PA198 Soil Properties under Arabica Coffee Culture in Long-Term Face Experiment.

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Ecosystem responses to rising [CO_2] are a major source of uncertainty in climate change projections. The artificial facilities, as Free-Air-CO_2-Enrichment-systems (FACE) are suitable for investigating the plant responses and the effects of elevated [CO_2] on whole ecosystems. The hypothesis of this study was that the physical soil properties, both with soil N and C, would suffer modifications over the soil profile during Brazilian FACE experiment established to follow Arabica coffee and ecosystem responses to rising [CO_2].

Coffee plants were exposed to elevated air [CO_2] under FACE facility from winter 2011. Plants were grown under actual (~390 µL CO_2 L^{-1}, named a[CO_2]), and elevated air [CO_2] (actual + 200 µL CO_2 L^{-1}, named e[CO_2]). The soil was collected in all 12 octagonal plots exposed to e[CO_2] and a[CO_2] in January 2013, and in two particular plots in July 2015. The sampling in Kopeck rings included 5 - 7 soil depths from 0 - 60 cm, effectuated 30 cm from coffee lines. Granulometry analyses were performed by pipette method based on Stoke's law, bulk density and porosity were analyzed on tension table, total C and N content were determined on Leco Truspec CHN, while organic C was combusted in muffle furnace. Analyses were made in bi- and triplicates.

Soil macro-, micro- and total-porosity were higher under a[CO_2] than e[CO_2] in 2013. The situation was inverted in 2015, showing higher porosity under e[CO_2] than a[CO_2] that diminished gradually to 40 cm of depth. Values of soil porosity were reduced from 2013 to 2015, and reductions were more expressed under a[CO_2] than e[CO_2]. The soil density was higher under e[CO_2] than a[CO_2] in 2013, and situation was inversed in 2015. The compaction occurred in plowed layers (0 - 20 cm), because the soil management and weed control in octagonal rings were executed manually, while the physical structure in the beginning of 2013 still had the impacts of experiment establishment. The soil humidity was higher in e[CO_2] than a[CO_2] only in the dry winter period of 2015. Total C and N content in 2015 were higher under e[CO_2] than a[CO_2] in all observed depths with exception of the 0 - 5 cm where the response to air [CO_2] was inverted. In a case of C, this inversion was due to inorganic C content, since the organic C did not differ between two air [CO_2] treatments for this soil layer.

After long-term experiment, soil physical properties were improved under e[CO_2] compared to a[CO_2]. In the dry winter period of 2015, the plant leaf area under e[CO_2] was about 50% lower than a[CO_2] (Rakocevic et al., in press), likely associated with more violent coffee leaf rust disease under e[CO_2]. Lost leaf mass could better preserve the soil humidity, permitting quicker leaf C decomposition on soil surface and slower in deeper soil layers. The higher C and N contents over the soil profile under e[CO_2] suggest the presence of higher mass of microorganisms, small animals, and coffee roots formation and decomposition that have to be investigated in the future.

Keywords: Arabica coffee; elevated [CO_2]; soil density; soil porosity; soil profile.

Reference

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