

# Earthworm and Soil Carbon after Twenty One Years of Continuous Notillage Corn-Legume Rotation in Sumatra, Indonesia

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Earthworm and soil carbon are important components in sustainable tropical agro ecosystem. Long-term experiment was initially conducted in 1987, at the experiment farm of Politeknik Negeri Lampung, Sumatra, Indonesia. The soil is a Typic Fragiudult with slope ranging from 6 to 9 percent. The site of experiment was previously a *ladang* (a local land rotation with period of fallow), which was abandoned and covered by *Imperata cylindrica* grass with dry matter of 15 Mg ha<sup>-1</sup>. The experiment was a factorial, randomized complete block design, with 4 replications. Tillage treatments were conservation tillage (no-tillage, NT and minimum tillage, MT), and intensive tillage (IT); while nitrogen fertilization rates were 0 and 200 kg N ha<sup>-1</sup>. Cropping pattern of the long-term experiment was cereal-legume-fallow rotation. Nitrogen fertilizer treatment was not applied when legume was planted. Due to soil compaction in 1997 and 2002, all plots of conservation tillage were plowed. After eleven years of cropping, the soil became acid therefore; in 2004 all plots were limed with 4 Mg ha<sup>-1</sup> of CaCO<sub>3</sub>. To determine the effects of long-term no-tillage and N fertilization on earthworm and soil carbon, the soil samples were collected at depth of 0-10 Cm in 2008, after twenty one years of long-term continuous experiment.

The only treatment that affected earthworm population was tillage treatment. After twenty one years, NT had averaged 1.0 Million ha<sup>-1</sup> earthworm population, 245 percent higher than IT, but 67 percent lower than MT. Refer to previous experiment after nine years (1996), the response of earthworm to conservation tillage after twenty one years was similar, but weaker than after nine years. After nine years of cropping, NT had averaged 4.7 Million ha<sup>-1</sup> earthworm population, 158 percent higher than IT, but 40 percent lower than MT. Different from earthworm response, the biomass of microorganism after twenty one years of cropping was affected by either tillage or N fertilization treatments, even though did not affected by their interaction. No-tillage had 56.1 mg C-CO<sub>2</sub> kg<sup>-1</sup> day<sup>-1</sup>, 15 percent higher than IT, but 33 percent lower than MT; while 200 kg N ha<sup>-1</sup> N treatment had 42 mg C-CO<sub>2</sub> kg<sup>-1</sup> day<sup>-1</sup>, 34 percent lower than 0 kg N ha<sup>-1</sup> treatment. The superiority of conservation tillage over IT was mainly due to additions of previous weed and crop residues on the soil surface. The additions of averaged 13 Mg residues have created a favorable micro-climate for earthworm, and have increased soil organic C of conservation tillage. After twenty one years of cropping, soil organic carbon of NT at 0-10 Cm soil depth was 13.9 Mg ha<sup>-1</sup> and MT was 15.8 Mg ha<sup>-1</sup>, or 17.8 percent and 34 percent higher than IT, respectively