ABSTRACT

Sequestering Carbon and Improving Soil Fertility Using Organic Amendments

Renaldo Belfon

Biochar is thought to be more effective at sequestering carbon and improving soil fertility than traditional amendments. However, few direct comparisons have been conducted to support this claim. The primary aim of this research was to compare biochar's ability to sequester carbon and improve soil fertility with that of spent mushroom substrate compost (SMS) compost and corn stalks, while the impact of the aforementioned amendments on early plant growth was examined using soil-based and soil-less bioassays. The mechanics behind the interpolation methods used to estimate stability was also probed using cross-validation techniques.

A range of cross validation techniques were used to compare linear, natural cubic spline and constrained cubic spline interpolation methods for estimating carbon dioxide flux. Linear interpolation accurately predicted most measured data points but produced non-smooth curves whereas natural cubic spline interpolation produced relatively smooth curves but had low predictive accuracy. Constrained cubic spline interpolation produced the smoothest curves while its predictive accuracy was comparable to that of linear interpolation. This suggests that the constrained cubic spline interpolation technique may be more suitable for

estimating soil CO_2 flux than other tested methods as it fits the data more realistically.

Biochar had the lowest decomposition rate among amendments in an 80-day incubation but had no influence on soil fertility indicators apart from increasing the pH of acidic soils. The opposite was observed with corn stalks, which suggest that these amendments may be better suited to sequestering carbon and improving soil fertility respectively. SMS compost was relatively resistant to decomposition, increased soil pH, available nitrogen and MBC content. This suggests that SMS compost may be ideal for fulfilling both needs but it increases soil salinity to levels potentially harmful to plant growth.

A soil-based bioassay indicated that corn stalks and SMS compost had more adverse effects on early plant growth and development than biochar. However, unlike other amendments SMS compost improved the vigour of cucumber seedlings. Results suggest that biochar is unlikely to be more harmful to plant growth than traditional amendments but does not provide comparable agronomic benefits to some plants. Further, comparisons between soil-based and Petri-dish bioassays suggest that the latter method is ineffective at screening biochar toxicity.

Keywords: Climate change; Carbon dynamics; Interpolation; Cross Validation; Organic amendments; Tropical agriculture; Phytotoxicity.