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Conservation tillage influence on topsoil aggregation and carbon content on the Loess Plateau , China

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Key words : soil property , organic carbon , no-till , stubble retention , sustainability

Introduction In the Loess Plateau , the deterioration of the environment and in particular soil erosion are severe . In addition to frequent droughts in the area , soil is characterized as both having poor structural stability and as being infertile . Conservation tillage is believed to have beneficial effects on agricultural production , the environment and the economy . This paper reports the findings of a study which investigated the soil aggregation stability , total carbon , organic carbon and inorganic carbon under different tillage methods , in doing so it has aimed to confirm which tillage method and soil management program is most suited to the Loess Plateau .

Materials and methods This long term conservation tillage experiment was carried out in the western Loess plateau (35°40' N , 107°51' E) . Long-term average rainfall was 562 mm . Treatments were conventional tillage (T) , conventional tillage with stubble retention (TS) , no-till (NT) and no till with stubble retention (NTS) . A completed randomized block design with four replications was used . The soil samples were collected after wheat harvest and analyzed for the proportion of water-stable aggregates (>0.25mm) by wet sieving method . Total carbon (TC) , total organic carbon (TOC) and total inorganic carbon (TIC) were measured by use of the combustion method with liquiTOC (elementar , Germany) .

Results In the 0-2.5 , 2.5-5cm layers , the highest water stable aggregate (>0.25mm) , organic carbon and total carbon content for were measured under NTS treatment , however for the 5-10cm layer these measurements were highest under the TS treatment . Stubble retention with no-till had a significant effect on increasing the content of water-stable aggregates , OC and TC content for 0-5 cm depth , compared with those under the T treatment . No-till increased the organic carbon proportion within the total carbon pool significantly . There was a significant positive correlation between aggregate and OC content for top soil (P<0.01) (see table) .

Table 1 Water stable aggregates proportion and Carbon content under different tillage treatments after seven years implementation .

Soil depth (cm)	treatment	Water-stable aggregate proportion (%)>0.25mm	OC(g kg ⁻¹)	TC(g kg ⁻¹)	OC/TC
0-2.5	T	35.51	6.32	16.93	0.38
	TS	26.72	6.96	17.77	0.39
	NT	35.85	7.76	17.68	0.44
	NTS	37.85	9.40	19.08	0.49
	LSD _{0.05}	4.72	1.02	1.829	0.075
2.5-5.0	T	19.3	6.40	16.58	0.39
	TS	22.03	5.83	17.30	0.35
	NT	28.83	6.84	17.02	0.40
	NTS	32.03	8.43	18.56	0.46
	LSD _{0.05}	4.51	0.94	1.99	0.073
5.0-10.0	T	17.59	6.01	16.79	0.36
	TS	23.53	6.64	17.51	0.38
	NT	21.98	6.00	16.61	0.36
	NTS	18.98	6.657	16.97	0.39
	LSD _{0.05}	4.9	0.874	1.739	0.072

Conclusion Conservation tillage had obvious effects on soil organic carbon improvement after seven years of implementation . Soil properties under conservation tillage were both more suitable for crop growth and long-term soil sustainability , both of which will be beneficial to developing a more sustainable farming system in the Loess plateau .