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Oil palm and the emission of greenhouse gasses- from field measurements in Indonesia

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Palm oil from the oil palm (Elaeis guianensis) has in recent years become the world's most important vegetable oil. The increasing demand for palm oil has led to expansion of oil palm plantations, which has caused environmental controversies associated with carbon losses and the use of large amounts of mineral fertilizers. Efforts to increase sustainability of oil palm cultivation, include recycling of oil-mill residues and pruning's, but with this comes increased potential for methane emission from the plantations. Until now no field-based data on greenhouse gas emissions from oil palm plantations have been reported. Here for the first time we present data from a long term (360 days) field trial in Bah Lias Research Station, North Sumatra, Indonesia on greenhouse gas emissions from an oil palm plantation with various treatments of recycled oil palm waste products, fertilizers and simulated rainfall. The first experiment was conducted over a full year (dry + wet season) with mineral fertilizer treatments including urea and ammonium sulphate, and organic fertilizer treatments constituting: empty fruit bunches (EFB), enriched mulch (EFB + palm oil mill effluent (POME)) and pruned oil palm fronds (OPF). Treatment doses represent the current management in Indonesian plantations and the higher doses that are expected in the imminent future. For the organic treatments several methods of application (applied in inter-rows, piles, patches or bands) were evaluated. The second experiment investigated effects of soil water saturation on GHG emissions through adding 25 mm simulated rainfall per day for 21 days. Each palm tree received 1 kg of N fertilizer as urea or ammonium sulphate and enriched mulch. The gas fluxes in the fields was measured by a large static-chamber (1.8 m x 1.2 m) method and CH4 and N2O concentrations were determined using gas chromatographs. We found that emissions were significantly affected by the type and dose of mineral fertilizers. Application of urea leads to significantly higher N2O emission than application of ammonium sulphate. Organic fertilizers resulted in significantly higher CH4 emissions than N2O. The combination of enriched mulch and urea produced the highest N2O emission. When applied in piles, organic fertilizers emitted significantly more N2O and CH4 than when spread out. 25 mm simulated rainfall daily resulted in 76% higher N2O emissions than in the control (no water addition) with highest rates day seven after fertilization. This study will contribute to the development of more accountable and sustainable oil palm production systems and help to guide nutrient management practices to slow down or counteract climate change.