Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS03-P06 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

ブラジル・パラ州トメアスーにおける異なる遷移過程のアグロフォレストリーにおける炭素循環
Carbon cycle at different succession stages of agroforestry in Tome-Acu, Para, Brazil

小畑 雄司 [1] ; 木村 園子ドロテア [1*] ; 山田 祐彰 [1] ; イラエ アマラル [2] ; ウメムラ エリオ誠 [1] ; ドスサントス ディナルド　アントニオ [3]
KOBATA, Yuji[1] ; KIMURA, Sonoko dorothea[1*] ; YAMADA, Masaaki[1] ; IRAE, Amaral g[2] ; UMEMURA, Helio makoto[1] ; DOS SANTOS, Dinaldo antonio[3]

[1] 東京農工大学院農学研究院, [2] サンパウロ州立大学ボツカツ校, [3] トメアスー総合農業共同組合
[1]Tokyo University of Agriculture and Technology, Graduate School of Agriculture, [2]Sao Paulo State University, Botucatsu, [3]CAMTA

Introduction

In Tome-Acu, Para, Brazil, farmers plant crops to establish a series of successive harvests that is called Agroforestry System of Tome-Acu (SAFTA: Subler, 1993; Tanaka, 1997). Its sequence is similar to natural succession and farmers can use the fields for a long period (Subler and Uhl, 1990; Subler, 1993; Yamada and Gholz, 2002). Based on farmers experience, the mechanism of SAFTA has not been well documented. Especially the change during the succession or the effect of the change on nutrients and carbon (C) flow has not been documented. Thus, the objective of this study was to clarify the change in C flow during succession and its mechanism to clarify the advantage of SAFTA.

Method

Three different succession stages were selected; since 2008 (6 years old; 6YO), since 2002 (12YO) and since 1980 (34YO). The C flow was analyzed by measuring the C abundance in (1) aboveground biomass, (2) soil, (3) litter and (4) yield and (5) the carbon dioxide (CO_2) emission from soil. In addition to the agroforestry field, abundance of C in soil and litter as well as soil respiration were monitored in a secondary forest. The measurement was conducted from September 2012 to July 2014. The C balance was calculated by the difference of all input (aboveground biomass increase, litter and harvested yield) and output (soil respiration and yield residue).

Result and Discussion

The increase of aboveground biomass of cocoa from 2013 to 2014 was 3.2 kg tree $^{-1}$ in 6YO and significantly larger than other stages (1.5 and 1.9 for 12YO and 34YO, respectively) The yield of cocoa was highest in 12YO and contained 3.3 kg-C tree^{-1}. The yield in 6 and 34YO were almost same with 1.5-1.9 kg-C tree^{-1}. Litter was highest in secondary forest with 8.2 Mg C ha^{-1} year^{-1}. The litter of 6YO, 12YO and 34YO increased with the age, and were 4.6, 5.6 and 7.1 Mg C ha^{-1} year^{-1}, respectively.

Soil carbon stock from 0 to 30 cm depth was 109.8 Mg ha^{-1} in secondary forest, those for 6YO, 12YO and 34YO were 57.4, 77.7 and 101.3 Mg ha^{-1}, respectively. There was no significant difference among them. But as the agroforestry stages progressed, the amount of litter fall and soil carbon tended to increased.

Soil respiration rate in litter removed chamber (L-) in secondary forest was 129 mg CO_2-C m^{-2} h^{-1}, those for 6YO, 12YO and 34YO were 81, 84 and 92 mg CO_2-C m^{-2} h^{-1}, respectively. Soil respiration rate in chamber with litter (L+) in secondary forest was 176 mg CO_2-C m^{-2} h^{-1}, those for 6YO, 12YO and 34YO were 77, 104 and 113 mg CO_2-C m^{-2} h^{-1}, respectively. The soil respiration rate in removed litter chamber was significantly lower than the chamber with litter in each site except 6YO. The respiration is the sum of root respiration and soil organic matter decomposition. The high soil respiration rate in secondary forest can be attributed to the litter fall as well as the high amount of roots.

Soil respiration rates in this study were similar to results reported for tropical forest in Brazil (59-139 mg CO_2-C m^{-2} h^{-1} (Fernandes et al. 2002; Davidson et al. 2000), but lower than that of pasture in Brazil (117-317 mg CO_2-C m^{-2} h^{-1} (Fernandes et al. 2002). It was suggested that carbon turnover in agroforestry is similar to forest and harder to decompose compared with herbaceous plant in pasture.

As a consequence, the C balance in 6YO, 12YO, 34YO were 4.1, 4.5, 3.9 ton C ha^{-1} year^{-1}, respectively.

Conclusion

Our results showed that the amount of litter fall and soil C increased as the agroforestry stages progressed, indicating a higher internal nutrient cycling according to the Agroforestry age. All agroforestry stages in this study were found to be a C sink. The applied fertilizer at the younger age will be stored in the aboveground plant parts, as well as in the soil.

キーワード: 熱帯土壌, 土壌呼吸, 炭素循環, アグロフォレストリー
Keywords: Tropical soil, Soil respiratoin, Carbon cycle, Agroforestry