A TECHNIQUE FOR MEASURING GREENHOUSE GAS EMISSIONS FROM PEAT SOIL

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The understanding of greenhouse gas (GHG) emissions and the oil palm environment have increased considerably over the last decade. Three of the most important GHG are nitrous dioxide (N_2O), carbon dioxide (CO_2) and methane (CH_4). A number of potential strategies has been formulated to reduce such emissions. The chamber method is commonly used to measure the emission of trace gases from the soil surface. The closed chamber method is based on the accumulation of soil gases in a cylindrical chamber with a known volume which is placed on the soil surface. The variation in the CO_2 concentration inside the chamber over time is directly proportional to the soil CO_2 flux (Inubushi *et al.*, 2003; Melling *et al.*, 2005; Watanabe *et al.*, 2009). Gas samples are collected with a gas-tight syringe from the chamber and filled into glass vials or tedlar bags, and the concentrations of CO_2, CH_4 and N_2O quantified subsequently with a gas chromatograph. A suitable method for measuring of CO_2, CH_4 and N_2O from peat soil in the oil palm plantation has been developed based on these procedures.

MATERIALS AND METHODS

The study site was at Sepang, Selangor in an area with 11-year-old oil palm planted on peat and fertilised with the varying nitrogen (N) rates. The area had an average peat depth of 1.5 m, with the water-table maintained at 60 cm from the peat surface. The GHG flux was measured from three different points in relation to the palms, *i.e.* the weeded circle, the inter-row and the frond pile areas. Each treatment was replicated three times.

Fluxes of GHG at the soil surface were measured using closed chambers made from polyvinyl chloride (PVC) and were of 20 cm diameter and 10 cm height (*Figure 1*). Soil GHG flux was measured by placing the open end of a chamber on the soil surface that had been cleared of vegetation. GHG from the chamber was pumped into a 1-litre tedlar gas bag using a grab air sample pump (SKC, United State of America) (*Figure 2*). The change in GHG concentrations within the chamber headspace was sampled at 0, 5, 10 and 15 min after placing the chamber. GHG gas samples were analysed by a photoacoustic field gas monitoring system (INNOVA 1412, Denmark) (*Figure 3*). A linear regression of the increasing GHG concentrations over time was used to calculate the GHG flux rate and converted into units of mg m^{-2} hr^{-1} (Parkin and Venterea, 2010).

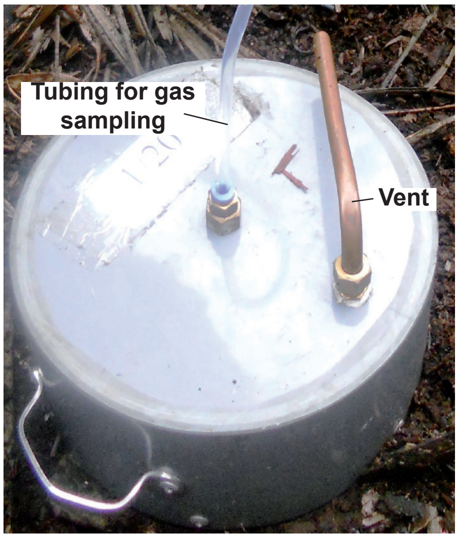

Figure 1. A vented soil chamber (20 cm diameter x 10 cm height) used for GHG gas sampling.

RESULTS

The results show that the CO_2 flux was 18% higher in the plot receiving the normal rate of N as practised in the estate (1 kg N $palm^{-1}$) compared to the control plot (no fertiliser) (*Figure 4*). The N_2O flux was 4% higher where 80 g N $palm^{-1}$ had been supplied (*Figure 5*) and the CH_4 flux was 41% higher in the plot receiving 120 g N $palm^{-1}$ compared to the plot receiving the normal estate practice (*Figure 6*).

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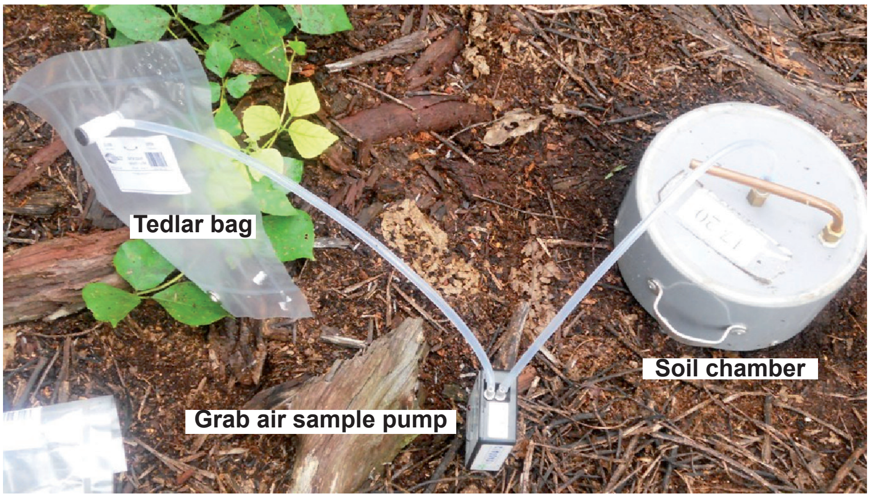

Figure 2. GHG samples from the soil chamber were collected using a tedlar gas bag aided by a grab air sample pump.

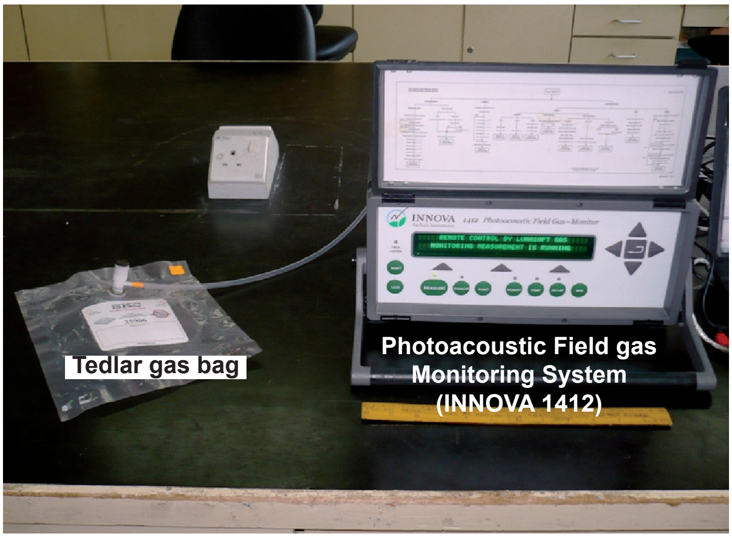

Figure 3. GHG sample in the tedlar gas bag was analysed using a photoacoustic field gas monitoring system.

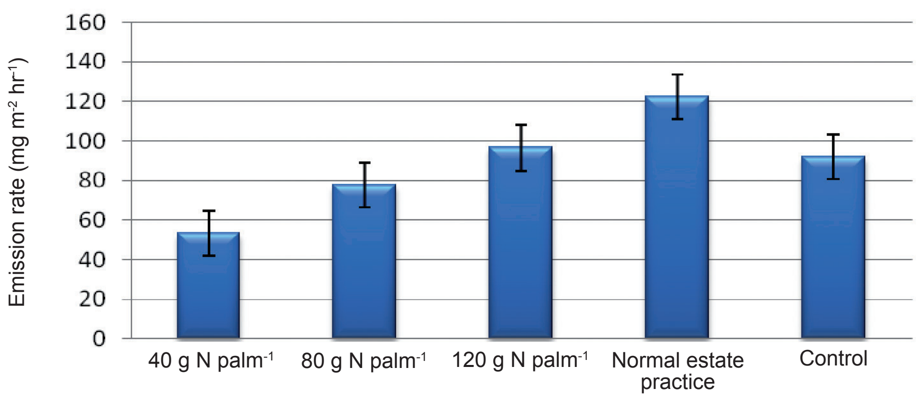

Figure 4. Carbon dioxide (CO_2) flux from oil palm planted on peat receiving different nitrogen rates at Sepang, Selangor.

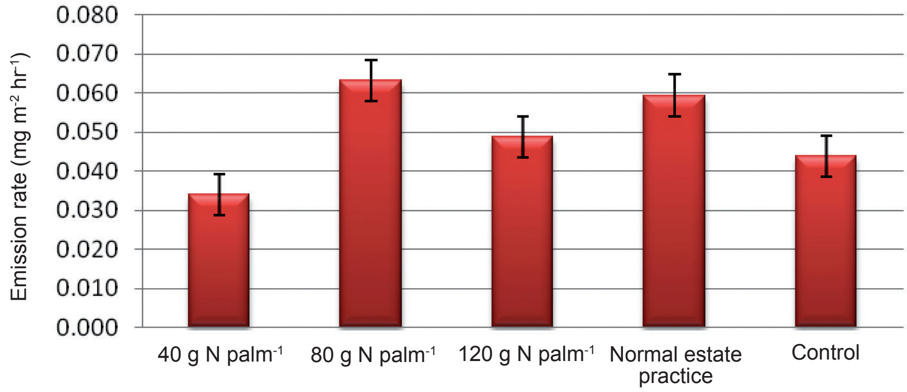

Figure 5. Nitrous dioxide (N_2O) flux from oil palm planted on peat receiving different nitrogen rates at Sepang, Selangor.

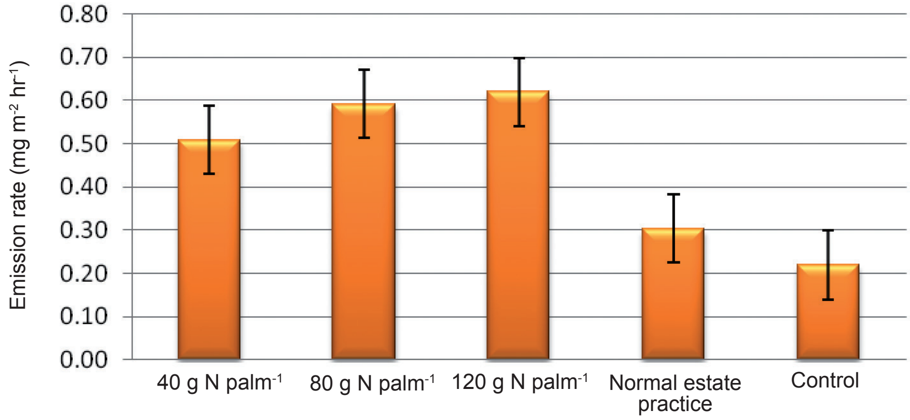

Figure 6. Methane (CH_4) flux from oil palm planted on peat receiving different nitrogen rates at Sepang, Selangor.

BENEFITS

With this technique for sampling GHG, MPOB offers a service to researchers, universities, environmentalists and anyone else who is interested in measuring soil GHG emissions. The service offers fast measurements of GHG samples and also the detection of low levels of CH_4 and N_2O fluxes (*Table 1*).

TABLE 1. DETECTION LIMITS FOR THREE GREENHOUSE GASES FOR THE PHOTOACOUSTIC FIELD GAS MONITORING SYSTEM

Gas	Detection limit (ppm)
Carbon dioxide (CO_2)	1.5
Nitrous dioxide (N_2O)	0.1
Methane (CH_4)	0.1

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