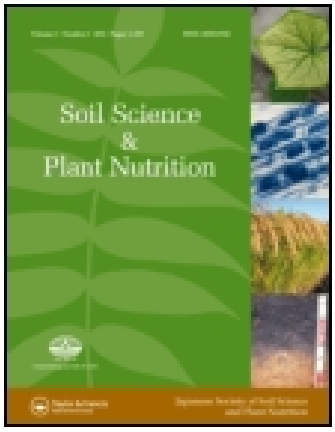

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Evaluation of nitrogen status of agricultural soils in Java, Indonesia

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ORIGINAL ARTICLE

Evaluation of nitrogen status of agricultural soils in Java, Indonesia

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Abstract

To evaluate the content of nitrogen (N) fractions of agricultural soils in Java, Indonesia, in relation to soil type and land use, 46 surface soil samples, 23 from paddy and 23 from upland, were collected throughout Java to include various types of soils. Soil N was separated into four fractions according to form and availability: inorganic extractable nitrogen (Iex-N), fixed ammonium nitrogen (Ifix-N), organic mineralizable nitrogen (Omin-N) and organic stable nitrogen (Osta-N). The total-N content was determined by the dry combustion method. The Iex-N content was determined by extraction with a 2 mol L^{-1} potassium chloride (KCl) solution and the Ifix-N content by extraction with an hydrofluoric and hydrochloric acid (HF-HCl) solution after removal of organic-N. The Omin-N content was evaluated as the potentially mineralizable N based on a long-term incubation method. The Osta-N content was calculated as the difference between the contents of total-N and the three other fractions. The total-N content was 2.06 g kg^{-1} on average. The contents of Iex-N, Ifix-N, Omin-N and Osta-N were 25.8, 99.1, 103 and 1,832 mg kg^{-1}, respectively, and corresponded to 1.3, 4.8, 5.0 and 88.9% of the total-N. Hence, available (Iex-N and Omin-N) and stable (Ifix-N and Osta-N) fractions accounted for 6.3% and 93.7% of the total-N, respectively. Correlation analysis indicated that the contents of total-N and Osta-N had positive correlation with (Alo + 1/2Feo) as an index of amorphous minerals ($p < 0.01$), suggesting strong influence of volcanic materials for the accumulation of organic matter in Java soils. The content of Ifix-N had a positive correlation with nonexchangeable potassium (K) content ($p < 0.01$), suggesting the contribution of 2:1 clay minerals which can fix both ammonium (NH_4^+) and K^+ in their interlayer sites. On the contrary, Omin-N did not have any significant correlation with soil properties, implying the importance of management for the improvement of the available N level in soils, rather than intrinsic soil properties. Soil N status further showed strong topographical trends depending on the elevation where soil developed. The contents of total N, Iex-N, Ifix-N, Omin-N and Osta-N in Java soils were on average 80, 69, 90, 65 and 80% of those in Japanese soils, respectively, suggesting that the soil N level in Java was lower than that in Japan, probably due to accelerated decomposition of organic matter, especially degradable fractions, reflecting high temperature, but that the level was relatively high for tropical soils due to the effect of volcanic materials. In conclusion, these results should be taken into account for the sustainable management of soil N in agricultural fields in Java, Indonesia.

Key words: Availability, Java, nitrogen, soil type, tropical soil.

INTRODUCTION

Nitrogen (N) is one of the most important essential nutrients for plants and N content in the soil significantly affects plant growth and crop yields (Brady and Weil, 2002). The total N content in soils is reported, on average, to be 2.0 g kg^{-1} with a range of 0.2–5.0 g kg^{-1} (Bowen, 1979), or 1.63 g kg^{-1} with a range of 0.15–2.18 g kg^{-1} (Batjes, 1996). It is well known that soil N content in the tropics is generally much lower than that in temperate areas, as a result of the accelerated decomposition of organic matter at higher temperature in the tropics. For example, Kawaguchi and Kyuma (1977) reported that the total N content of 410 soils from tropical Asia was on average 0.13 g kg^{-1}. Soil N status in the tropics is,

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