Estimation of nitrous oxide emission from pulse cultivation in rainfed uplands

There is a gradual increase in the concentration of greenhouse gases (GHGs) like CH_4 and N_2O in ambient air due to intensive agriculture, rapid industrialization and the expanding transport sector[1]. About 80% of N_2O is produced biologically and the major sources are agricultural fields, wetlands, sediments, animal wastes and landfills. Emission of N_2O from the soil is due to nitrification and de-nitrification processes. These two mechanisms are controlled by various environmental and soil parameters[2] such as pH, carbon, water content and nutrient-N. There are various studies on the emission of N_2O from agricultural activities, such as cultivation of vegetables[3], sugarcane[4] and maize–wheat[5]. Pulses having root nodules are capable of absorbing atmospheric N, which on denitrification emits N_2O.

The prime objectives of this correspondence are: (a) estimation of N_2O from cultivation of different pulses, (b) determination of factors affecting N_2O emission from these pulses and (c) the role of these crops in the emission of N_2O.

Three pulses, black gram (BG), horse gram (HG) and green gram (GG) raised in two different rainfed upland areas, i.e. Tangibanta (near the coast: 20°20′N, 85°49′E, 35 m asl) and Sorada (hilly forested: 19°50′N, 84°19′E, 140 m asl) were selected for the study. The land in Tangibanta is used for raising kharif paddy followed by rabi pulses. Farmers use nitrogen and farmyard manure during land preparation before paddy. For pulses, however, they use neither fertilizer nor pesticide. Soroda is a tribal village in southern Orissa, where the farmers follow traditional agricultural practices with no fertilizer application. The soil is porous and sandy, with no accumulation of water. The field is used for raising a single crop only during the monsoon and after harvesting, kept fallow due to lack of water.

Air fluxes were collected at regular intervals during the cropping period. Gas samples were collected following the closed chamber technique ($52 \times 31.7 \times 34.5$ cm^3)[6]. The N_2O concentration was measured using a Shimadzu AA12 Gas Chromatography. NIST traceable primary and secondary standards were used frequently for standardization during estimation. Concentration of N_2O in ambient air as well as in the cultivated field was measured at least twice a day, i.e. in the morning and afternoon.

Soil parameters like NH_4^+-N, NO_2^--N, NO_3^--N, carbon and moisture content were determined[7]. pH and Eh were measured in the field using the respective meters of Orion-make. Temperature of the air inside the box was measured during each flux collection.

N_2O emission for BG is shown in Figure 1 for Soroda and Tangibanta. Similar curves were also obtained for other pulses. Maximum emission of N_2O occurred in BG just before flowering at both places. However, N_2O flux in Tangibanta was always higher than at Soroda. This may be due to lower nitrogen concentration, soil moisture, carbon content and temperature in the former. In both places redox potential (Eh) was positive (100–200 mV), which facilitated N_2O formation. The crop was raised during kharif season in Soroda and so the average temperature was lower compared to Tangibanta. The soil carbon in both places varied in the range 4–6 g/kg. The soil moisture in Soroda was also less compared to Tangibanta. In both places, pH of the soil was slightly acidic (5.5–6.9).

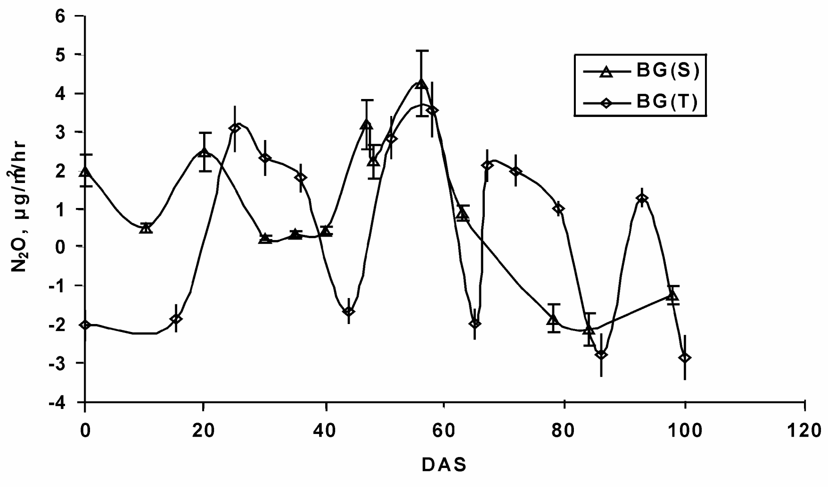

Figure 1. N_2O emission from black gram in Soroda and Tangibanta. DAS, Days after sowing.

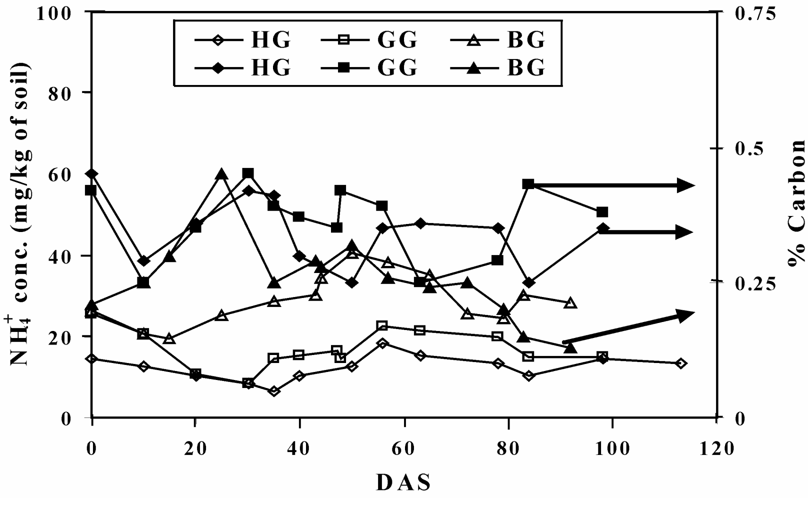

Figure 2. Ammonium and carbon concentration in soil during pulse cultivation (Soroda).

Table 1. Seasonally integrated flux (SIF) of N_2O (g/ha)

Crop	Duration of cropping (days)	Soroda (SIF)	Tangibanta (SIF)
Green gram	72	8.652	14.75
Horse gram	105	11.835	14.005
Black gram	93	11.999	16.712

For GG, the maximum N_2O emission occurred during 20–40 days after sowing. N_2O emission was also higher in Tangibanta compared to Soroda. The soil N-content was less in Soroda compared to Tangibanta. Both places showed positive soil Eh. N_2O flux was also collected during HG cultivation in both places. In most of the cases, positive N_2O flux was observed. Maximum flux was observed after 56–70 days of sowing in both the places. pH of the soil was near neutral or slightly acidic throughout the cropping period. In all the cases, Eh of the soil was positive throughout the measuring period. The soil carbon content varied in the range 4–6 g/kg.

N_2O emission from agricultural activities depends on various factors such as N-content, moisture content, pH, Eh and temperature[2,3,7]. The NO_3^-, NO_2^- and NH_4^+ content in the soil at Soroda was found to be lower than that at Tangibanta. It was observed that in both the places, the highest N_2O emission was associated with the higher N-content of the soil. The increase in N-content may be associated with the biological N_2-fixation by leguminous crops, which might have increased the availability of NH_4^+ in the soil, to serve as the substrate for nitrification[8]. The seasonally integrated flux was observed to be different for different crops (Table 1). This variation may be attributed to nitrogen requirement and its management, the moisture regime, root type, pH, redox potential and temporal variation. The root can induce some microbial activity, including nitrification and denitrification processes through bacterial activities in the soil[8]. The pulses are cultivated during rabi season in Tangibanta and kharif season in Soroda. The temporal variability of N_2O emission during both the seasons might be due to variations in soil moisture content[9], soil N-content[10] and variable plant growth[11].

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Influenza virus infection during a pilgrimage at Pandharpur, Maharashtra, India

Influenza is an air-borne disease, and crowding during large gatherings or pilgrimages facilitates person-to-person transmission of influenza virus among highly susceptible population. Poor living conditions and stress during pilgrimages probably exacerbate susceptibility to infection. Many studies have been conducted on the role of influenza viral infection during the Haj[1–4]. Respiratory tract infection is the most common disease transmitted during this period, with influenza viruses identified as one of the most common etiological agents. India, as a confluence of different religions, has always attracted pilgrims from all over the world. The Kumbha Mela (the Great Fair) is a gathering of between 10 and 20 million Hindus upon the banks of the holy rivers, as periodically ordained in different parts of India, and is regarded as the largest gathering of humanity on earth. Many such small and large pilgrimages take place all over India all through the year. The present investigation is a pilot study conducted in 2005 during a pilgrimage to Pandharpur, Maharashtra, to investigate the extent of influenza during the pilgrimage.

The Pandharpur pilgrimage, a unique feature of Maharashtrian culture, is a 1000-year-old tradition followed by the warkaris (people who follow the wari, a fundamental ritual). People from different parts of Maharashtra gather at Alandi, a small town near Pune city and collectively go singing and dancing every year from Alandi to the holy town of Pandharpur in the months of June–July, cov-