2.37, 0.15, 1.26 and 1.44 in the north, south, east and west, respectively (Figure 4.23).

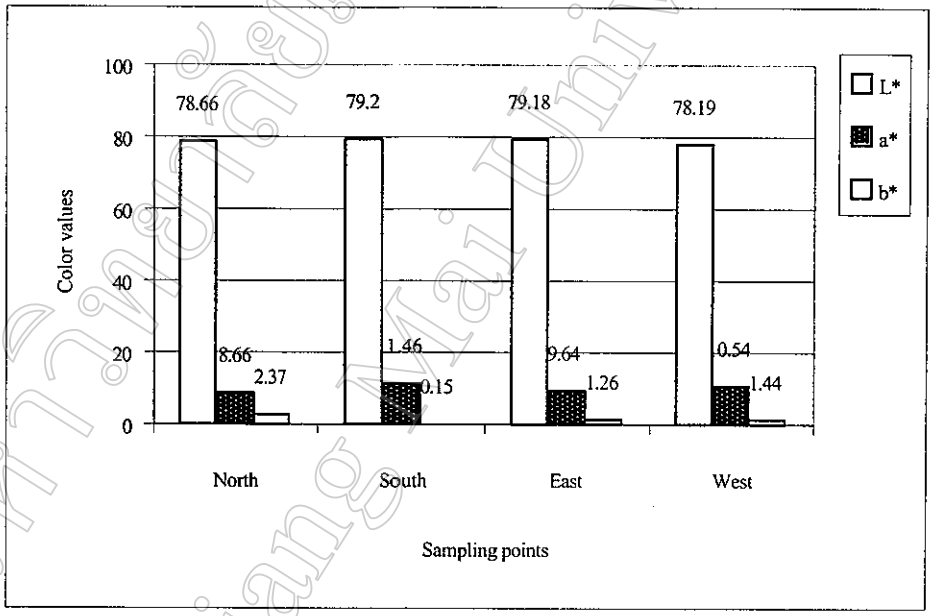


Figure 4.23 The color of lychee fruits at four cardinal points

4.2 Fruit size of lychee

The widths of lychee fruits at four cardinal points were 2.78, 2.73, 2.92 and 2.89 cm in the north, south, east and west, respectively. The Lengths of lychee fruits were 3.27, 3.72, 3.20 and 3.34 cm the north, south, east and west, respectively. For fruit weight, the average weight per fruits were 16.46, 16.03, 16.28 and 16.24 in the north, south, east and west, respectively. (Figure 4.24).

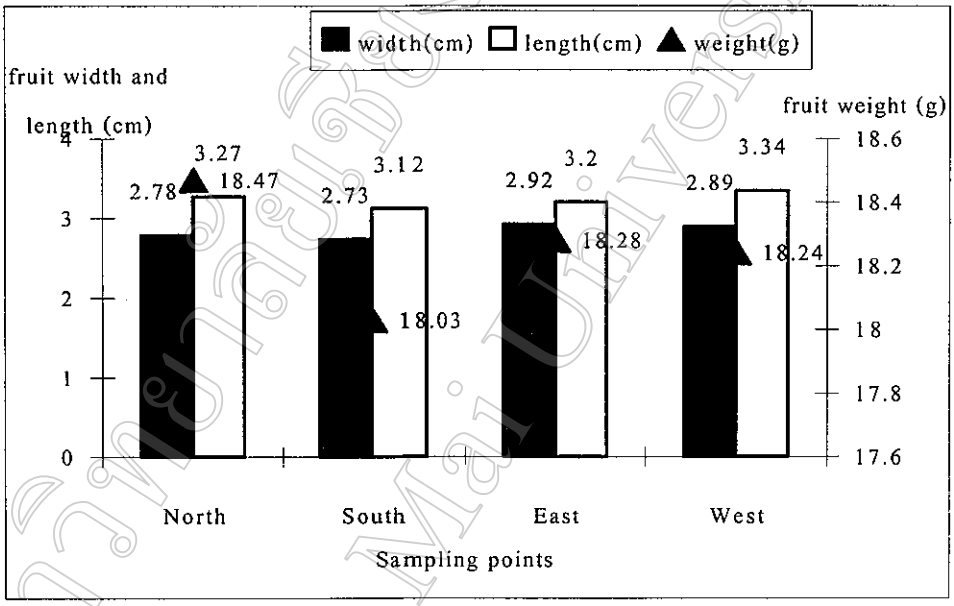


Figure 4.24 Fruit size and weight per fruit of lychee at four cardinal points

4.3 Fresh and dry weight of fruit parts at different four cardinal points.

Propotion of fruit fresh weight indicated that more than 70% of fruit was aril and less than 30% were seed and peel. The ratio of fresh and dry weight per fruit was 4.7: 1. The data of fruit proportion were presented in table 4.1.

Table 4.1 Fruit proportion and ratio of fresh per dry weight of lychee at four cardinal points

Sampling points	Fruit parts (g)						Fresh : dry ratio
	seed		peel		aril		
	fresh	dry	fresh	dry	fresh	dry	
North	2.53	1.77	2.17	0.77	13.77	1.44	4.64:1
South	2.80	1.73	2.32	0.76	12.91	1.38	4.66:1
East	2.67	1.70	2.16	0.75	13.45	1.41	4.73:1
West	3.08	1.72	2.26	0.77	12.90	1.40	4.69:1
Sig.	ns	ns	ns	ns	ns	ns	

4.4 Total soluble solid (TSS) and Titratable acid (TA) of lychee fruit

TSS of lychee fruit in east side slightly greater than others but there was not significant different. The levels of TSS were 14.03, 14.83, 16.36 and 15.18 ^{0}Brix in the north, south, east and west, respectively.

In the case of titratable acid (TA), the citric acid was determined and calculated for this value. The levels of TA were 0.51, 0.52, 0.58 and 0.61 percent in the north, south, east and west, respectively (Figure 4.25).

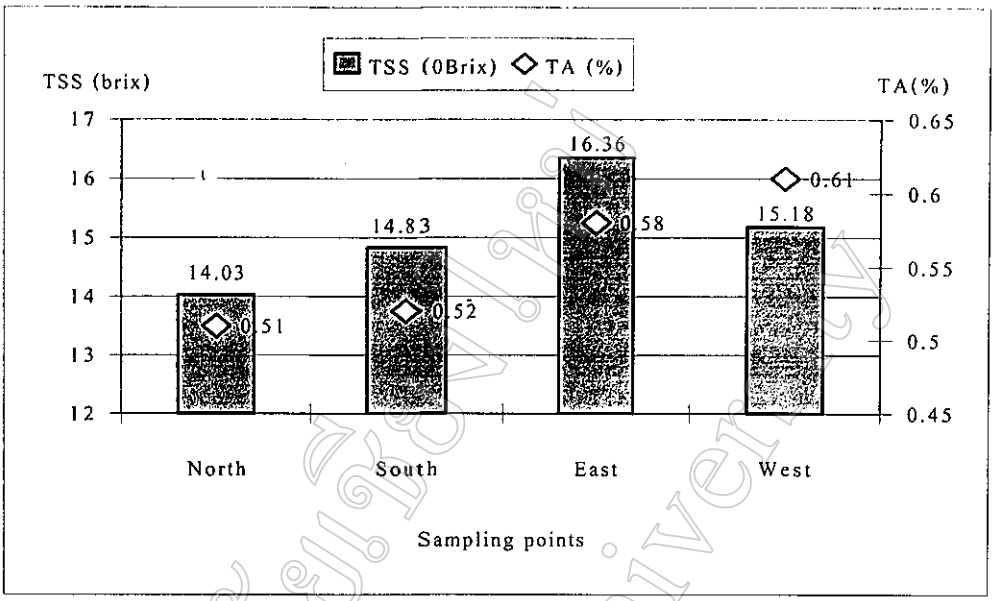


Figure 4.25 Total soluble solid and titratable acid of lchee fruit at different four cardinal points

4.5 Nutritional concentration of fruit parts at four cardinal points

There was no significantly different in terms of nutrient concentration in all four different cardinal points.

4.5.1 Nitrogen concentration

The results of fruit analysis showed the nitrogen concentration in aril was greater than in peels and seeds. In arils, the levels of nitrogen were 1.19, 1.17, 1.17 and 1.23% in the north, south, east and west, respectively. The nitrogen concentration in seed were 0.97, 0.97, 0.99 and 0.97 % and in peels were 1.11, 1.03, 1.03 and 1.03 % in the north, south, east and west, respectively (Figure 4.26)

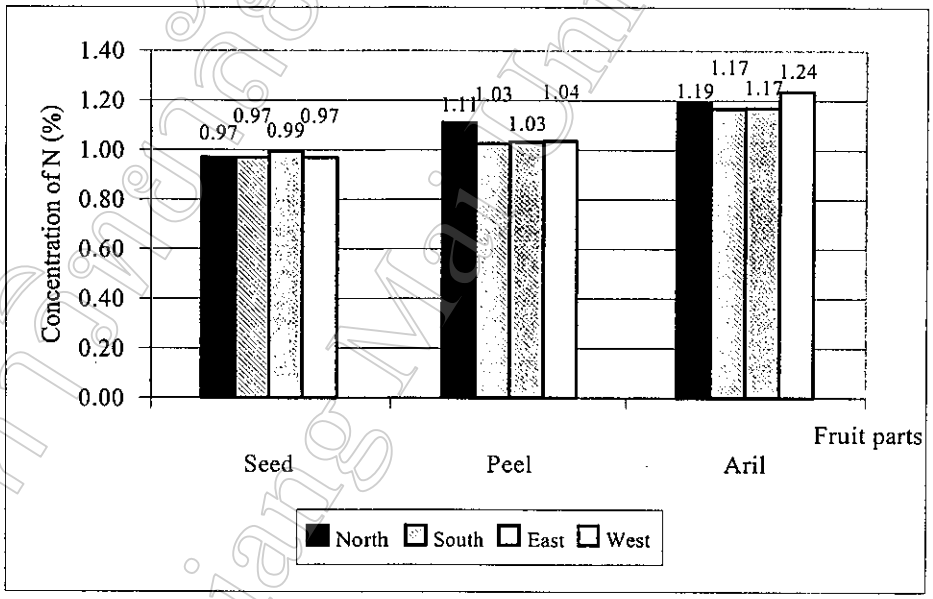


Figure 4.26 Nitrogen concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

4.5.2 Phosphorus concentration

The greatest phosphorus concentration in different fruit parts at four cardinal points was in aril. The level of this nutrient in aril were 0.14, 0.14, 0.13 and 0.14% in the north, south, east and west, respectively. In lychee seed, the level of phosphorus were 0.11, 0.11, 0.11 and 0.11 %. The lowest amount was found in peel, 0.08, 0.08, 0.08 and 0.07 % in the north, south, east and west, respectively (Figure 4.27)

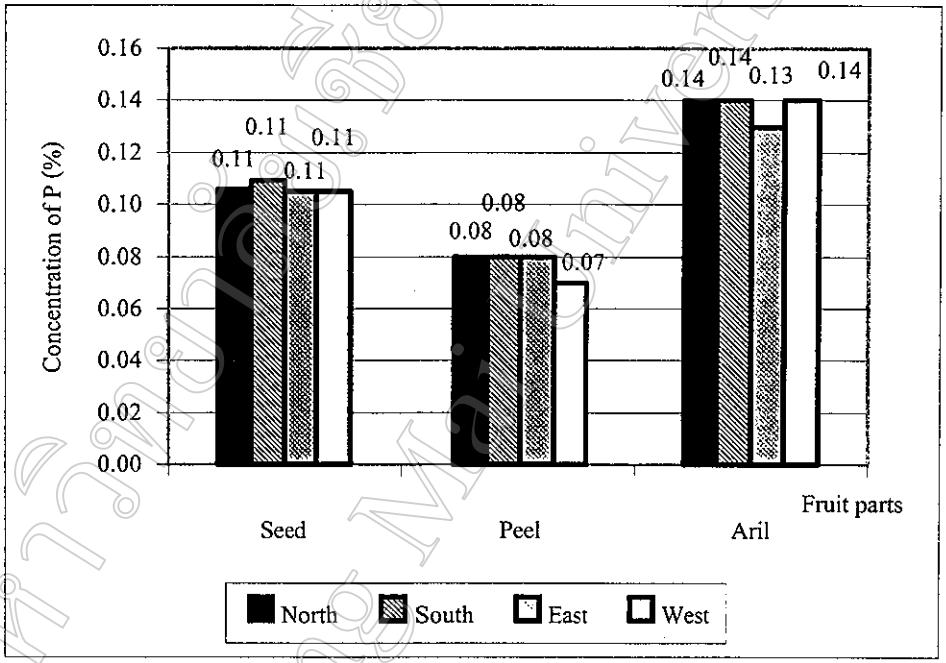


Figure 4.27 Phosphorus concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

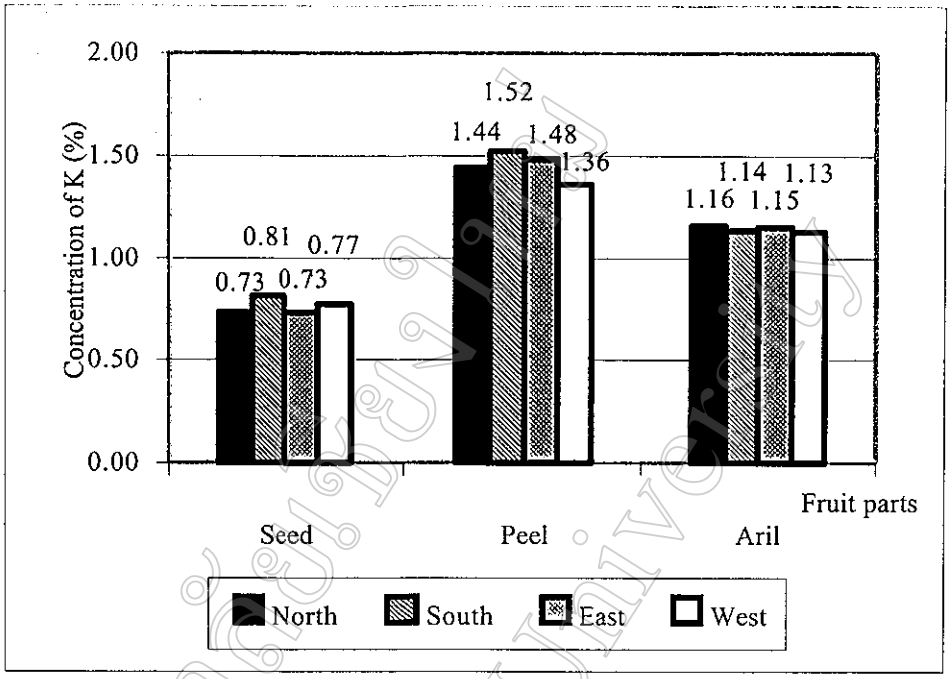


Figure 4.28 Content of K in the seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

4.5.3 Potassium concentration

Potassium concentration was greater in peel than in aril and seed. In seed, potassium concentrations were 0.73, 0.81, 0.73 and 0.77%, in peel were 1.44, 1.52, 1.48 and 1.36% and in aril were 1.16, 1.14, 1.15 and 1.13% in the north, south, east and west, respectively (Figure 4.28)

4.5.4 Calcium concentration

The greatest amount of calcium concentration was found in fruit peels, 0.079, 0.065, 0.072 and 0.077% in the north, south, east and west, respectively. In seeds, calcium concentration at four cardinal points were 0.04, 0.04, 0.05 and 0.04% in the north, south, east and west, respectively. In addition, calcium concentration in aril was lower than those of others.

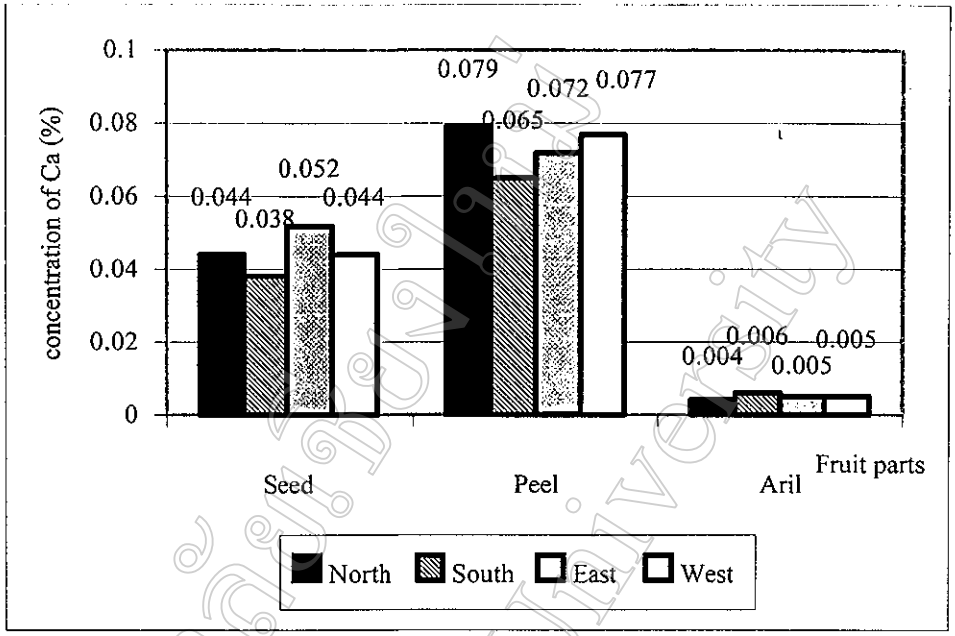


Figure 4.29 Calcium concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

4.5 Magnesium concentration

The levels of magnesium in peel were 0.32, 0.26, 0.34 and 0.10% in the north, south, east and west, respectively. The nutritional status of magnesium on west side was the lowest (0.1%) as compared with others. Magnesium concentrations in seeds were 0.06, 0.06, 0.07 and 0.07%, in arils were 0.05, 0.04, 0.05 and 0.05% in the north, south, east and west, respectively. (Figure 4.30)

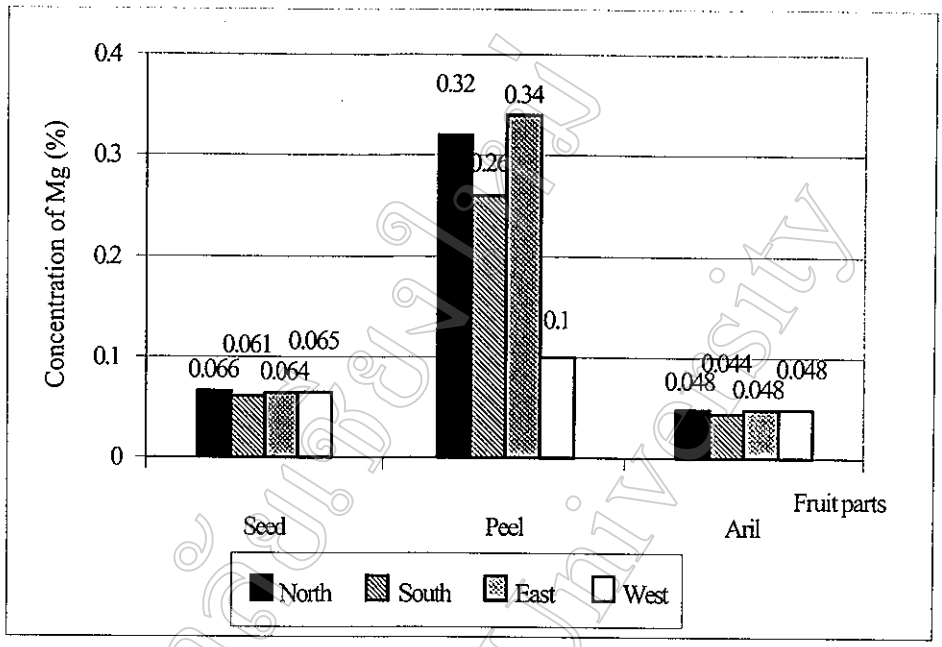


Figure 4.30 Magnesium concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

4.4.6 Sulfur concentration

Sulfur concentrations in seed were 0.09, 0.09, 0.10 and 0.12% in the north, south, east and west, respectively. In peels, the levels of sulfur were 0.07, 0.06, 0.06 and 0.07%, in arils were 0.11, 0.10, 0.10 and 0.11% in the north, south, east and west, respectively (Figure 4.31)

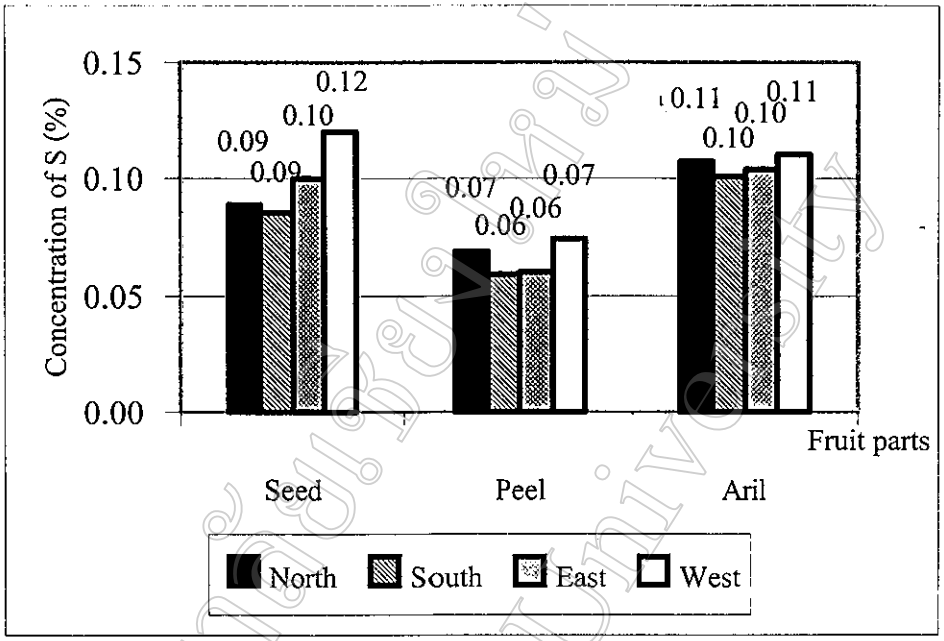


Figure 4.31 Sulfur concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

4.7 Manganese concentration

Manganese concentrations in seeds and arils were lower than in peel. In peel, the level of manganese were 57,4, 49,0, 54,4 and 64,6 mg/kg DW in the north, south, east and west, respectively. Manganese concentrations in seed were 6.0, 5.0, 6.1 and 5.8 mg/kg DW, in arils were 4.0, 1.0, 1.0 and 3.0 mg/kg DW in the north, south, east and west, respectively. (Figure 4.32).

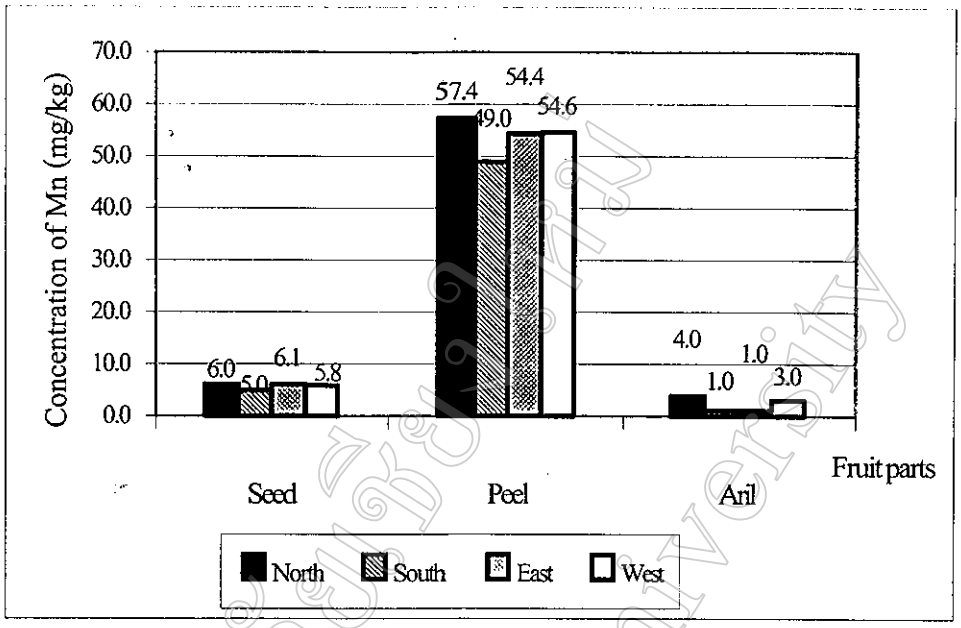


Figure 4.32 Manganese concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

4.8 Iron concentration

Iron concentration in aril at four cardinal points was greater than those in seed and peel. The values in aril ranged from 28.0 – 33.0 mg/kg DW. In seed, the concentration ranged from 14.4 – 17.0 mg/kg DW. In peels ranged from 18.2 – 26.6 mg/kg DW. (Figure 4.33).

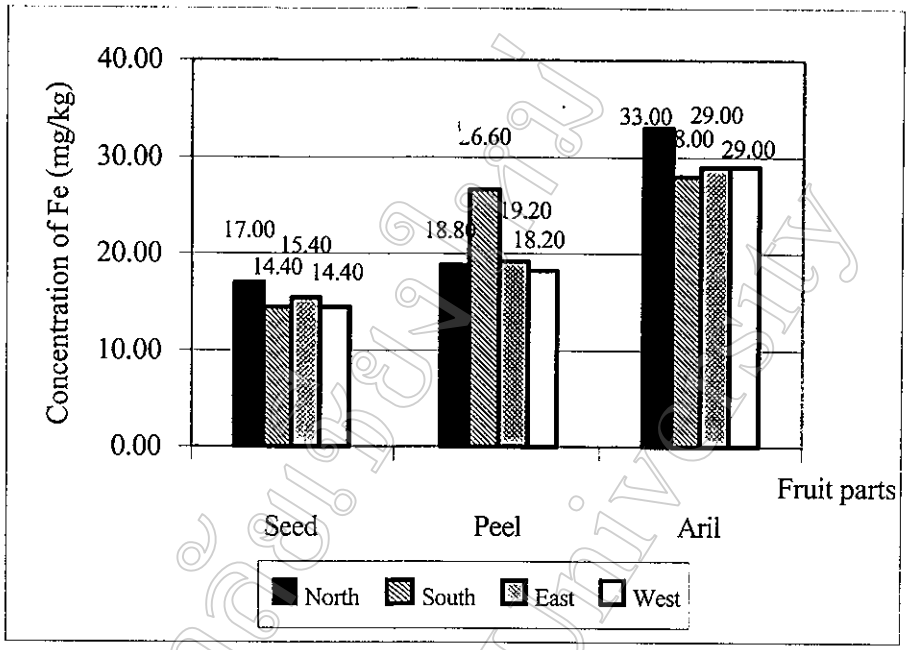


Figure 4.33 Iron concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

4.9 Zinc concentration

Zinc concentrations in each part of fruits ranged from 8.6 – 12.4 mg/kg DW. In seed the level of this nutrient slightly greater than in other parts (Figure 4.34).

4.10 Boron concentration

Boron concentration in lychee seed sampled at four cardinal points was around 0.001 mg/kg DW which was in the same range as in peels, 0.001 – 0.002 mg/kg DW. The greatest concentration was found in aril, 0.007 – 0.008 mg/kg DW (Figure 4.35).

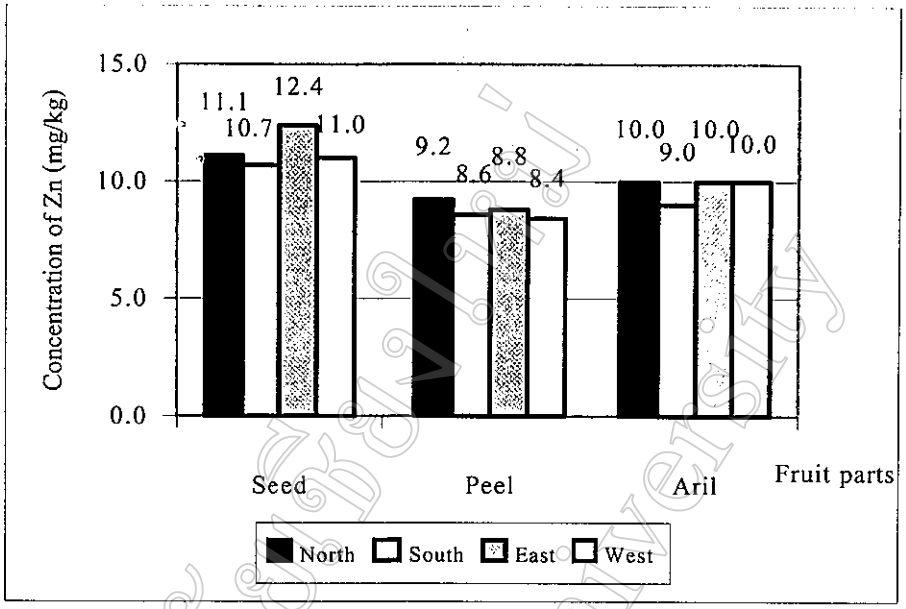


Figure 4.34 Zinc concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

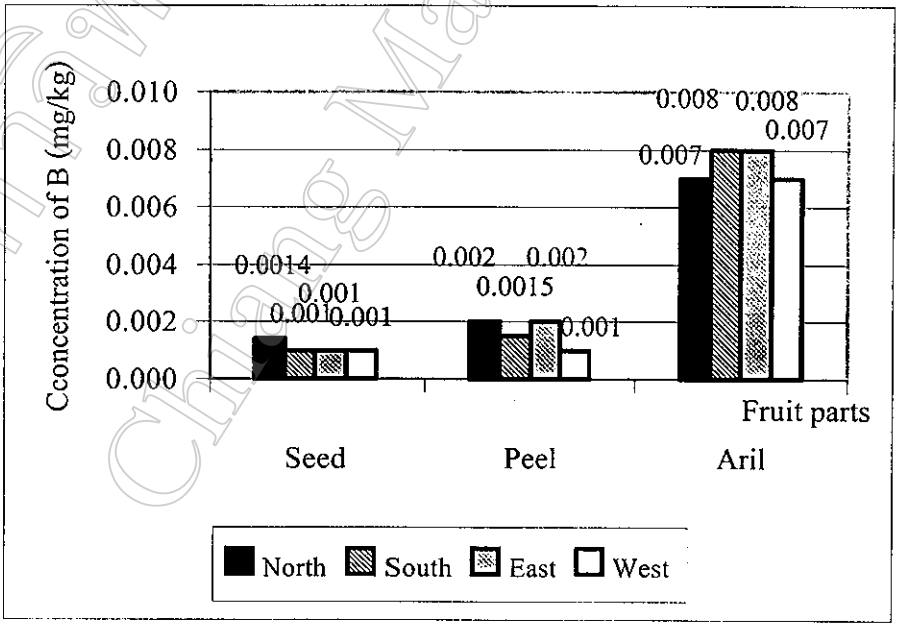


Figure 4.35 Boron concentration in seed, peel and aril of lychee fruit at different sampling points (North, South, East and West)

5. The Relationship of nutritional concentration in soil, lea and fruit of lychee

The coefficient of determination (R^2) represented the proportion of variation in the dependent variable that had explained of account for by the regression line. R^2 indicated the proportion of total variation that was explained by the regression line. Thus R^2 was a relative measure of the goodness of fit of the observed data points to the regression line. For example, if R^2 was calculated and found that R^2 =0.70, this means that 70% of the total variation in the observed values of Y is explained by X . Some applications require R^2 of at least 0.7 or 0.8, whereas R^2 of < 0.25, which corresponds to an R < 0.5, would never be acceptable. Figure 4.36 showed that concentration of N, Mg and Fe in leaf and fruit closely correlated with concentration in soil (R^2 > 0.9). In contrast, P, K, Ca, Zn and B had less correlation that values R^2 was less than 0.9. In addition, fruit nutrient concentrations had less in correlation with that of leaves. (R^2 < 0.9).

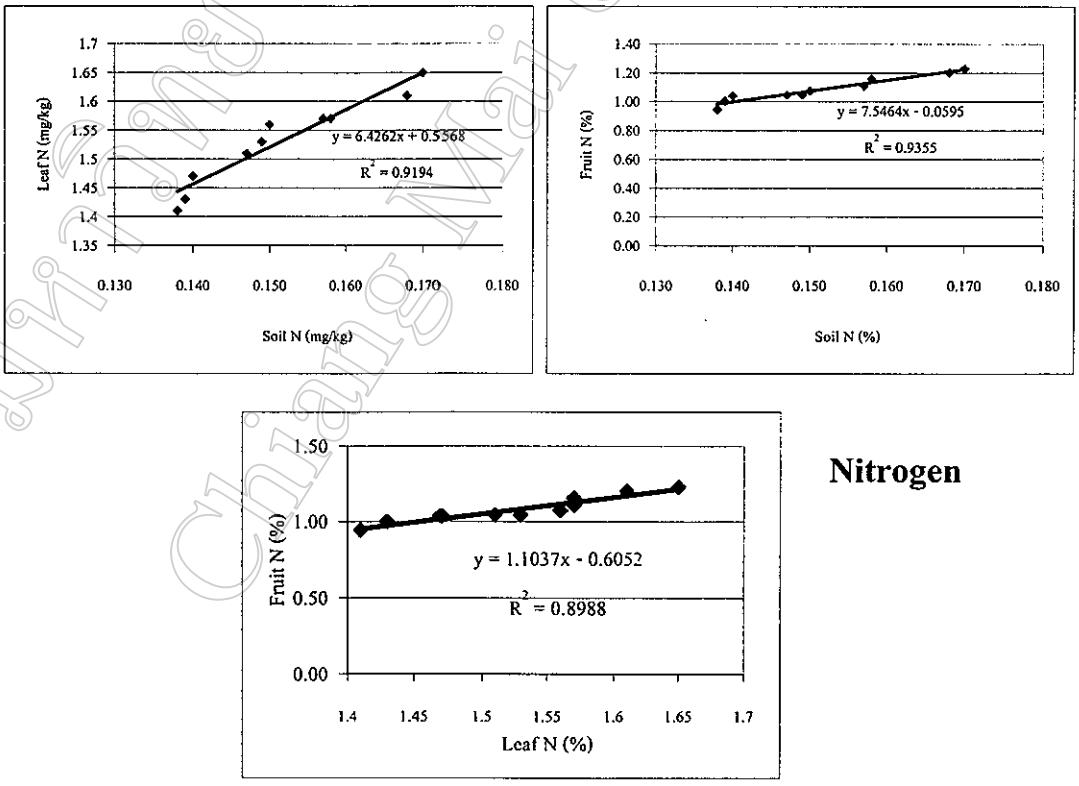
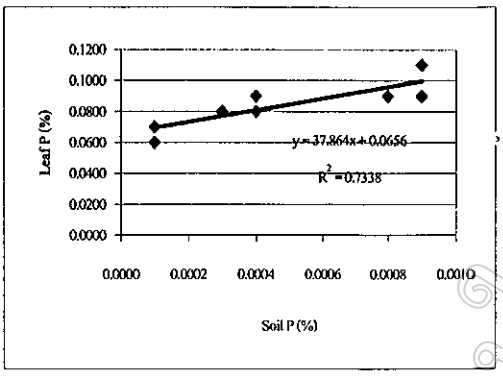
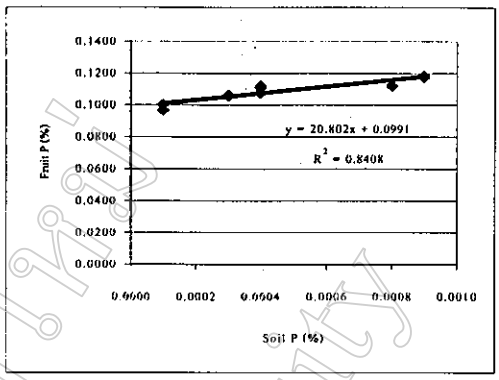
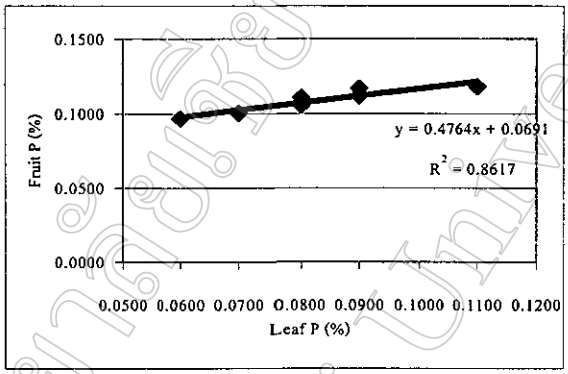


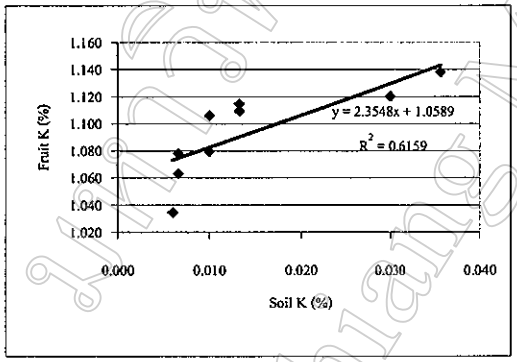
Figure 4.36 The relationship between the content of nutrients in soil, leaf and fruit of lychee.

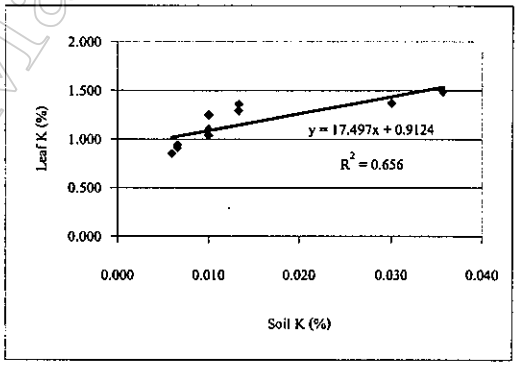


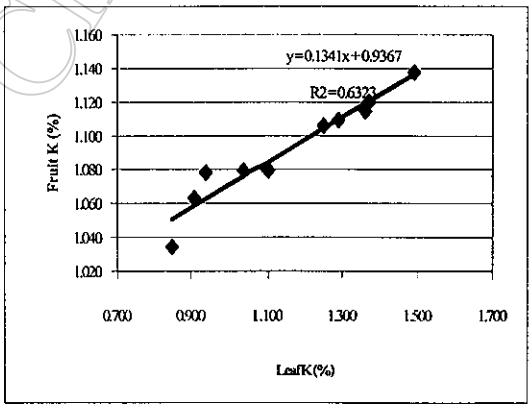




Phosphorus

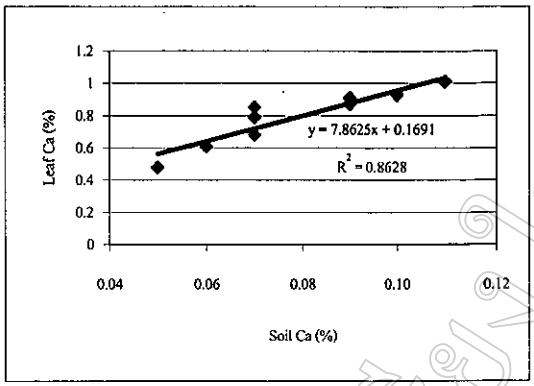


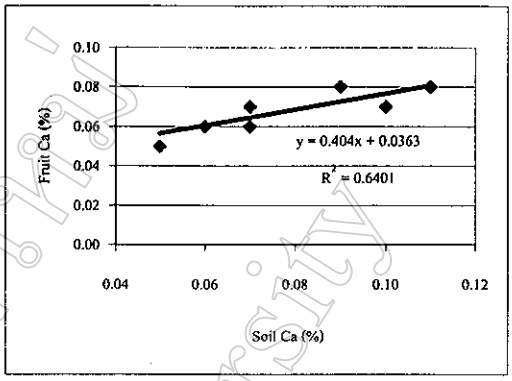


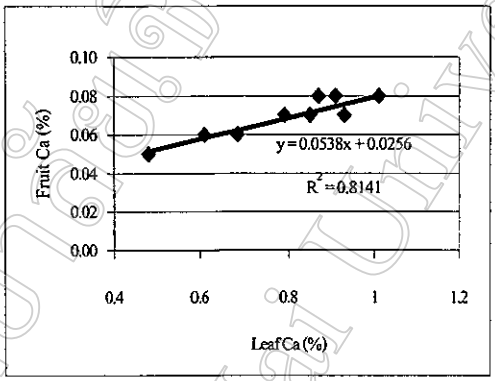


Potassium

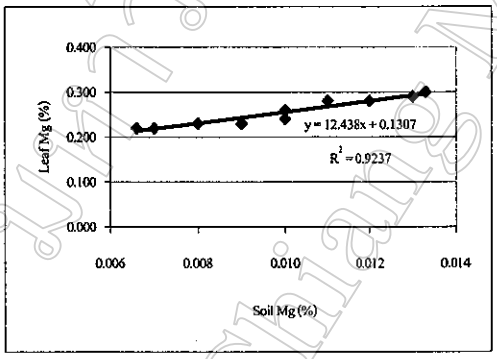
Figure 4.36 (continued)

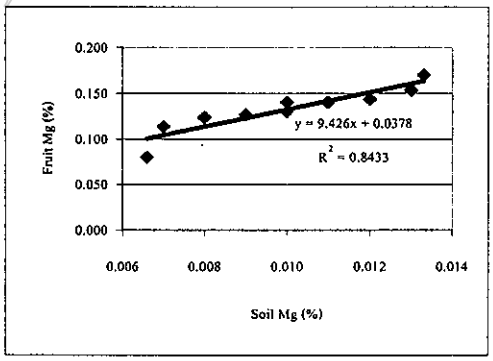


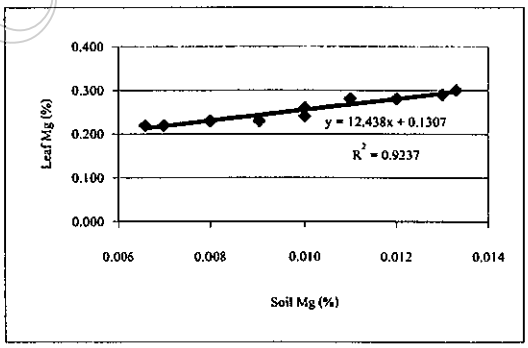




Calcium

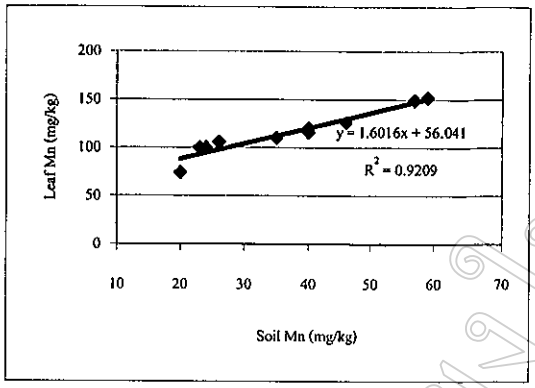


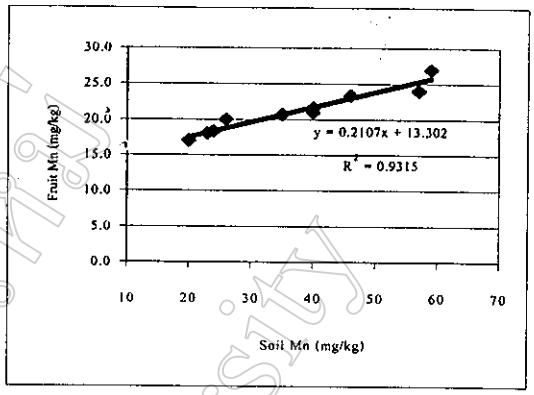


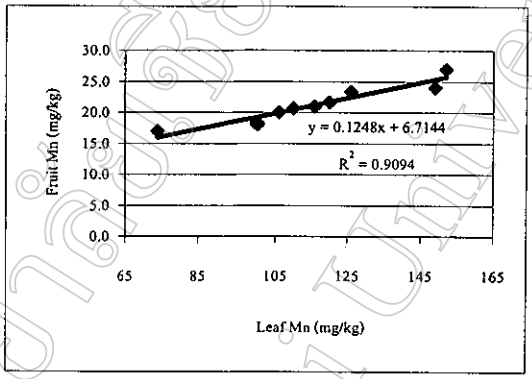


Magnesium

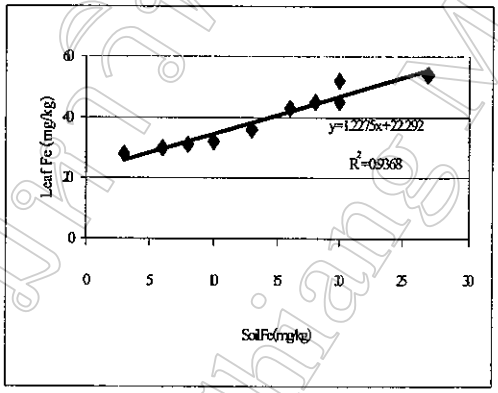
Figure 4.36 (continued)

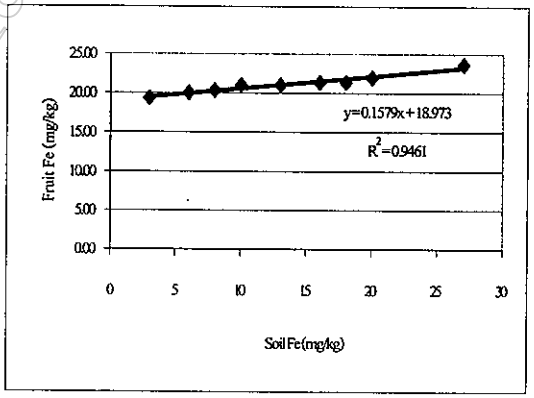


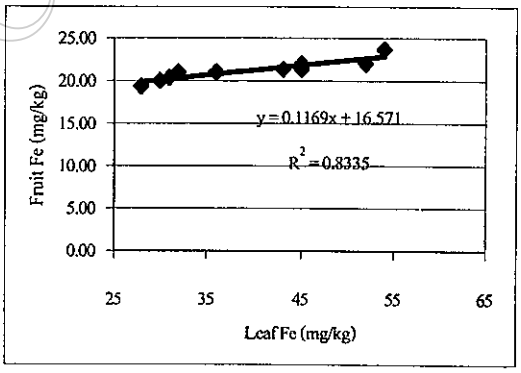




Manganese

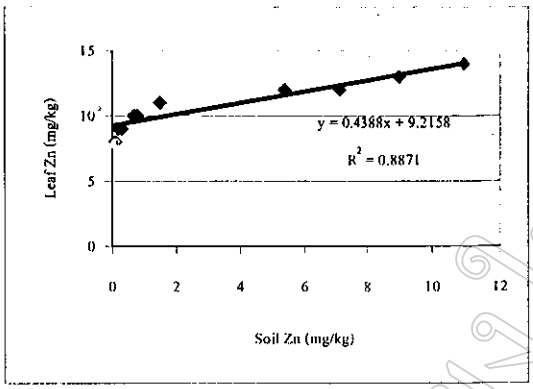


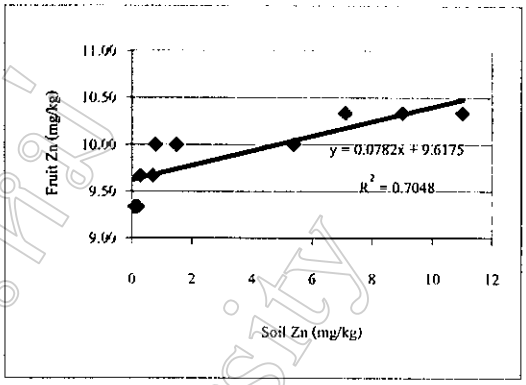


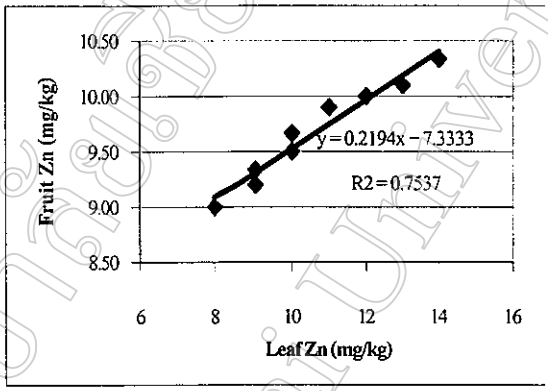


Iron

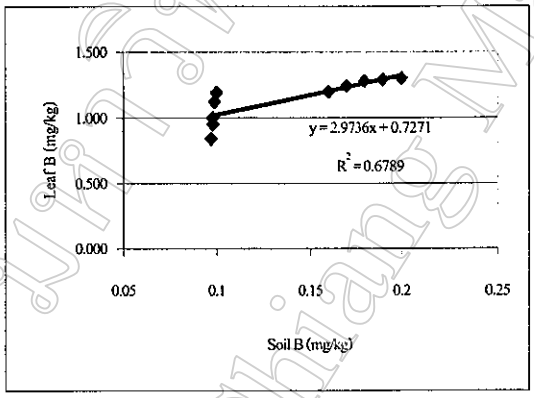
Figure 4.36 (continued)

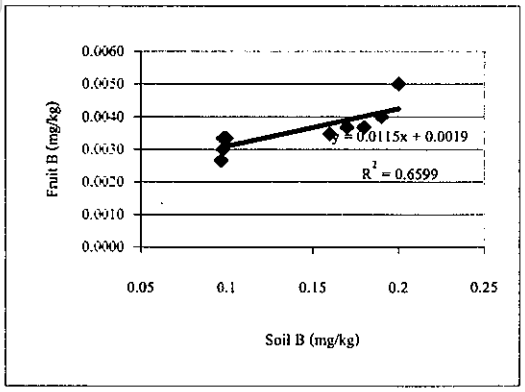


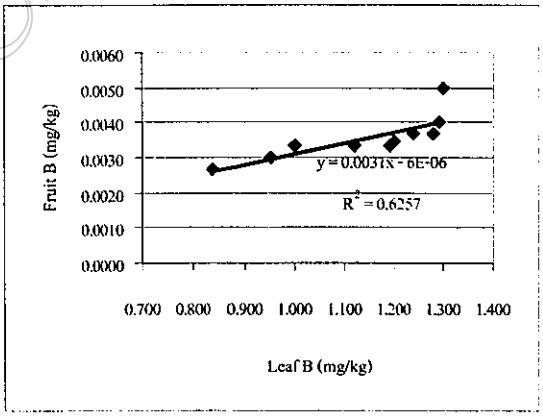




Zinc







Boron

Figure 4.36 (continued)