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Biomass; Crop Physiology; Greenhouse Gases; Photosynthesis; Water Vapor; Volatile Organic Compounds; Ultraviolet Radiation

Abbreviations

GHGs: Greenhouse Gases; NxO: Nitrogen Oxides; VOCs: Volatile Organic Compounds; UV: Ultraviolet Radiation

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Case Report

Tropical Agriculture and Emissions of Green House Gases: the Case of Brazil

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Case Report

The activity of atmospheric Greenhouse Gases (GHGs), such as Water Vapor (H_2O), Carbonic Gas (CO_2), Methane (CH_4), Nitrogen Oxides (N_xO), and Ozone (O_3), became an object of study because of their concentration rise in the atmosphere, increasing air temperature, drought events, and other factors stresses. However, most studies of their effects on agriculture were done in a temperate climate, especially in the northern hemisphere, with only a few studies in the tropics. For example, there are only two seasons in a tropical environment, the dry and the rainy season. In the tropics, there is an increase in anthropogenic and natural fires and, consequently, GHGs formation during the winter (dry season) due to biomass burning, considered the principal source of GHGs in the tropical climate. The concentration of GHGs in the atmosphere, produced principally during the dry season, is still high at the beginning of the rainy season. In addition to CO_2 produced by biomass burning, there was an increase in Volatile Organic Compounds (VOCs), and N_xO formed naturally in the Amazonian forest or due to biomass burning. VOCs and N_xO , in ambient with high Ultraviolet Radiation (UV), generate O_3 , toxic to all living beings. The beginning of the summer (rainy season) is the principal sowing season in Brazil, but the GHGs are still high, causing effects on crops. Therefore, the GHGs, CO_2 , CH_4 , VOCs, N_xO , and O_3 , are produced in tropical countries, like Brazil, but from different sources than in temperate climates. In tropical agriculture, CO_2 air concentration increases from biomass burning, Amazonian Forest respiration, agriculture, soil respiration (microorganisms and roots), fossil fuel burning, growing plants and microorganisms during the wet season, etc. CH_4 concentration increases from the Amazonian forest (Wetlands), flooded land (Pantanal in the Cerrado biome), oceans, enteric fermentation (cattle and termites), garbage dump, biomass burning, etc., O_3 air concentration increases from biomass burning, Amazonian forest, lightning, etc., VOCs concentration increases from biomass burning, Amazonian forest (Produces more than 80% of Global Isoprene), etc. N_xO air concentration increases from biomass burning, Amazonian Forest (Wetland), nitrogen fertilization, smaller than in developed countries, rapid organic matter decomposition due to microbial activity all year long in tropics, etc.

Therefore, in tropical countries, the atmospheric concentration of CO_2 , CH_4 , N_xO , VOCs, and thus O_3 are increased, mainly due to biomass burning during the dry season in Amazonia and Cerrado. The last is the principal biome for agriculture in Brazil. The increase in the atmospheric concentration of CO_2 will cause an increase in photosynthesis and biomass of C_3 plants, especially in the woody and C_3 grasses species, but not of C_4 plants. However, this increase in photosynthesis is lower than predicted in studies carried under controlled conditions, as shown in field results. The increased concentration of this GHG and others in the atmosphere raises the air temperature, alters precipitation and evaporation from the soil, causing water stresses, which can annul the fertilization effect of CO_2 , potentially extending the harmful impact in the biosphere. On the other hand, the O_3 concentrations in the Amazonian forest attain 40-100 ppb during the dry season and reduce to 8-20 ppb during the rainy season; and in the Cerrado, the O_3 concentrations vary from 40- 80 ppb, in the dry season, to below 20 ppb, in the rainy season. The O_3 concentrations at the troposphere above 40 ppb reduce the photosynthesis and yield of crops, especially the most sensitive, as soybean and cotton, important Brazilian crops. It is essential to state that the O_3 produced naturally or due to biomass burning in Amazonia is dispersed by wind to the Cerrado and Africa Occidental biomes, reducing the yield of sensitive crops. In industrialized countries, the increase in O_3 and CO_2 is mainly due to fossil fuel burning, especially during summer. In tropical countries like Brazil, the rise in the air concentration of these gases occurs primarily in the dry season (winter and spring), in the savannahs, as in the Cerrado ecosystem in Brazil. Thus, GHG production in tropical countries is mainly due to natural or anthropogenic biomass burning. It will affect the crops during the rainy season when the crop has its maximal yield potential [1-6].

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