

Biochar combined with manure application can decrease organic matter decomposition compared to manure alone in the dry tropical cropland of south India



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Introduction

- Soils in the dry tropical croplands of south India are inherently low in soil carbon (C) stock and it is essential to accumulate the soil C for sustainable soil management and mitigating climate change
- Biochar is generally considered to be an useful material that enhance the soil C stock, though biochar's real effect on soil C dynamics is still unclear especially in the alkaline tropical croplands such as south India

Our objective was ...

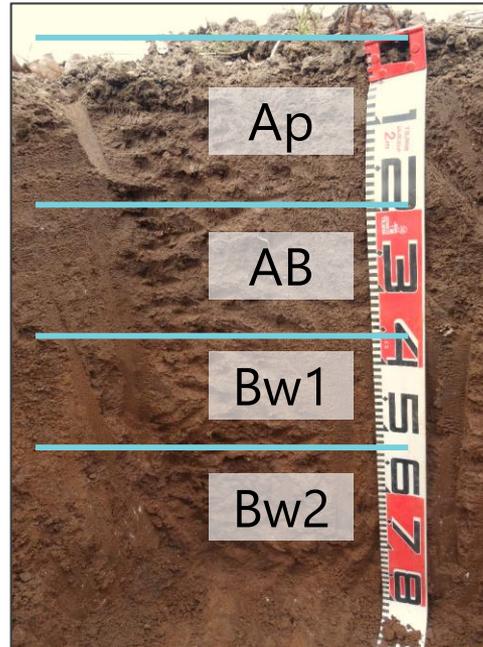
to evaluate the effect of biochar application on soil C dynamics for optimal soil management in south India

Materials and Methods

□ Study site



Study site



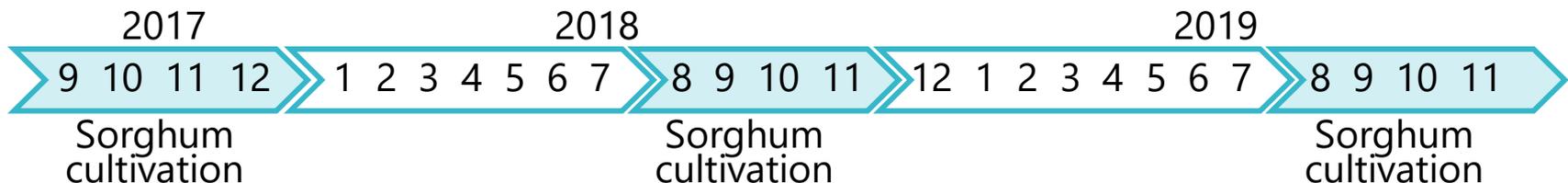
Soil profile of study site

pH(H ₂ O)	TC (g kg ⁻¹)	Clay (%)
8.5	3.3	27.2
8.8	2.5	25.1
8.7	1.2	26.1
8.6	1.1	30.4

- ◆ Annual rainfall: 800 mm
- ◆ Average air temperature: 28.2 °C
- ◆ Soil classification: Cambisols (WRB)

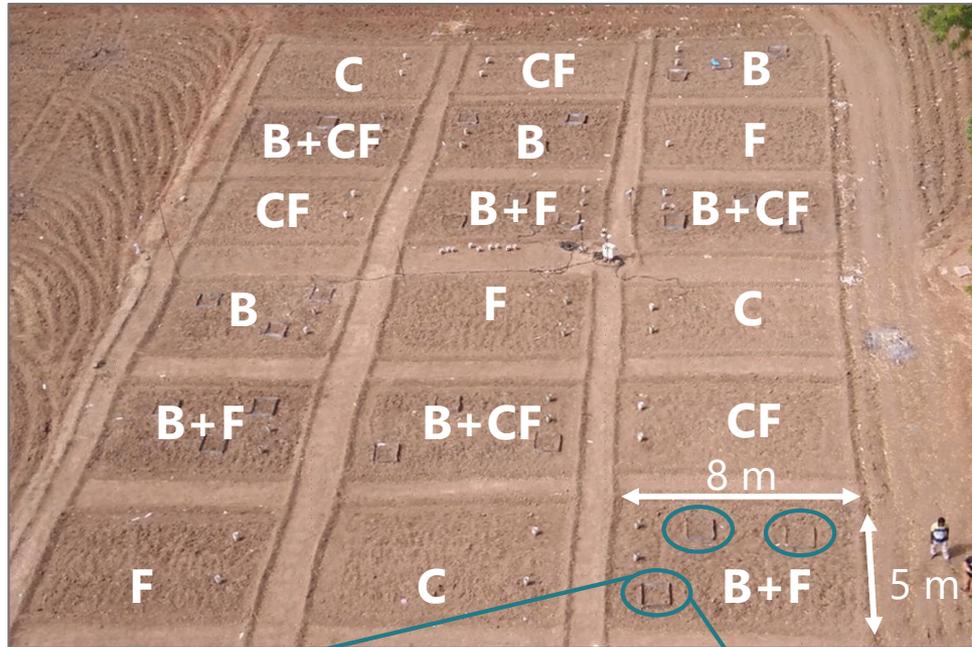
□ Experimental schedule

We conducted a field experiment from Sep.2017 to Dec.2019



Materials and Methods

□ Experimental design

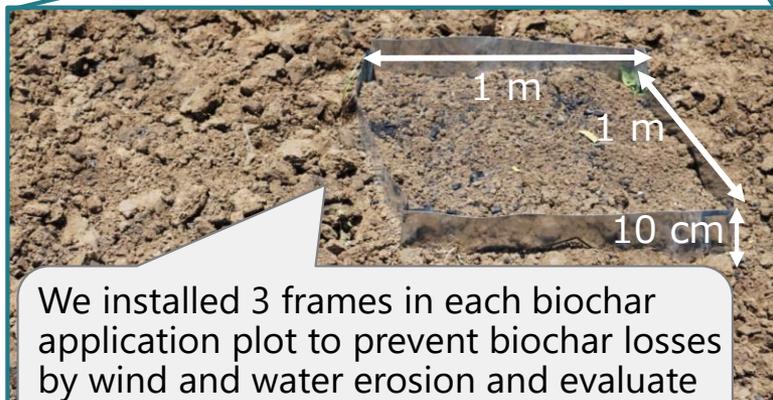


6 treatments with 3 replicates

Application amount ($\text{ha}^{-1} \text{ yr}^{-1}$)
C; Mg N; kg

◆ Control (C)		
◆ Biochar (B)	8.2*	
◆ Farmyard manure (F)	1.1**	100
◆ Chemical fertilizer (CF)		100
◆ Biochar + FYM (B+F)	8.2+1.1	100
◆ Biochar + CF (B+CF)	8.2	100

* applied only in the 1st year (10 Mg ha^{-1})
** conventional amount of local farmers



We installed 3 frames in each biochar application plot to prevent biochar losses by wind and water erosion and evaluate the effective duration of biochar in soil

Biochar material: Mequite (*Prosopis Juliflora*)



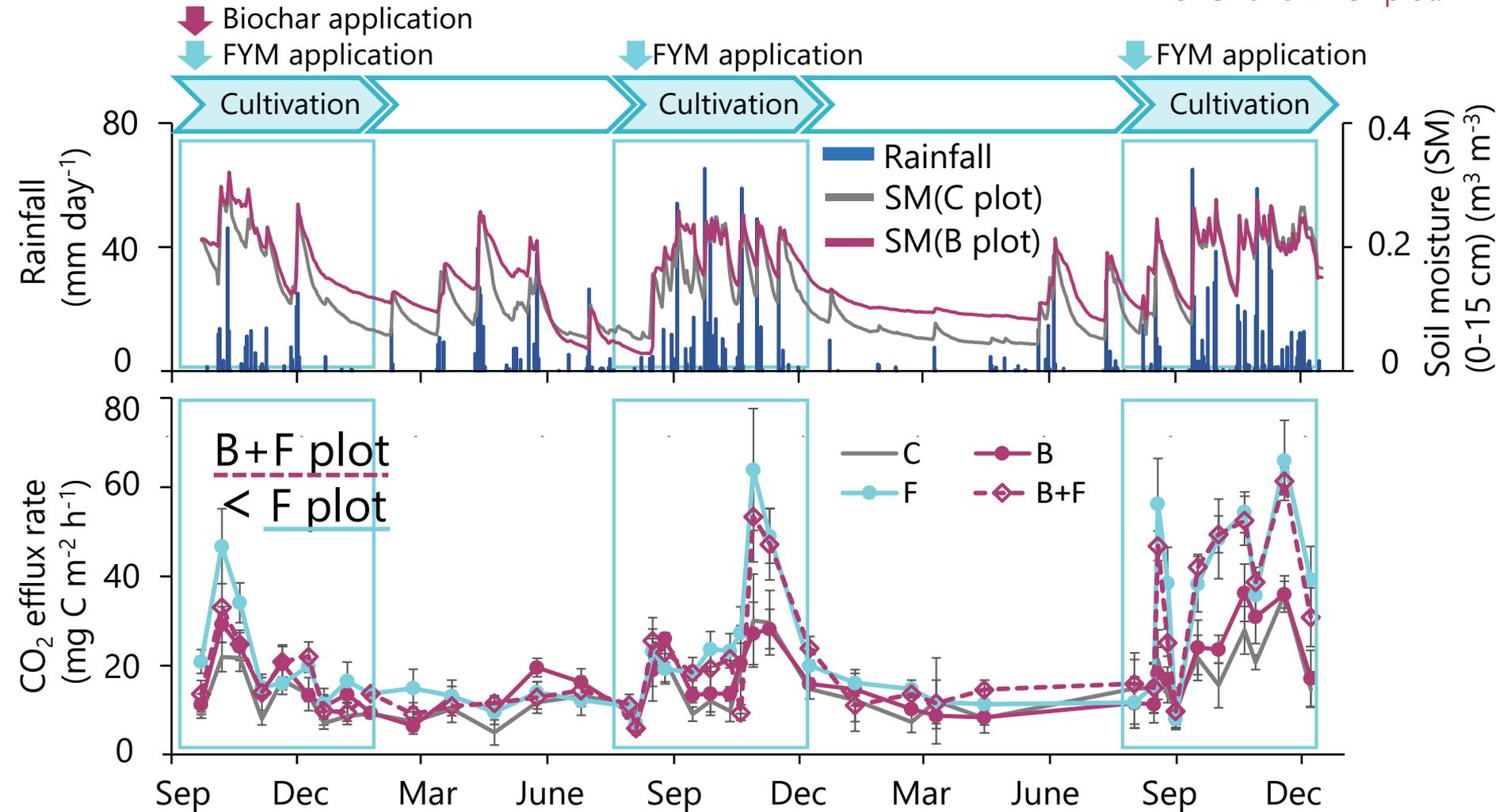
- Invasive species in the dry areas such as India and Africa
- Eradication is recommended

We utilized "charcoal powder" derived from mesquite

Results and Discussions

□ Environmental data and CO₂ efflux rate

※ Here we excluded the data of CF and B+CF plot.

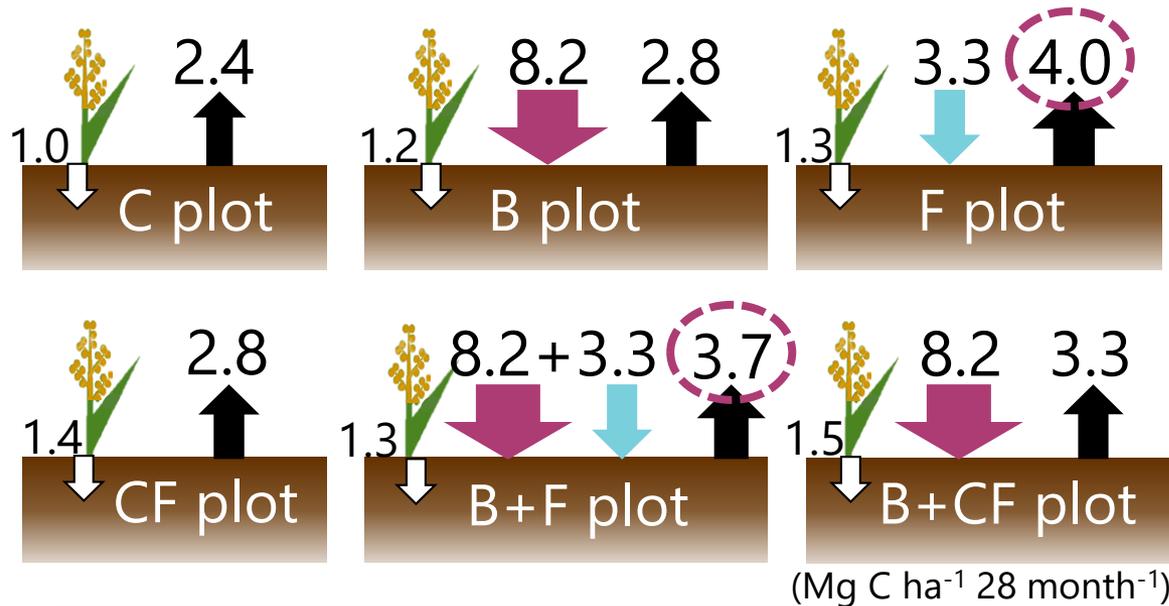


➤ CO₂ efflux rate in the B+F plot was significantly lower than the F plot only during the cultivation period of 1st year ($p < 0.05$)

Results and Discussions

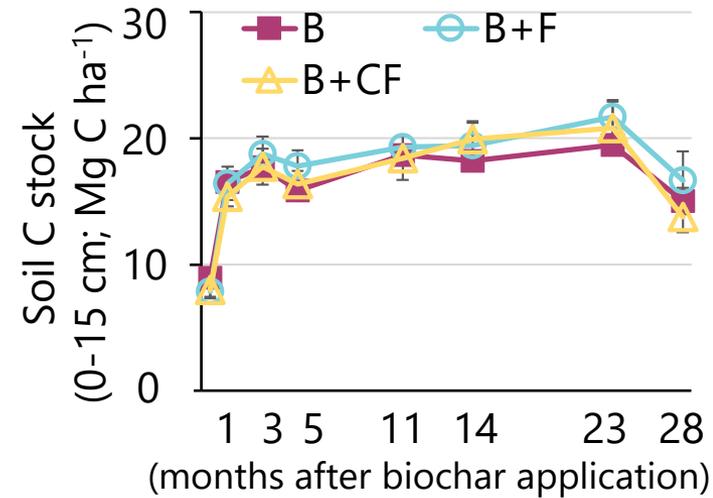
Soil C budget

We estimated the cumulative CO₂ flux as C output, based on the relationship between the CO₂ efflux rate and environmental data such as soil moisture and temperature



↑ Cumulative CO₂ flux ↓ Biochar application
↓ Root-derived C ↓ FYM application

Surface soil C stock



➤ Inside the frames of biochar application plot, C derived from biochar didn't clearly loss (70-90 % of the applied amount persisted)

- Cumulative CO₂ flux in the B+F plot (3.7) < F plot (4.0)
- Biochar combined with FYM application decreased the soil microbial activity, resulting in the lower decomposition in the B+F plot

Conclusion

- Biochar combined with FYM application depressed 0.3 Mg C ha⁻¹ organic matter decomposition a few months after biochar application (only in the 1st year of the experiment).
- Our result of soil C budget for 28 months indicates that biochar and FYM application would be the best land management for soil C sequestration.

Future plans...

- To find out the mechanism that biochar and manure application depress organic matter decomposition, we evaluate the effect of changes in microbial community composition on organic matter decomposition

