Cadmium content in soils and leaves of oil palm from continuous application of phosphate rock fertilisers

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Introduction

Concern about the entry of heavy metals into the human food chain is of much interest lately due to high amounts of fertilisers usage in crop production and their contaminants being accumulated in soils. Cadmium (Cd) has been singled out as one of the more dangerous pollutants for the possibility of its transfer from the soil to the human food chain and its association with diseases (Schroeder, et al. 1967). Among the fertiliser used in agriculture that contains Cd contaminant is phosphate(P). Depending on source, Cd concentration in P fertiliser can reach 90mg kg^{-1} (Kabata-Pendias and Pendias,1992). The accumulation of Cd in soil from long term application of P fertiliser has been well documented in many countries (Anderson and Simon, 1991). In a perennial crop such as oil palm, continuous application of P rock fertiliser is practiced and there is the possibility of Cd accumulation in the soil and its uptake by plant in the long run. This study aims to look into the effects of continuous use of several sources and levels of P rocks fertilisers on the soil and leaf Cd content of oil palm.

Materials and Methods

This study was made possible with the help of MPOB, FELDA Agricultural Services Sdn. Bhd. and Golden Hope Plantations. This study was carried out at three locations namely, Golden Hope Plantations , Carey Island, Selangor, Tabung Haji Plantations, Bukit Lawiang, Kluang, Johor and at Felda Plantation, Lepar Utara 10, Sungai Tekam, Pahang. The soil types are Jawa, Rengam and Segamat series respectively. The P fertiliser treatments were first applied in 1992 in the three plantations on an 8 years old palms and were continually applied annually since then. When samples were taken in 1992, the palms have been fertilised for 8 years. The P rocks used were Christmas Island phosphate rock, Tunisian phosphate rock, Jordanian phosphate rock, North Carolina phosphate rock and China phosphate rock. These rocks were compared to the soluble P form, triple superphosphate. Phosphate rates used were 1.5, 3 and 4.5 kg CIPR equivalent P per palm per year . A RCBD design was used for the experiment consisting of 4 blocks, with each replicate in a block. Each replicate consisted of 12 palms. Nitrogen and potash fertilisers were given to the palms according to recommended rates. Soil samples were taken from the 3 plantations in 1998. Samples were taken to a depth of 15 cm within the canopy area,. Leaves samples were taken from frond number 17 randomly from each replicate plot of the treatments. Soils and leaf samples were prepared accordingly and analysed for Cd content using atomic absorption spectrophotometer.

Results and Discussion

There was no difference in the levels of extractable Cd within the three soils due to the different sources and rates of phosphate rocks used. However among the soils, Segamat series had the highest Cd content followed by Jawa and Rengam series respectively. The soils' parent material could be a factor in determining the the Cd content of the soil. The parent material for Jawa series is marine alluvium, andesite for Segamat soil and granite for Rengam soil. The Segamat soil is fine in texture whilst Rengam has a coarser texture. The soil extractable Cd values for all the soil were below 1 μgg^{-1} and were below the trashhold value of Cd polluted soil (McLaughin et al., 1996). When the soil samples were collected in 1999, eight annual P treatments have been applied to the soils. The highest P treatment rate of 4.5 kg CIPR equivalent per tree would have accumulated about 2 g Cd in the soil within the broadcast zone. This amount of accumulated Cd in the soil was however not detected by the 0.01M HCl extractant.

Cadmium content in oil palm leaves was higher compared to that in the soils. The different sources and levels of P treatments applied to the soils did not affect Cd content in leaf of plants within the soil, however different soils gave different Cd content in leaves. Highest Cd content in leaves was from the Jawa soil followed by Segamat then Rengam. The low pH of the Jawa series could result in more Cd present in the soil solution and being taken-up by the plants.

Conclusions

The different sources and levels of phosphate rocks applied annually for 8 years to 3 different soil series did not significantly increased the Cd levels within each soil, however the 3 soils have different Cd content due the different parent materials of the soils. Cadmium content in leaves of palms treated with the different sources and levels of P rocks was not significantly different within each soil series, however different soil series resulted in different Cd content. The highest Cd content was from

the Jawa series followed by Segamat then Rengam. Leaves of palm grown on Jawa soil on the average has 0.48 ppm Cd content.

Benefits from the study

Long term applications of phosphate rocks at rates of up to 4.5 kg CIPR equivalent per palm per year did not influenced the extractable Cd content of the soil as compared to the control. Cadmium content in the leaves of palms was also not affected by the continuous applications of phosphate rock fertiliser. Work on Cd content in fruit of oil palm in ongoing.

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Project Publications in Refereed Journals:

Nil.

Project Publications in Conference Proceedings

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Expertise Development

Name of Graduate	Degree Awarded	Field of Expertise	Graduation Year
Susilawati Kassim	M.S. Agric.	Fertiliser development & Use	2002

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