



Research project of counterparts funded at UNTAD and Universitas Brawijaya (UB)

Name

Counterpart

Title

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A05

Nutrient release from decomposition of oil palm empty fruit bunch

Background and Methods

The expansion of oil palm plantations strongly reduces the quality of ecosystem functions provided such as severe reductions in organic carbon stock in above ground biomass and below ground (i.e. soil carbon stocks). This consequently reduces soil microbial biomass and soil nutrient retention efficiency, changes nitrogen cycling and changes trace gas fluxes. To counter these effects organic matter addition is needed. It would be especially useful if the organic matter came from oil palm residues. This study therefore aimed: 1) to measure the decomposition rate and micronutrient release from oil palm empty fruit bunches (EFB), and 2) to assess soil organic carbon and total nitrogen after the application of oil palm residues. For the FIRST OBJECTIVE, we set up field research in smallholder oil palm plantations (HO3) by using litter bags. The fresh EFB (~ 16 tonnes ha^{-1}) was put into the litterbag and then the litterbags were spread on soil surface and buried in the top soil (0-10cm deep). The litter bags were then collected monthly from September 2017 and the dry weight and micronutrient concentrations (i.e. Fe, Mn, Zn, B) were measured. For the SECOND OBJECTIVE, we conducted laboratory experiments to assess the dynamics of soil organic carbon and total nitrogen after addition of oil palm residues. We collected two soil types from smallholder oil palm plantations which were different in soil texture (i.e clay and sandy loam Acrisol soils). The clay soil was collected from Bukit Duabelas (BO4 plot and the sandy loam soil was taken from Harapan (HO3 plot). The soil was air-dried, ground, weighed ($\sim 400\text{g}$ oven dry) and placed in plastic bags. Three treatments of organic matter from oil palm residues were applied to each soil type. The treatments included fibre, EFB, and mixed (fibre and EFB) with doses equal to 10 tonne ha^{-1} . Each treatment was replicated three times. We added ionic water until field capacity to each bag. Then we measured soil organic carbon and total nitrogen at 0, 4, 6, 8, 10, and 12 weeks after incubation.

Results and discussion

Decomposition rate and micronutrient release from oil palm empty fruit bunches

EFB decomposed slowly as indicated by the loss of dry weight being less than 20% over 17 weeks of measurement (figure 1A). In addition, applying EFB on the soil surface led to higher amounts of Mg and B remaining ($P \leq 0.05$) compared to when material was buried in the top 10cm of the soil. The amounts of Zn and Fe remaining were not significantly different between the two locations. The higher amounts of nutrient remaining (i.e. Mg and B) when EFB is spread on the soil surface than when it is buried in the soil indicated that the decomposition rate of EFB tends to be lower on the soil surface than it is actually in the soil. This finding is supported by the higher mean residence time (MRT; figure 1B) of EFB in the soil surface (83 weeks) than in the soil (72 weeks).

Soil organic carbon and total nitrogen dynamics by application of oil palm residues

Overall, the study showed that application of oil palm residues (i.e EFB, fibre, and mix) during 12 weeks resulted in higher soil organic carbon and total nitrogen in the clay than in the sandy loam ($p < 0.01$). However, in each soil type, the study was unable to detect significant differences of soil organic carbon and nitrogen ($p > 0.05$) among different oil palm residues (figure 2A and 2B). In addition, total nitrogen in the soil (especially in the clay Acrisol) from all treatments during 12 weeks incubation tend to be lower than in the beginning (before organic matter addition), probably due to nitrogen immobilization by soil microbes.

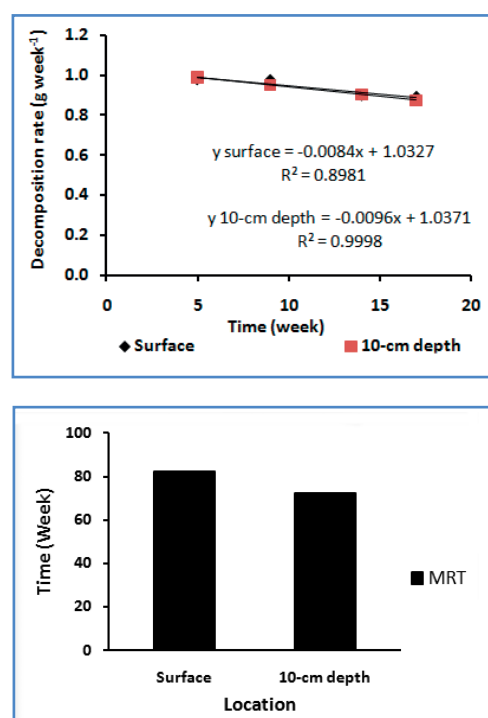


Figure 1. Decomposition rate (A) and mean residence time (B) of oil palm empty fruit bunches during 17 weeks in the field.

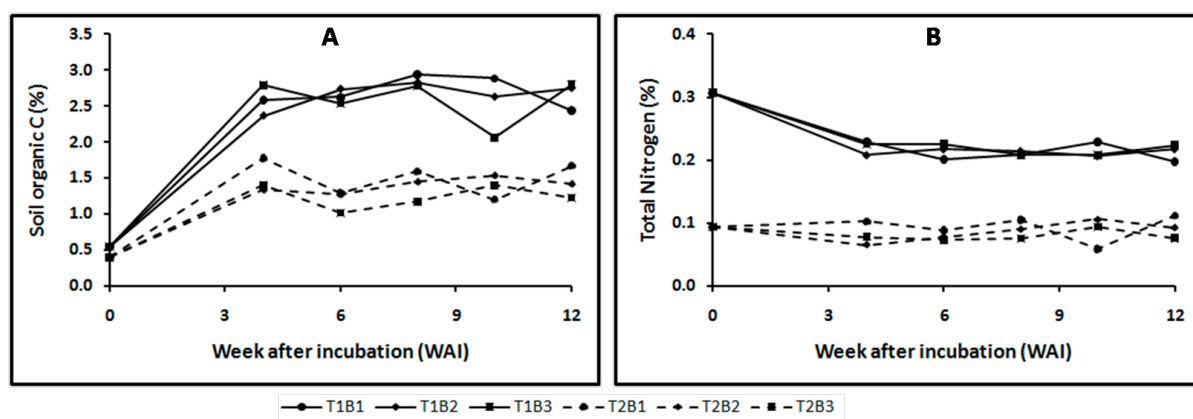


Figure 2. Soil organic C (A) and total N (B) in clay (solid line) and loam (dash line) acrisol soils after application of oil palm residues (i.e EFB = B1, fibre = B2, and mix = B3) during 12 weeks incubation.