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Soil carbon stocks in oil palm (*Elaeis guineensis* Jacq.) plantations in agroforestry systems and monoculture in eastern Amazonia

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Background/Question/Methods

Oil palm-based agroforestry systems may represent a sustainable form of expanding the production of the crop in the Brazilian Amazon in comparison to the conventional cultivation system (oil palm monoculture). However, little is known about the soil carbon (a proxy for soil ecological sustainability) spatial variability in these systems. We quantified the soil carbon stocks in two oil palm-based agroforestry systems and in one oil palm monoculture in Tome-Acu, which is one of the hotspots of the crop expansion in the Brazilian Amazon. The intraspecific hybrid of oil palm Tenera was planted as the main crop of the agroforestry systems that differed in species composition: a low-diversity system (OP_{low}) and a high-diversity system (OP_{high}). In both systems, oil palm seedlings were planted in double rows interspersed with strips consisting of nine rows of herbaceous, shrub, and tree species. Soil nutrients were applied through organic fertilization in the agroforestry systems and mineral fertilization in the monoculture. Samples were collected at four depths (0-5, 5-10, 10-20, and 20-30 cm) in different distances from the oil palm trunk (0.6, 1.2, 2.0, and 4.0 m) and in three locations (between plants, frond pile, and inter row).

Results/Conclusions

In general, the soil C concentration at all depths was higher in the area closest to the oil palm base (0.6 m) than in the other areas (1.2, 2.0, and 4.0 m), consistent with the distribution of fine roots in such areas. The oil palm-based agroforestry systems showed significantly higher soil carbon stocks than the oil palm monoculture at the 0-30 cm depth (OP_{high} = 56.2, OP_{low} = 51.7, monoculture = 43.3 Mg C ha^{-1}), as well as at the 0-5 and 20-30 cm. At the 5-10 and 10-20 cm depths, the OP_{high} showed higher soil carbon stock than the monoculture, and the OP_{low} showed intermediary values that did not differ from the OP_{high} and monoculture values. The higher carbon stocks in the agroforestry systems very likely resulted from the combination of fire-free land preparation and organic fertilization, whereas the conventional management of the oil palm monoculture may have not favored soil carbon accumulation in

this system. Our results suggest that the cultivation of oil palm in organic agroforestry systems has higher potential to provide ecosystem services linked to the maintenance/improvement of soil quality and climate change mitigation than the cultivation of oil palm in monoculture.

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