Comparison of aggregates content and carbon proportion of top soil in perennial forage

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Introduction Carbon storage in cropland soil , a potentially huge carbon pool , accounts for approximately 10% of global terrestrial carbon storage . In croplands , tillage is one of the key drivers behind the degradation of soil stability and leads to the accelerate decomposition of soil organic carbon . Perennial forages are widely accepted as being beneficial to the storage of soil organic matter and the formation of the soil aggregates , which can effectively improve and enhance soil fertility . In this study the carbon sequestration rate was estimated to be on average 0. 332Mg . ha^{-1} . a^{-1} after cropland was converted to forage land , this outcome has positive effects in terms of improving sustainable agriculture , including a reduction in CO_2 emissions . The purpose of this study was to compare the carbon fixation rates of various perennial forage at different topsoil depths .

Materials and methods This study was carried out in the western Loess plateau (35°40′N , 107°51′E) , which has an annual rainfall of 562 mm . In 2002 , seven different species of forage were sown . In august of 2007 , soil samples from 0-5cm and 5-10cm depths were collected , with six subsamples collected using a cutting ring (volume of 200 g cm^{-3}) to determine bulk density . The proportion of water-stable aggregation (>0 .25mm) was measured by wet sieving . Total organic carbon (TOC) , total carbon (TC) were determined through a combustion method using liquiTOC (elementar , Germany) .

Results For the 0-5cm layer , water-stable aggregates (>0 .25mm) was the highest under bromegrass . The TC ranged between 19 .687-25 .75 g/kg , with the highest under clover . Every index measured was significant lower in the 5-10cm layer compared to 0-5cm layer , with water-stable aggregates reduced by 50% , and TOC and TC declining by approximately 20% (see table) . A significant positive correlation was found between water-stable aggregates (>0 .25mm) and TOC/TC (R = 0 .340* and 0. 448** , respectively) .

Table 1 *Water-stable aggregates(>0 .25mm) ,carbon content and bulk density of 7 different perennial forages .*

Sample	Layer	Water-stabe aggregate (>0 .25mm)%	Bulk density (g/cm^3)	TC (g/kg)	TOC (g/kg)	TOC/TC
AM sweet pea		16 .873 a	1 .066 ab	19 .687 a	10 .163 a	0 .514 a
Bromegrass		33 .988 b	0 .986 a	22 .623 b	13 .259 bcd	0 .585 b
Clover		17 .536 a	0 .983 a	25 .750 c	15 .062 d	0 .584 b
Crowtoe	0-5 cm	21 .447 a	1 .152 b	20 .438 ab	10 .354 a	0 .506 a
Lucerne cv . longdong		19 .526 a	1 .155 b	21 .036 ab	11 .421 abc	0 .541 a
Lucerne cv . saditi		18 .038 a	1 .119 ab	19 .774 a	10 .893 ab	0 .547 ab
Sainfoin		17 .376 a	1 .149 b	23 .125 bc	13 .778 cd	0 .585 b
AM sweet pea		10 .599 a	1 .139 a	17 .460 bc	7 .931 ab	0 .454 bc
Bromegrass		15 .046 b	1 .191 ab	17 .664 bc	8 .213 bc	0 .465 bc
Clover		8 .282 a	1 .272 bc	18 .518 d	8 .304 bc	0 .448 d
Crowtoe	5-10 cm	10 .272 a	1 .247 bc	17 .754 bc	7 .578 a	0 .427 bc
Lucerne cv . longdong		8 .894 b	1 .197 ab	18 .084 cd	8 .573 c	0 .474 cd
Lucerne cv . saditi		8 .147 a	1 .250 bc	16 .347 a	7 .491 a	0 .458 a
Sainfoin		10 .89 a	1 .325 c	17 .339 b	8 .232 bc	0 .475 b

Conclusions In this study the organic carbon of perennial forage in the topsoil accounted for over 50% of the total carbon , with water-stable aggregates and TOC showing significant differences between 0-5cm and 5-10cm layer . This finding indicates that tillage disturbs the soil causing the spatial distribution of organic matter to become more homogenous . Further , tillage has no beneficial effect in terms of both carbon fixation and maintaining soil health . Lastly this study indicated that different perennial forages result in significant differences in organic carbon fixation .