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Emission factors of particles, black carbon an gases from crop residues burning

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Agricultural residues' burning is a common practice carried out mostly in developing countries to eliminate plagues and prepare the land for the next crop. However, farmers and nearby population are exposed to high emissions of particles and gaseous pollutants as carbon monoxide (CO), hydrocarbons and nitrogen oxides, which have been related to health damages. In addition, greenhouse species such as CO_2, CH4 and black carbon aerosol (BC), that is a short lived climatic pollutant, are discharged to the atmosphere contributing to global climate change, since they can cause a positive radiative forcing.
In order that policy makers have reliable data to know the magnitude of negative impacts of crop residues burning, as well as the benefits that would be obtained when applying alternatives to that agricultural practice, this research was conducted to determine the emission factors (EF) of particulate matter (PM), black carbon (BC), organic carbon (OC), CO_2, CH4, and CO from the biomass burning of sugarcane, maize, rice, sorghum and wheat.
Three different varieties of crop residues were collected from different location of the country. Moisture content, elemental composition, contents were measured to characterize each crop. A combustion chamber was constructed in order to simulate open combustion of crops in the field. A hood was located over the chamber and connected to a stack. In order to have a standardized method, an isokinetic sampler was employed applying a modified 201-A method of Federal Code of Regulations No. 40. CO and CO_2 analysis were performed with a Bacharach gas analyzer. Gaseous emissions were collected in tedla bags in order to determine CH4 concentrations with a Chromatograph (Agilent, 6890) with a thermal conductivity detector. Black carbon concentrations were estimated as elemental carbon (EC) using an OC/EC Analyzer (Sunset Lab) with NIOSH 870 method. Modified combustion efficiency for each burning test is the deltaCO_2 (concentrations of CO_2 measured during the essays minus de background CO_2) by deltaCO_2 + deltaCO. EFs of different pollutants were estimated dividing the mass of the quantified pollutant by the burnt mass of crop residue.
MCE was 97% for sugarcane, maize and wheat, whereas for rice and sorghum were 92% and 87%. Carbon content ranged between 40.8-43.8%, for rice and sorghum respectively.
PM2.5 EF ranged from 1.8 to 21.6 on the following order sugarcane < maize < wheat < rice < sorghum; that order was the same for the OC EF which varied from 0.44 to 5.29, and for the CO EF which varied from 25.7 to 155.7; the coincidences in the order are related to the combustion efficiency. In the case of elemental carbon the EFs followed a completely different order, depending more with the time that residues burned during flaming stage. EC EFs were 0.15, 0.18, 0.24, 0.29, 0.34 for rice, maize, wheat, sorghum, and sugarcane respectively. Results show that each crop has a different behaviour burning, meaning that it is not accurate the use of the same EFs for all kind of residues, as default EFs value proposed by IPCC.