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STUDY OF HEAVY METALS IN MANGO(*MANGIFERA INDICA* L) IN PERLIS, MALAYSIA

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ABSTRACT:

Mango (*Mangifera indica* L.) is one of the most popular fruit of the tropics. Malaysia produces mango mainly for the local market and only exports small quantity of fruits. Therefore, the presence of any heavy metals higher than the allowable limit considered a source of concern. Fourheavy metals, namely, Cadmium (Cd), Lead (Pb), Nickel (Ni), and Chromium(Cr) were assessed in three separate locations of mango plantations at two soil depths. This study included most rice cultivation lands in Perlis northern Malaysia during wet season in 2014. Results showed that Cd, Pb, Ni and Cr not exceeds the allowable limit in all studied sites. Where were the ratio in site 2 is higher than that of other sites (0.98 and 0.96 mg. kg-1 soil), (0.42 and 0.36 m.kg−1 soil), (2.89 and 2.34 m.kg−1 soil) and (2.38 and 1.53 m.kg−1 soil)for Cd, Pb, Ni and Cr in the (0–15 and 15–30 cm) soil depths, respectively. Results showed that the values of heavy metals vary according to soil depth.

Keywords: Malaysia, Perlis, Cadmium, Lead, Nickel, Chromium, Mango.

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1. INTRODUCTION

Soil is an essential compartment for recycling and redistribution of nutritive elements, this medium is usually considered as a sink for all pollutant that deposited into soil (Maas et al., 2010). Heavy metals have been well documented as they are amongst the most hazardous materials threatening the environment worldwide and are characterized by its long period of residual, high invisibility, little transfer, high toxicity, and complexity of chemical behaviors and eco-reaction(Khairiah, Lim, Ahmad-Mahir, & Ismail, 2006). The presence of toxic metals in soil can severely inhibit the biodegradation of organic contaminants(Maslin & Maier, 2000).The objective of this study was to determine the concentration of four heavy metals (Cd, Pb, Ni and Cr) in soil of Kangar due to various human activities. Malaysia does not have any standard guidelines for heavy metal content in soil, therefore the results of the study were compared with Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Site, and with the standards or guidelines from the previous studies as well. These guidelines were marked as Maximum Allowable Limit (MAL) and served as a benchmark for the determination of heavy metal content allowed in the soil. Data generated in this study may also be useful as a basis for formulation of more effective protective legislations.

2.METHODOLOOGY

2.1 Soil sample collection.

We chose five sites for the cultivation of rice in Perlis Northern Malaysia (Table 1), which included three from most important sites for the cultivation of mango.Samples were taken from the upper layer with 0–15 cm depth and from the second layer with 15–30 cm depth. All samples were stored in clean brown polyethylene soil bags.

2.2 Sample Preparation

Samples were dried at a temperature of 105 °C. Approximately 3 g of soil was digested by 10 mL of hydrochloric acid and 3.5 mL of concentrated nitric acid. The mixtures were left overnight under the switch-on fume cupboard and were heated for 2 h at 140 °C on the next day. After adding the distilled water, we filtered the mixture by using filter paper and then added up to 100 mL of distilled water (Wahidatul, Zainon, Mohammed, Ismail, & Amiza, 2012)

2.3 Data Analysis

The concentrations of heavy metals (Cd,Pb, Ni and Cr) in soil samples were analyzed using an atomicabsorption spectroscopy. The concentrations of heavy metals present in soil samples were compared using the maximum allowable limit (MAL) of each heavy metal.

Table 1) Soil sampling sites (Mango plantations)

Sites	Name of the site
1	Agro technology Research Station
2	Bukit BintangAgricultural Park's
3	Panggas

3.RESULTAND DISCU SSION

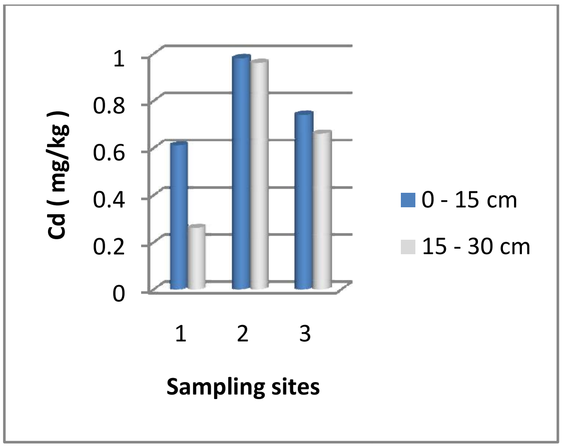
3.1 Depth of soil

Results showed Figures 1, 2 and 3 that the concentration of Cd, Pb, Niand Cr in all sites in the 15–30 cm to 0–15 cm soil depths decreased. The heavy metal concentration increase is higher in the 15–30 cm than in the 0–15 cm soil depth. This finding was confirmed by most previous studies, which discovered (Liu, Zhang, et al, 2007) that heavy metal concentration decreased with increasing soil depth and declined with both distance and depth because of physical dilution and increasing limits in mobility (Florescu, Iordache, Piciorea, & Ionete, 2011)

3.2 Concentration of Cd

Showed the results of the analysis (Figure 1) that the value of Cd concentration in all soil samples is low compared with the ratio of MAL for all countries in (Table 2). Where he showed the site (2) the highest Cd concentration was (0.98 and 0.96 mg. kg-1 soil) in depths (0 - 15 cm and 15-30 cm), respectively. while, the location (1) a lower concentration of cadmium was (0.61 and 0.26 mg. kg-1 soil) in depths (0 - 15 cm) and (15-30 cm), respectively. This increase in Cd concentration can be attributed to the use of phosphate fertilizers and the use of herbicides excessively In the sites of study (Odukoya, Bamgbose, & Arowolo, 2000) indicated that the addition of fertilizer to address the lack of certain nutrients in the soil leads to soil contamination because of its high mobility in soil. In addition, (Lee et al., 2013) confirmed that Cd is released into the soil environment through the application of phosphate fertilizers.

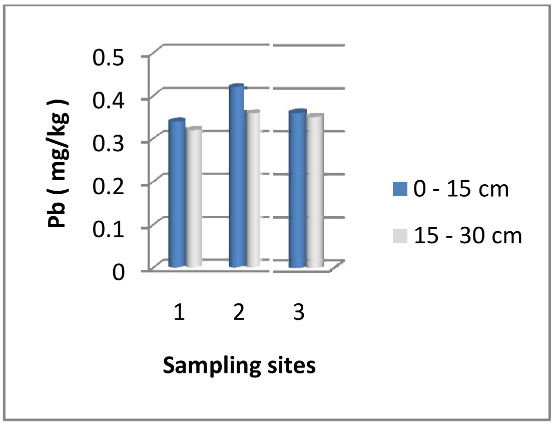
(Figure 1) . The concentration ofcadmiumin thesoilsites.



3.3 Concentration of Pb

Figure 2 shows that the value of Pb concentration in all soil samples is very low compared with the ratio of MAL for all countries in (Table 2). This result indicates the safe level of Pb in the soil. Site (2) had the highest concentration of Pb, which reached (0.42 and 0.36 m.kg−1 soil) at (0–15 and 15–30 cm) soil depths, respectively. The Pb existing naturally in the soil or the emissions from vehicles (Yang, Lu, Long, Bao, & Yang, 2011)may have caused the high Pb concentration. Low Pb concentration in sites (1) amounted to (0.34 and 0.32 m.kg−1 soil) was observed at the (0–15 and 15–30 cm) soil depths, respectively.

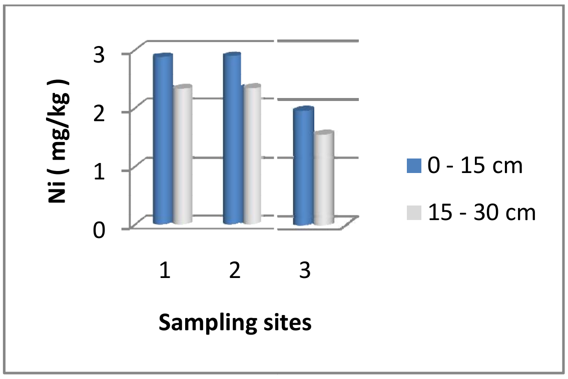
Figure 2:The concentration of lead in the soil sites



3.4 Concentration of Ni

Figure 3 shows that the Ni on all soil samples was low compared with the ratio of MAL for all countries in (Table 2). Site (2) had the highest Ni concentration, which reached (2.89 and 2.34 m.kg−1 soil) at (0–15 and 15–30 cm) soil depths, respectively. However, site (3) showed less concentration of Ni (1.95 and 1.54 m.kg−1 soil) at the (0–15 and 15–30 cm) soil depths, respectively. This ratio is often observed in all sample soils because Ni is present in the original material and soil parent, as noted by (Xianghua, Yongcun Zhao, et al, 2010). (Banin, Novort, et al.1981) confirmed the ratio in the 0–15 cm soil depth. They also noted that Ni had the highest percentage in the 15–30 cm soil depth for all study sites because of the adsorption of clay and organic matter as well as the formation of chelating substances.

Figure 3:The concentration of Nickel in the soil sites



3.4 Concentration of Cr.

The concentration of Cr (Figure 4) in all soil samples is very low when compared with the ratio of MAL for all countries in (Table 2). This result indicates the safe level of Cr in the soil. Site (2) had the highest concentration of Pb, which reached (2.38 and 1.53 m.kg−1 soil) at (0–15 and 15–30 cm) soil depths, respectively. This percentage is very few of the chromium concentration resulted from the parent materials (natural sources) in the soil, this result confirmed by (Zhongping, et al., 2011) and (Xianghua, Yongcun Zhao, et al, 2010).Low Pb concentration in sites (3) amounted to (1.36 and 1.23 m.kg−1 soil) was observed at the (0–15 and 15–30 cm) soil depths, respectively.

Figure 4:.The concentration ofChromium in the soil sites

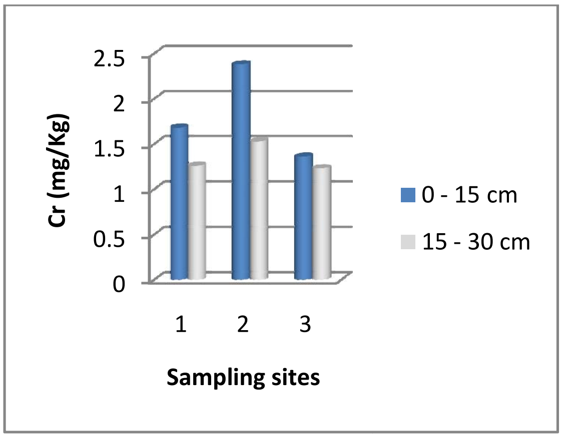


Table 2: Values of Maximum Allowable Limits (MAL) for Heavy Metals in Soil (mg/kg) used in Different Countries

Chemical element	Austria	Canada	Poland	Japan	Great Britain	Germany
Cd	5	8	3	-	3	2
Pb	100	200	100	400	100	500
Ni	100	100	100	100	50	100
Cr	100	75	100	-	50	200

Ref.: (Lacatusu, 2000)

4. CONCLUSION

The result indicate the prescence of heavy metals in Perlis. This may be due to atmospheric deposition. Malaysia is a tropical country where humidity is usually high, and the average annual rainfall is 250 cm(Hock, 2007). Pollutants can get from the air into the water through rain.

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