Effect of Carbonized Biomass Application on Carbon Accumulation and Soil Respiration

Sun-il Lee* · Woo-Kyun Park · Gun-yeob Kim
Climate Change & Agroecology Division, National Institute of Agricultural Sciences
silee83@korea.kr

Rural Development Administration
National Institute of Agricultural Sciences

Abstract

Carbonized biomass is a carbon-rich solid product obtained by the pyrolysis of biomass. It has been suggested to mitigate climate change through increased carbon storage in soils. The carbonized biomass was made a mobile **pyrolyzer with field scale**, which a reactor operated about 400 ~ 500℃ for 2 hours using soybean residue. A pot experiment with soybean in sandy loam soil was conducted for 133 days in a greenhouse, by a completely randomized design with three replications. The treatments were consisted of a control without input of carbonized biomass and three levels of carbonized biomass inputs as 9.75 Mg ha^{-1}, C-1 ; 19.5 Mg ha^{-1}, C-2 ; 39 Mg ha^{-1}, C-3. A facility of BAPS (Barometric Process Separation) was used to determine soil respiration. It was appeared that soil respiration rate were 347.1 ㎍ CO_2 kg^{-1} h^{-1} for control, 467.7 ㎍ CO_2 kg^{-1} h^{-1} for C-1, 562.2 ㎍ CO_2 kg^{-1} h^{-1} for C-2 and 934.5 ㎍ CO_2 kg^{-1} h^{-1} for C-3 at the end of experiment. It was shown that the soil carbon contents were 9.76 g kg^{-1} for C-1, 13.43 g kg^{-1} for C-2, 17.24 g kg^{-1} for C-3 and 6.16 g kg^{-1} for the control after experimental periods. The contents of accumulated soil carbon were significantly ($P < 0.01$) increased with enhancing the carbonized biomass input amount. The slopes (0.282) of the regression equations are suggested that carbon storage from the soil was increased about 0.282 g kg^{-1} with every 1 Mg ha^{-1} of carbonized biomass input amount.

Objectives

The objective of this study was to evaluate soil respiration and carbon storage to application of carbonized biomass derived from soybean residue.

Materials and methods

○ Chemical properties of the studied soil

Soil Texture	pH (1:5)	EC (dS m^{-1})	OM (g kg^{-1})	T-N (g kg^{-1})	Av.P_2O_5 (g kg^{-1})	1N NH4OAc Extractable K	Ca	Mg
						----($cmol^+$ kg^{-1})----		
Sandy loam	7.8	0.55	15.8	0.92	369	0.29	10.7	3.46

○ Chemical properties of the carbonized biomass

	pH (1:10)	EC (dS m^{-1})	TC	TN	C/N ratio
			---(g kg^{-1}) ---		
Carbonized biomass	10.0	1.35	555.8	7.4	75

○ Process of carbonized biomass

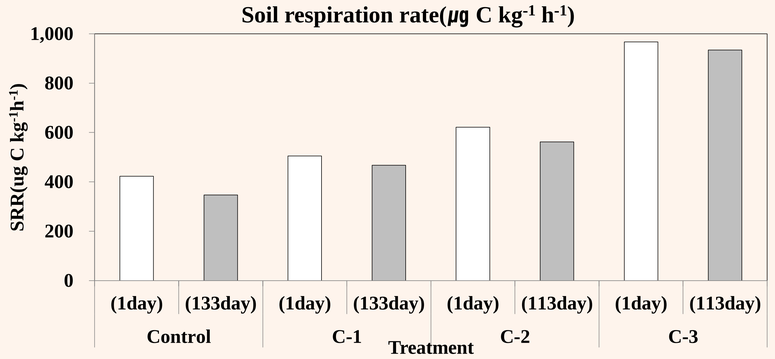
〈Soybean residue〉 〈Pyrolyzer〉 〈Carbonized biomass〉

○ Treatment

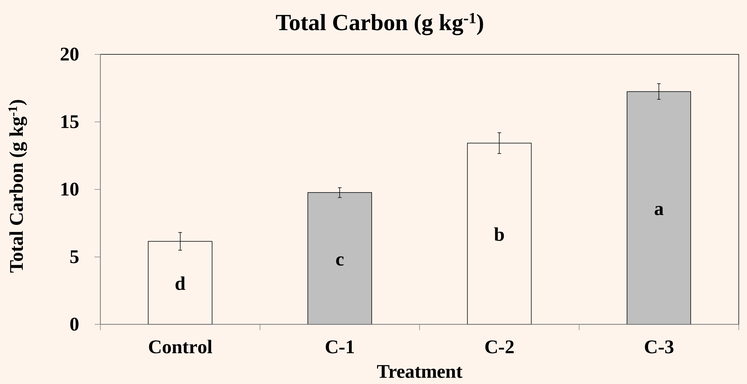
Treatment	Control	C-1	C-2	C-3
Carbonized biomass input	-	9.75 Mg/ha	19.5 Mg/ha	39 Mg/ha

Results

○ Respiratory quotient during experiment periods using BAPS system



○ Carbon contents of the soil after 133 days of the treatments



Conclusion

The carbonized biomass for byproducts such as soybean residue could increase soil carbon. It might be considered that the experimental results will be applied to soil carbon sequestration for future study. More long-term studies are needed to prove how long does soil carbon stay in agricultural soils.