Infiltration and soil erodibility benefits of conservation tillage

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Conservation tillage practices have been reported to improve soil structure and reduce soil erosion problems (e.g. 1, 3, 4). No explicit knowledge exists, however, with respect to the extent that they reduce runoff and erosion. This paper reports the findings of infiltration and rainfall simulation experiments aimed at specifying these soil conservation benefits on two established tillage trials.

Methods

Rainfall simulation (2) and soil physical measurements were undertaken on two established tillage comparison trials. These were at the CSIRO Ginninderra Experiment Station and the Wagga Soil Conservation Research Centre. At the time, the former had been in operation 8 years and the latter 4 years. The surface texture of the Ginninderra soil is loamy sand; Wagga, fine sandy loam. The experimental data collected were time to ponding, total runoff and sediment loss, and infiltration. Sorptivity and hydraulic conductivity measurements were made to predict time to pending and infiltration. Bulk density and organic matter were also determined. Knowledge of the rainfall applied and the sediment lost gave erodibility estimates for the different tillage treatments on these soils.

Results and Discussion

Data	Location	Treatments		
		Direct Drill	Reduced Till	Conventional Till
Sediment Loss ($kgha^{-1}$)	G	<30	244	330
	W	173	291	420
Runoff (mm)	G	0.4	3.5	4.6
	W	2.3	5.6	13.0
Infiltration (mm)	G	9.6	6.5	5.4
	W	27.7	24.4	17.0
Bulk Density (gcm^{-3})	G	1.22	1.36	1.41
	W	1.33	1.34	1.42
Organic Matter (%)	G	2.5	2.0	1.7
	W	4.5	3.4	3.6
USLE Erodibility (K)	G	0.004	0.031	0.046
	W	0.006	0.008	0.012

G-Ginninderra; W-Wagga, Rainfall applied at G, $30mmhr^{-1}$ for 20 min; W, $45mmhr^{-1}$ for 40 min.

Sorptivity and hydraulic conductivity measurements gave good predictions of time to ponding and infiltration, which identify well the treatment differences. A major reason for reduced erosion is thus reduced runoff. A further reason is the apparently reduced detachability of the soils of treatments with higher organic matter. The likelihood of less runoff lessens the need for soil conservation earthworks. A more stable soil lessens soil movement when runoff occurs. The data clearly demonstrate the soil conservation benefits of conservation tillage practices. The magnitude of the benefits appears to be dependent on (i) the tillage implement used; (ii) the soil type and (iii) the length of time the practice has been in operation.

References

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