Amelioration of Soil Acidity in An Acid Sulphate Soil Using Organic Materials

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In Peninsular Malaysia, acid sulphate soils are commonly distributed in the coastal plains, resulting from seawater inundation over the years. Some of these soils are planted to crops, but the yield of these crops is low attributed to acid soil infertility especially Al toxicity. For acid sulphate soils, liming to eliminate Al toxicity is uneconomical. Application of organic materials to overcome the Al toxicity is considered a better option. Research conducted worldwide to determine the efficacy of organic matter to ameliorate acid sulphate soil infertility is few. Hence, this study was carried out to fill the gap in knowledge. The organic materials tested in this study were peat, green manure, rice straw, chicken dung, palm oil mill effluent and peat in combination with the organic materials. Nil treatment and lime were included in this study as the control treatments. Mung bean and cocoa seedlings were planted on the treated soils to determine the efficacy of the organic materials as amendments.

In some of the treatments, soil pH increased significantly. The highest pH increase was in the green manure treatment where a value of 4.88 was recorded. The pH increase was in part due to production of ammonia during mineralization of the green manure. The results also showed that Al was reduced substantially by addition of organic materials especially green manure and green manure mixed with peat. The mixture of peat and organic materials significantly lowered total and monomeric Al concentrations in the soil solution. Peat mixed with organic materials (especially green manure and rice straw) synergistically promoted complexation and chelation of monomeric Al, presumably forming Al-organic acid complex in the soil.

As a result of the organic materials treatment, mung bean grew better than the nil treatment. The reason being a better condition for growth was achieved when the organic materials reacted with the acid soil. This is shown by pH increase and elimination of Al. The relative root length (RRL) of mung bean was negatively correlated with various Al indices. The RRL of mung bean increased with decreasing total and monomeric Al concentration, monomeric Al activities, Al^{3+}, (Al^{3+} + $AlOH^{2+}$ + $Al(OH)_2^+$), ($3Al^{3+}$ + $2AlOH^{2+}$ + $Al(OH)_2^+$), aluminium activity ratio (AAR) and aluminium activity equivalent ratio (AER). The monomeric Al activities and Al^{3+} activities to maintain 90 % RRL were respectively 1.21 and 0.35 µM. These values are regarded as the critical values for the growth of mung bean on the acid sulphate soil under the condition set by the organic matter treatment.

Likewise, cocoa seedlings were able to grow better under the organic materials treatment. The best cocoa seedlings root growth was found for the peat treatment alone. The relative top dry weight of cocoa seedlings was negatively correlated with Al^{3+} as well as Al^{3+} $Al(OH)^{2+}$ + $Al(OH)_2^+$ activity in the soil solution. The critical values for these soil solution attributes were 10 and 15 um, respectively.

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