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SHAN DONG WEIFANG TOBACCO CO.,LTD

CORESTA 2021 Agro-Phyto Virtu@l

Effect of wheat straw and its biochar on physical and enzymatic properties of tobacco-growing soil

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CONTENT

There is only one world.

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Background

Relief map of Shandong Province

the earliest tobacco planting area in China

the most important tobacco growing areas in Shandong province

tobacco fields mainly concentrated in hilly and mountain areas

- **Annual tobacco straw removal and insufficient exogenetic organic matter input exacerbated tobacco-planting soil degradation**

Removal of tobacco straw to avoid soil borne disease

Tobacco straw removal

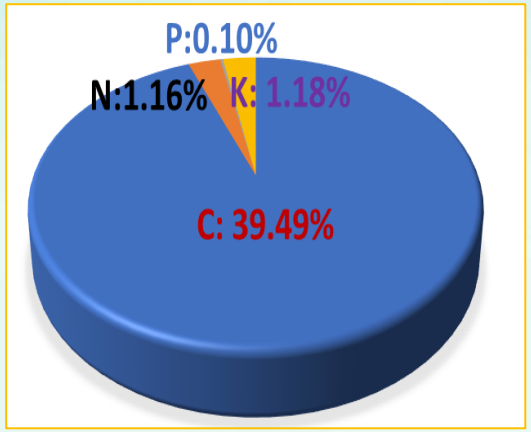
Black shank

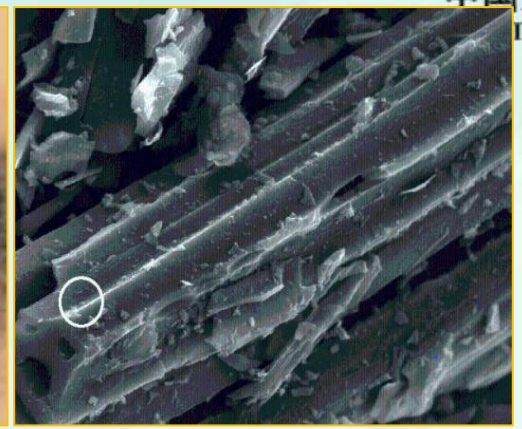
Tobacco-planting soil degradation

Soil compaction

Nutrient imbalance

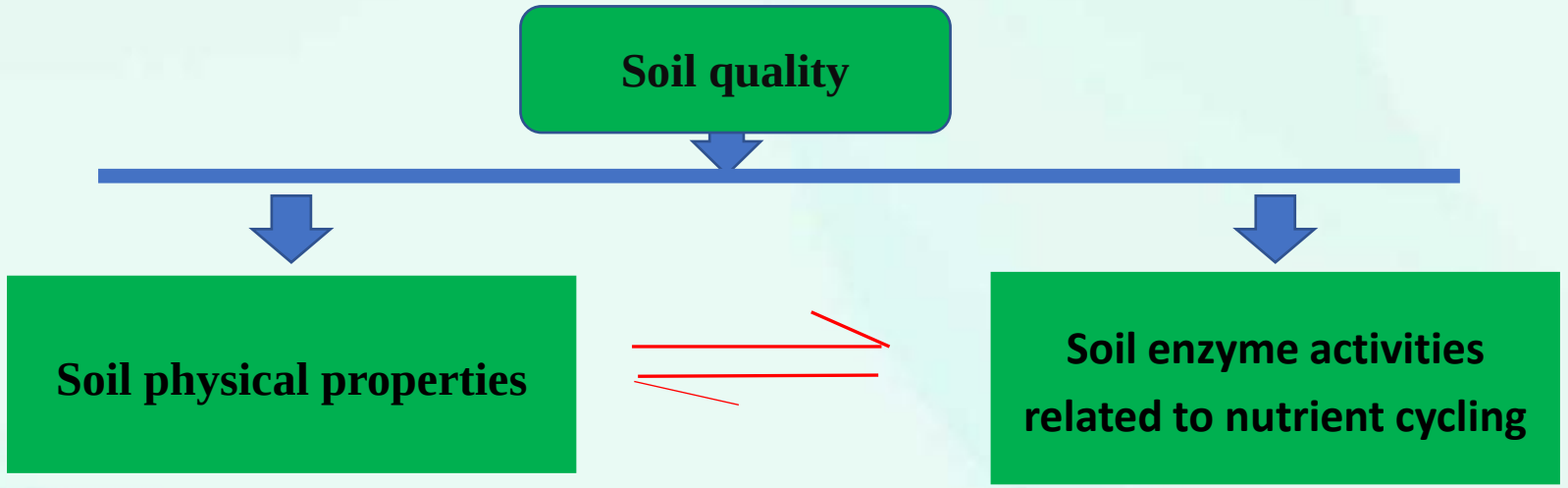
➢ Comparative effect of wheat and wheat straw-derived biochar on soil quality improvement





Wheat straw VS biochar

Objective



Experiment design and method

Four treatments:

CK: chemical fertilizer only (control)

WS: chemical fertilizer plus 6.75 t hm^{-2} wheat straw

FB1: chemical fertilizer plus 2.25 t hm^{-2} wheat straw-derived biochar

FB2:chemical fertilizer plus 4.5 t hm^{-2} wheat straw-derived biochar



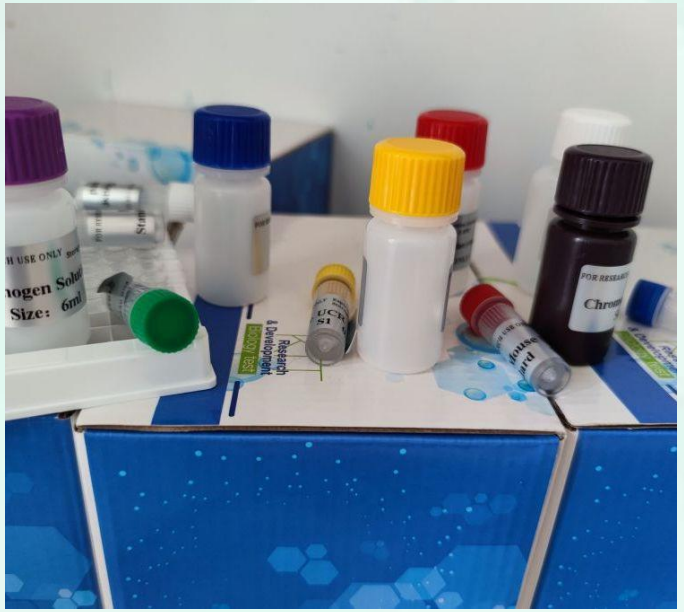

METHOD

Wet sieving fractionation

Soil bulk density

Six aggregate size fractions: > 2 mm,
1-2 mm, 0.5-1 mm, 0.25-0.5mm, 0.106-0.25 mm and < 0.106 mm

Detection of soil enzyme activity



Activities of sucrase, urease, phosphatase, catalase

Result

➢ Soil bulk density (0-40 cm)

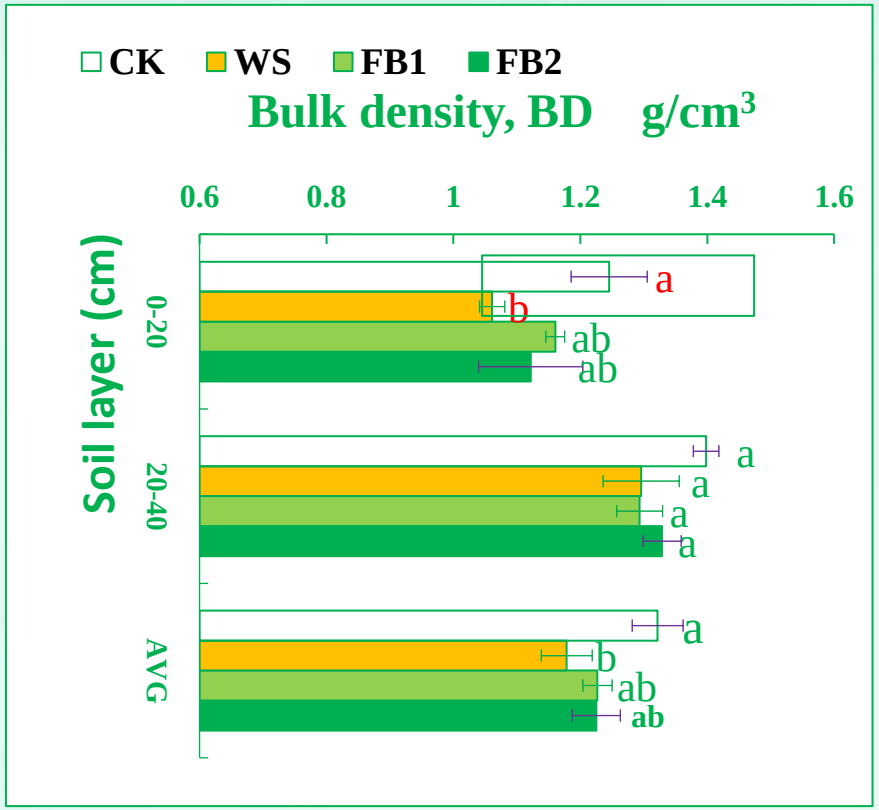


Fig 1. Change of soil bulk density at 0 - 40 cm depth under different treatments

➢ Soil field capacity

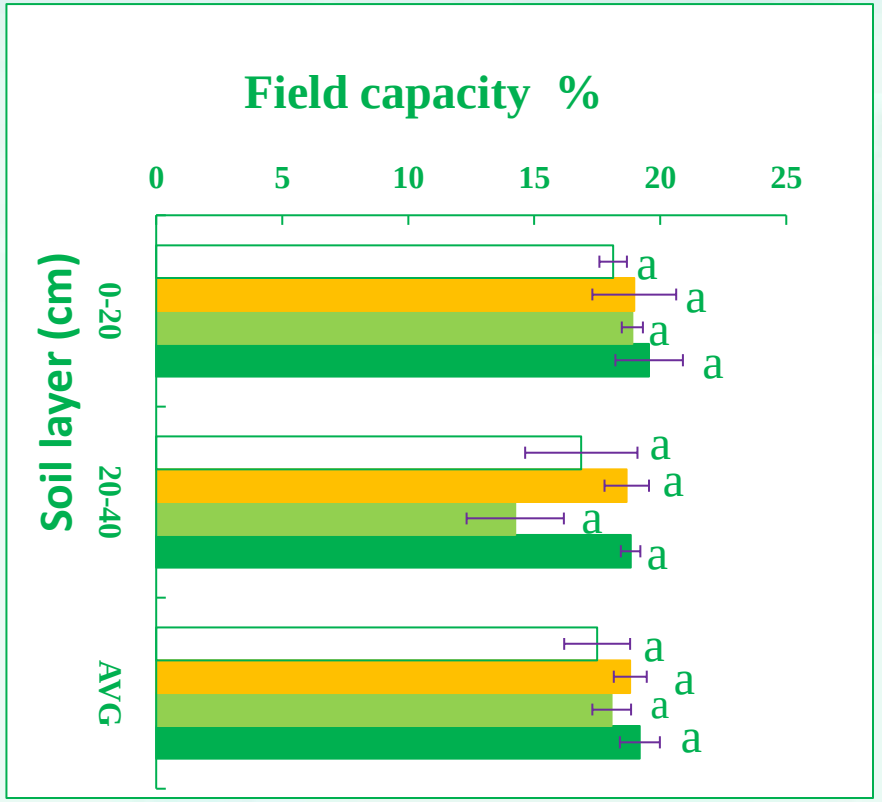


Fig 2. Change of soil field capacity at 0 - 40 cm depth under different treatments

Compared with CK, wheat straw incorporation could decrease **bulk density** (0-20 cm), whereas different adding amount of biochar showed no obvious difference.

Significant difference of the **field capacity** was not observed among different treatments.

Fraction of soil water stable aggregate

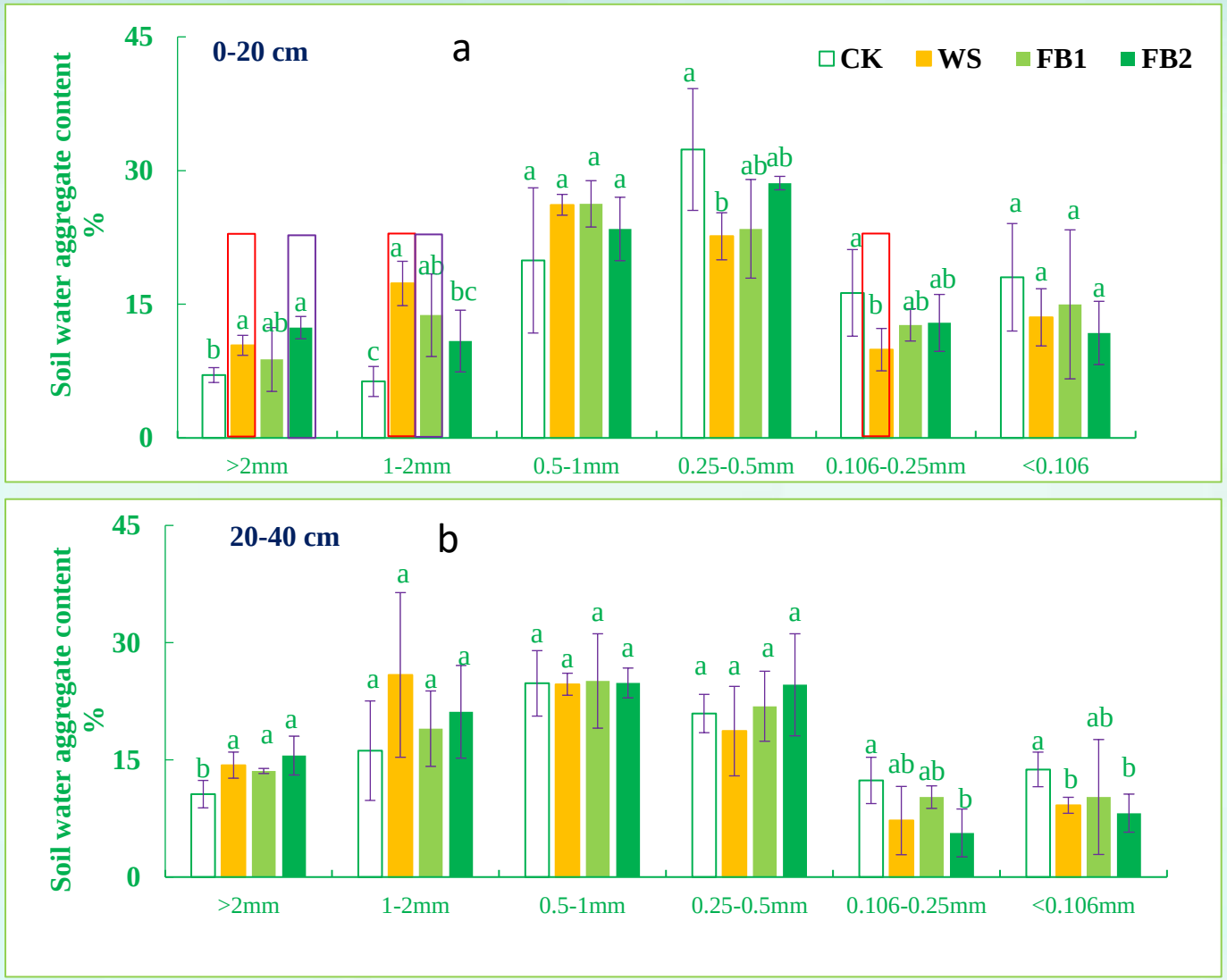


Fig 3. fraction of soil water stable aggregate at 20 - 40 cm depth under different treatments

The WS treatment increased **the >2 mm, 1-2 mm** water-stable aggregate content, whereas decreased **0.106-0.25** mm water-stable aggregate content compared with CK.

Biochar treatments (FB1, FB2) also increased the content of **> 1 mm** soil water stable aggregates.

Stability of soil water stable aggregate

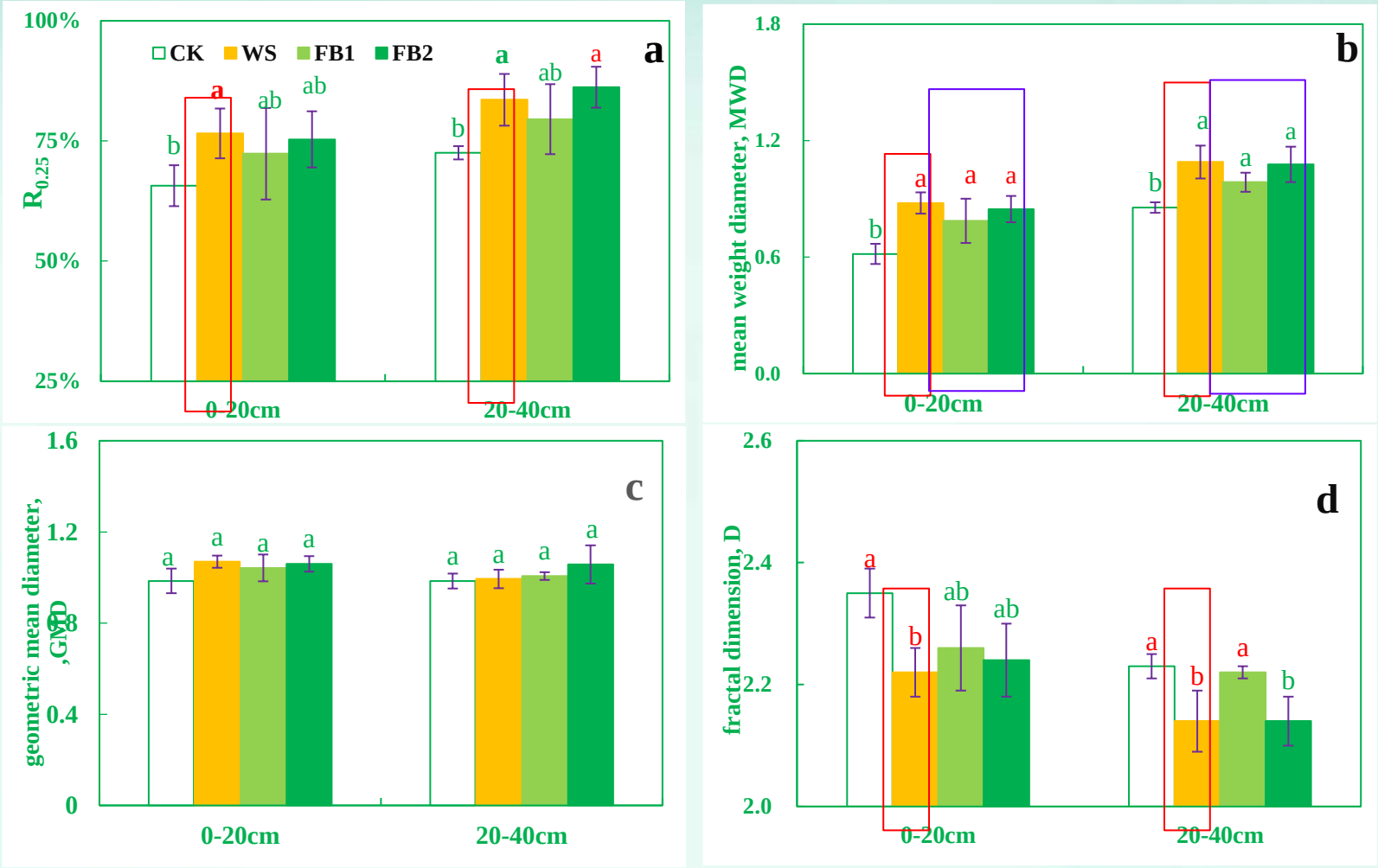


Fig 4. stability of soil water stable aggregate at 0 - 40 cm depth under different treatments

In comparison with CK, the WS treatments could improve content of > 0.25 mm aggregates ($R_{0.25}$), mean weight diameter (MWD) and fractal dimension(D), FB1 and FB2 treatments only improved MWD .

➢ Correlation among soil aggregate content and stability evaluation index

Table 1. Correlation among soil water stable aggregate and stability evaluation index under different treatments

soil layer cm	index	>2mm	1-2mm	0.5-1mm	0.25-0.5mm	0.106-0.25mm	<0.106
0-20	MWD	0.768**	0.687*	0.667*	-0.293	-0.760**	-0.789**
	GMD	0.691*	0.598*	0.735**	-0.131	-0.727**	-0.921**
	$R_{0.25}$	0.594*	0.581*	0.722**	0.089	-0.855**	-0.937**
	D	-0.659*	-0.704*	-0.707*	0.193	0.789**	0.872**
20-40	MWD	0.697*	0.694*	-0.166	-0.020	-0.713**	-0.655*
	GMD	0.023	0.628*	-0.251	-0.020	-0.701*	-0.196
	$R_{0.25}$	0.753**	0.360	0.176	0.422	-0.711**	-0.851**
	D	-0.561	-0.642*	0.075	0.016	0.750**	0.553

MWD, GMD, $R_{0.25}$, and D showed **strong positive or negative correlation** with different particle sizes of water stable aggregates.

➢ Enzyme activity

Table 2. Effect of straw incorporation and straw derived biochar on soil enzyme activity

Soil layer cm	Treatment	Sucrase mg glucose g^{-1} dry soil·$24h^{-1}$	Urease μg NH_4^+N g^{-1}drysoil·$24h^{-1}$	Phosphatase mg P nitro-phenol released g^{-1}dry soil·h^{-1}	Catalase 0.1NKMnO_4·g^{-1}dry soil·h^{-1}
0-20	CK	26.51±2.82b	1023.01±48.46b	0.74±0.08b	53.47±0.46a
	WS	56.34±7.43a	1102.95±14.29a	1.00±0.12a	52.70±0.94a
	FB1	37.95±8.42ab	1029.61±53.69b	0.74±0.17b	51.26±3.60a
	FB2	32.82±9.40ab	929.77±125.11b	0.63±0.05b	53.44±0.39a
20-40	CK	18.49±1.86b	950.19±132.61a	0.59±0.03b	53.72±0.22a
	WS	32.02±4.02a	1027.65±60.66a	0.78±0.11a	53.68±0.38a
	FB1	32.42±2.87a	1007.35±48.64a	0.71±0.07a	53.67±0.21a
	FB2	25.16±8.61ab	929.77±125.12a	0.59±0.11b	53.69±0.54a

The WS treatment significantly increased activities of sucrase, urease, phosphatase (0-20 cm) compared with CK application, respectively.

The enzyme activities treated by FB1 and FB2 showed little difference compared with CK.

➢ Correlation among soil physical index and soil enzyme activity

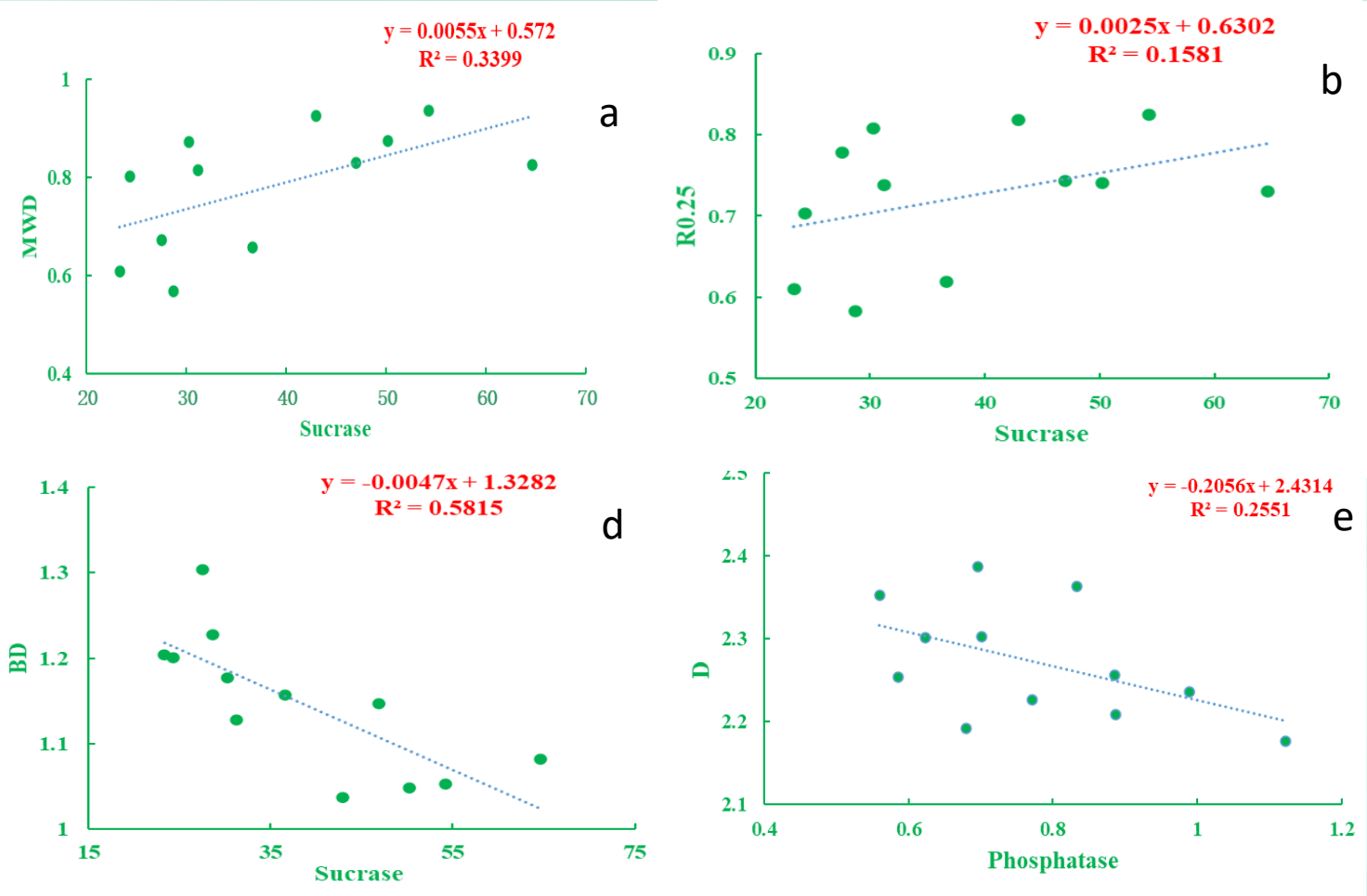


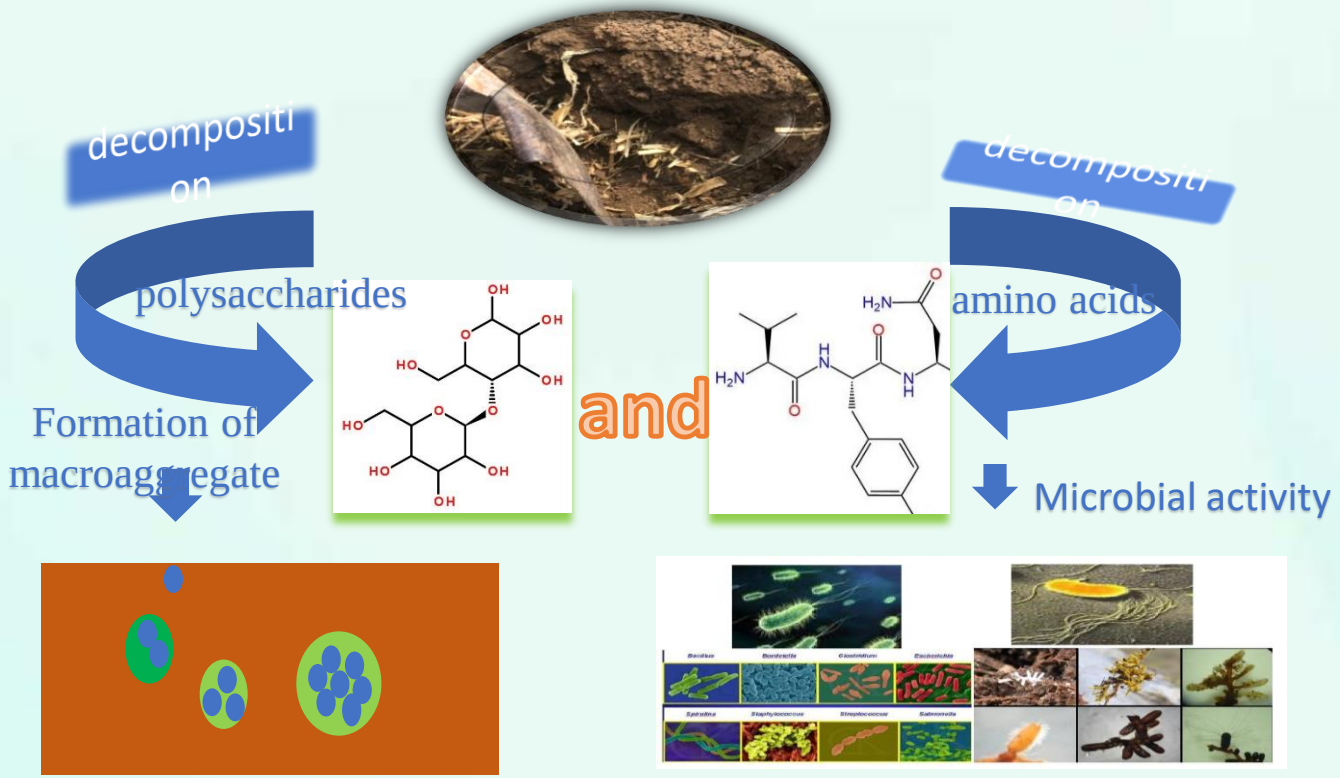
Fig 5. correlation among soil physical index and enzyme activities among different treatments at soil depth of 0-20 cm (a, b, c, d, e)

Sucrase was positively correlated with MWD and $R_{0.25}$, and negatively correlated with D and bulk density. Phosphatase was negatively correlated with D.

The result showed enzymes related to soil C, P cycling are more sensitive to changes in soil physical index.

Conclusion

- Straw incorporation directly promoted the formation of soil macroaggregates, improved stability of soil structure and soil enzyme activity.



- Different adding amount of biochar increased the content of soil macroaggregates, but had little effect on enzyme activity

- Enzymes related to soil C, P cycling are more sensitive to changes in soil physical index.

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