To explore effective ways to decrease soil CO₂ emission and increase grain yield, field experiments were conducted on two upland rice soils (Luvic Acrisols and Gleyic Luvic soils) in northern Benin in West Africa. The treatments were two tillage systems (no-tillage, and manual tillage), two rice straw managements (no rice straw, and rice straw mulch at 3 Mg ha⁻¹) and three nitrogen fertilizers levels (no nitrogen, recommended level of nitrogen: 60 kg ha⁻¹ and high level of nitrogen: 120 kg ha⁻¹). Potassium and phosphorus fertilizers were applied to be non-limiting at 40 kg K₂O ha⁻¹ and 40 kg P₂O₅ ha⁻¹. Four replications of the twelve treatment combinations were arranged in a randomized complete block design. Soil CO₂ emission, soil moisture and soil temperature were measured at 5 cm depth in 6 to 10 days intervals during the rainy season and every two weeks during the dry season. Soil moisture was the main factor explaining the seasonal variability of soil CO₂ emission. Much larger soil CO₂ emissions were found in rainy than dry season. No-tillage planting significantly reduced soil CO₂ emissions compared with manual tillage. Higher soil CO₂ emissions were observed in fertilized treatments compared with non-fertilized treatments. Rice biomass and yield were not significantly different as a function of tillage systems. On the contrary, rice biomass and yield significantly increased with application of rice straw mulch and nitrogen fertilizer. The highest response of rice yield to nitrogen fertilizer addition was obtained for 60 kg N ha⁻¹ in combination with 3 Mg ha⁻¹ of rice straw for the two tillage systems. Soil CO₂ emission per unit grain yield was lower under no-tillage, rice straw mulch and nitrogen fertilizer treatments. No-tillage combined with rice straw mulch and 60 kg N ha⁻¹ could be used by smallholder farmers to achieve higher grain yield and lower soil CO₂ emission in upland rice fields in northern Benin.

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