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Soil Research

Supplementary Material

WEPP interrill erodibility for clay soils in the crop lands of Northern NSW and Southern Queensland, Australia

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Table S1. Soil properties where settling velocity distributions were measured for the soil surface after 20 min rainfall on ‘flat plots’ (Loch 1994). ASC Australian Soil Classification (Isbell 2002), SPC Specific Profile Class (like a US soil series), Soil Taxonomy (Soil Survey Staff 1999). Note particle size distribution for Walkers is not calculated in the usual way for <2 mm fraction. (RS refers to Research Station, DPI – Department of Primary Industries, F – field number, N – north, S south i.e., end of field).

Soil	ASC or Soil Taxonomy	SPC	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Organic carbon (%)	CEC (meq 100g ⁻¹)	Lat/long if known	Related publication
Brookvale Park (Jondaryan)	Black Vertosol	Waco	5	13.5	15	67	1.1	53	-27°25.83S, 151°37.67E	Silburn <i>et al.</i> (2013)
Cecilvale	Grey Vertosol	Cecilvale	2.1	28.5	23.1	47.2	1.25	31		Silburn and Bosomworth (2022)
Douglas Daly RS conventional cult ^A	Red Kandosol	Oolloo class of Tipperia loamy soil family	13.0	54.4	10.5	22.1	0.84	3.2 ^B	13°50.151'S, 131°13.618'E	ROTGUT trial, Bithell <i>et al.</i> (2013)
Zero tillage	Red Kandosol		13.0	50.8	13.3	22.0	0.84	3.5 ^B		
Woodland	Red Kandosol		10.5	45.1	15.7	28.7	1.0	5.9 ^B		
Emerald Hopson Bay 2	Black Vertosol	TbUg-2 ^C	2.4	24.3	17.5	57.8	1.40	55	23°30.95'S, 148°7.24'E	Roberts site of Carroll <i>et al.</i> (1995)
Emerald Hopson Bay 5	Black Vertosol	TbUg-2 ^C	2.0	16.8	15.4	65.9	1.40	79	23°31.25'S, 148°7.85'E	

Emerald Denaro 2	Black Vertosol	B Ug-2 ^C	nd	nd	nd	nd	nd	nd	23°29.14'S 148°6.35'E	Carroll <i>et al.</i> (1995)
Gatton	Black Dermosol	Lockyer ^D	4.0	32.0	26.0	40.0	1.8	40	27°30'S, 152°27'E	Powell (1982) Tullberg <i>et al.</i> (2001) nearby on Lawes SPC
Kingsthorpe DPI Bay5&6	Black Vertosol	Craigmore/ Waco	0.32	5.8	19.5	75.4	1.2	66.5		Powell <i>et al.</i> (1988)
Kingsthorpe DPI	Black Vertosol	Craigmore/ Waco	0.6	12.4	20.3	69.0	1.5	81		“ “
Mt Murchison zero tillage	Grey Vertosol	---		47.6 ^E	12.0	40.4	1.2	32.9	24°22S 150°31E	Thomas <i>et al.</i> (1990)
Mt Murchison conv tillage ^A	Grey Vertosol	---		47.6 ^E	12.0	40.4	1.1	32.9		“ “
Mywybilla	Black Vertosol	Mywybilla	2.2	12.3	17.9	68.7	1.05	60		Silburn and Bosomworth (2022)
Narrabri F21	Grey Vertosol	unknown	3.6	18.0	19.1	59.8	0.8	43		Kennedy <i>et al.</i> (2001)
Warren F4N	Brown Fine Entric Chromustert	Mullah grey phase variant ^F	9.1	31.8	13.2	45.6	0.8	36		McKenzie (1992)
Warren F4S	Red-brown Earth	Buddah variant ^F	7.7	31.5	14.7	46.8	0.8	30		“ “
Warren F23N	Grey sodic cracking clay (Grey Vertosol)	Snake ^F	8.0	24.0	13.0	55.0	0.78	32		“ “
Warren F34	Dark grey to black cracking clay	Mullah grey phase variant ^F	14.2	24.1	14.8	47.8	0.45	27		McKenzie (1992)

Warren F42	Reddish brown fine Rhodic Paleustalf	Mitchell ^F	28.0	26.8	9.3	36.9	0.45	11	“ “
Walkers W3 (Imbil)	Lithic Tenosol (Lithic Eutropept)	Gravelly, loam to clay loam	72 ^G >5mm 44% 5-2mm 28% ^H	7 (Total sand)	13	8	1.7 n.d.	n.d. 14	Ciesiolka <i>et al.</i> (1995); Coughlan (1997)
Buchanan sand (Goomborian)	Typic Eutropept	Loamy sand	40 ^G	53	5	2	1.3	nd	Coughlan (1997)

Walker's soil contained 40% > 40mm, 20% 20-40mm, 10% 10-20mm and 10% <10mm particles by dry sieving

^A conventional cultivation, ^B sum of cations, ^D McDonald and Baker (1986), Powell (1982), ^E Total sand, properties from Thomas *et al.* (1990) except OC, measured per treatment, ^F Macquarie soils McKenzie (1992), ^G Coughlan (1997), ^H Ciesiolka *et al.* (1995).

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Table S2. Mean settling velocities (Std Error) of particles sampled from the soil surface after 20 min rainfall on ‘flat plots’ for the study soils and additional soils. Most soils had six measurements of settling velocity, except Emerald B5 1 (9), Walkers W_3 (3), Douglas Daly RS conventional cultivation (4), Douglas Daly RS woodland (3), Emerald Hopson B5 2 (3), Emerald Denaro 2 (3) and Jondaryan (14).

Soil	Cumulative settling velocity (cm s ⁻¹) % slower than						
	0.04	0.25	0.94	3.43	7.58	15.17	26
Brookvale Park ^A		84.5 (2.67)	86.9 (2.39)	94.1 (1.45)	98.9 (0.68)	100 (0)	100 (0)
Cecilvale		23.2 (0.62)	35.0 (0.60)	60.2 (0.70)	88.2 (1.36)	99.2 (0.28)	100.0 (0.05)
Douglas Daly RS conventional cult		14.3 (1.57)	26.2 (2.55)	55.9 (3.22)	70.5 (2.65)	76.3 (2.37)	84.1 (2.12)
Douglas Daly RS woodland		11.2 (1.67)	21.1 (2.09)	40.8 (2.47)	54.5 (3.06)	69.6 (3.26)	91.0 (3.05)
Emerald Hopson B2		15.7 (1.13)	28.0 (1.60)	63.4 (1.79)	95.3 (1.49)	99.8 (0.19)	100.0 (0.0)
Emerald Hopson B5 1	3.8 (0.64)	12.4 (0.64)	24.1 (0.79)	51.8 (2.02)	86.6 (4.05)	97.2 (1.42)	99.6 (0.11)
Emerald Hopson B5 2	3.8 (0.64)	11.2 (0.81)	24.8 (2.26)	47.2 (5.07)	75.3 (9.60)	94.0 (3.96)	99.4 (0.11)
Emerald Denaro 2	8.8 (2.73)	14.8 (2.06)	23.9 (1.40)	46.8 (1.24)	83.1 (1.19)	96.6 (0.36)	98.9 (0.29)
Gatton		20.4 (1.93)	32.4 (2.52)	53.6 (3.10)	73.3 (3.55)	95.6 (1.44)	99.9 (0.10)
Kingsthorpe DPI Bay5&6		20.6 (1.20)	34.2 (1.28)	73.8 (1.83)	98.0 (1.01)	98.9 (0.73)	99.6 (0.39)
Kingsthorpe DPI		22.9 (1.86)	36.8 (1.54)	78.5 (1.13)	99.3 (0.26)	100.0 (0.0)	100.0 (0.0)
Mt Murchison zero till		10.3 (1.86)	19.8 (1.76)	47.6 (1.64)	75.9 (2.19)	95.7 (0.77)	98.7 (0.55)
Mt Murchison conventional till		11.1 (0.94)	20.2 (1.09)	47.9 (1.43)	78.0 (1.18)	95.5 (0.94)	99.1 (0.42)
Mywybilla		19.3 (0.71)	27.7 (0.72)	52.3 (0.92)	85.2 (1.85)	99.6 (0.25)	99.7 (0.27)
Narrabri F21 rep 1		18.9 (1.97)	31.0 (1.56)	55.1 (0.91)	85.5 (1.56)	99.0 (0.70)	99.6 (0.39)
Narrabri F21 rep 2		15.8 (1.17)	24.8 (1.52)	48.8 (2.05)	79.4 (2.90)	97.4 (1.37)	99.1 (0.85)
Narrabri 2		15.8 (1.17)	24.8 (1.52)	48.8 (2.05)	79.4 (2.90)	97.4 (1.37)	99.1 (0.85)
Warren F4N		16.9 (1.27)	32.9 (1.00)	51.7 (0.67)	73.9 (1.61)	93.7 (2.11)	99.3 (0.23)
Warren F23N		15.8 (0.64)	27.2 (0.74)	49.6 (1.01)	76.5 (1.28)	96.5 (0.46)	99.0 (0.41)
Warren F34		13.4 (1.42)	24.1 (1.54)	45.0 (1.79)	70.1 (1.91)	93.7 (1.65)	97.8 (0.91)
Warren F42		17.8 (0.53)	30.1 (0.70)	49.2 (1.19)	67.8 (1.75)	94.2 (0.37)	99.0 (0.33)
Warren F4S		15.6 (1.29)	27.2 (1.42)	45.7 (1.64)	73.2 (1.52)	96.9 (0.32)	99.5 (0.16)
Walkers W_3		19.3 (0.80)	23.4 (0.61)	29.4 (1.03)	36.0 (1.41)	46.9 (2.85)	66.1 (5.52)
Buchanan sand		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

^A – field rainfall simulator plots on hill-furrow layout; considerable deposition occurred in the furrow, removing coarser sediment. Rainfall intensity ~70 mm h⁻¹ for 40 min, total rain 47mm.

Table S3. Mean sizes of particles (Std Error) sampled from the soil surface after 20 min rainfall on ‘flat plots’ for study and additional soils. Six samples were measured for silt and clay and eight for wet sieving. (n.d. not determined).

Undispersed particle sizes in rainfall wet surface						
Soil	Silt&clay (%)	Silt (%)	Clay (%)	Fines <0.125 (%)	Medium 0.5-0.125mm (%)	Coarse >0.5mm (%)
Brookvale Park ^A	12.5 (0.79)	8.1 (0.42)	4.4 (0.37)	31.9 (1.33)	55.0 (1.52)	13.1 (0.20)
Cecilvale	13.3 (0.67)	4.7 (0.32)	8.6 (0.53)	33.5 (1.24)	36.8 (1.18)	29.8 (1.23)
Douglas Daly RS conventional cult	1.8 (0.35)	0.4 (0.02)	1.4 (1.99)	35.9 (1.99)	29.4 (1.87)	34.7 (1.60)
Douglas Daly RS woodland	2.3 (0.18)	1.0 (0.05)	1.3 (0.15)	23.7 (1.82)	21.4 (1.75)	54.9 (2.54)
Emerald Hopson B2	7.3 (0.31)	1.4 (0.13)	5.9 (0.25)	26.0 (1.71)	44.7 (1.90)	29.3 (2.42)
Emerald Hopson B5 1	5.4 (0.20)	0.7 (0.13)	4.7 (0.21)	24.6 (1.31)	41.5 (1.36)	33.9 (1.80)
Emerald Hopson B5 2	n.d.	n.d.	3.9 (1.64)	24.3 (1.41)	34.3 (1.41)	41.5 (2.04)
Emerald Denaro 2	9.5 (1.0)	3.5 (0.16)	6.0 (1.20)	23.1 (0.54)	31.9 (0.50)	43.4 (1.21)
Gatton	10.7 (0.17)	1.7 (0.18)	9.0 (0.13)	31.0 (1.00)	28.8 (0.64)	40.2 (1.20)
Kingsthorpe DPI Bay 5&6	10.8 (0.51)	2.5 (0.23)	8.3 (0.35)	29.5 (1.32)	48.3 (1.88)	20.0 (1.85)
Kingsthorpe DPI	12.8 (0.24)	3.4 (0.14)	9.4 (0.32)	27.8 (1.12)	47.4 (1.39)	24.8 (2.29)
Mt Murchison zero till	5.2 (0.23)	0.9 (0.06)	4.3 (0.19)	19.5 (1.51)	44.3 (1.49)	36.1 (1.35)
Mt Murchison conventional till	6.1 (0.35)	1.4 (0.06)	4.8 (0.31)	19.5 (0.78)	48.0 (0.70)	32.6 (1.04)
Mywybilla	11.0 (0.40)	5.8 (0.49)	5.2 (0.49)	23.6 (0.49)	33.1 (0.96)	43.3 (0.81)
Narrabri F21 storm 1	5.7 (0.65)	1.4 (0.31)	4.3 (0.51)	27.0 (1.06)	38.5 (1.39)	34.6 (1.98)
Narrabri F21 storm 2	9.5 (0.32)	2.4 (0.15)	7.1 (0.36)	21.9 (1.12)	30.3 (0.64)	47.8 (1.07)
Warren F4N	5.4 (0.42)	1.1 (0.14)	4.2 (0.32)	27.5 (1.64)	31.8 (1.76)	40.8 (2.72)
Warren F23N	7.2 (0.29)	2.0 (0.26)	5.2 (0.19)	26.9 (1.82)	36.4 (1.42)	36.7 (1.12)
Warren F34	5.2 (0.44)	0.5 (0.07)	4.8 (0.39)	23.1 (0.51)	37.1 (1.68)	38.1 (0.51)
Warren F42	6.8 (0.21)	0.9 (0.10)	5.9 (0.17)	29.0 (0.91)	29.7 (0.65)	41.3 (1.18)
Warren F4S	6.7 (0.40)	1.1 (0.16)	5.4 (0.30)	27.3 (1.22)	29.8 (0.96)	42.9 (1.80)
Walkers W3	20.6 (0.47)	3.0 (0.32)	17.6 (0.39)	18.1 (0.79)	11.0 (0.38)	71.1 (0.61)
Buchanan sand	Too little to measure			14.2 (1.52)	38.0 (3.25)	47.9 (4.20)

^A – Brookvale Park. Field rainfall simulator plots on hill-furrow layout; considerable deposition occurred in the furrow, removing coarser sediment. Rainfall intensity $\sim 70 \text{ mm h}^{-1}$ for 40 min, total rain 47mm.

WEPP parameters from Titmarsh *et al.* (1994) and Titmarsh *et al.* (1995).

Soil type	Treatment	Interrill erodibility (Ki)	Rill erodibility (Kr)	Critical shear stress (Tc)
Prairie	Bare, cult	190000	0.0053	7
	Zero till, trash blanket	91000	0.00035	8.1
	Bare, cult, conv hill-up	190000	0.00085	2.3
	Delver board hill-up, bare, cult	190000	0.00066	8.1
	Trash cult in	69000	0.00019	9
Grey Kandosol, fine sandy grey earth	Zero till, trash blanket	373000	0.00206	5
	Bare, cult	1340000	0.0055	3
	Trash cult in	2219000	0.0042	11
	Cane tops rotary hoed in		0.0053	3
	Centre rip		0.0039	3
Black Earth	Zero till, trash blanket	45000	0.00047	13
	Bare, cult	240000	0.0023	4
	Trash cult in	150000	0.00044	11
	Cane tops rotary hoed in		0.0034	11
	Centre rip		0.00038	7
Krasnozem	Zero till, trash blanket	105000	0.0013	7
	Bare, cult	571000	0.0052	5
	Trash cult in	320000	0.0004	10
	Cane tops rotary hoed in		0.0064	8
	Centre rip		0.0028	8
Podzolic	Zero till, trash blanket	238000	0.0013	5
	Bare, cult	2576000	0.0154	5
	Trash cult in	2107000	0.0078	5
	Cane tops rotary hoed in		0.0049	2
	Centre rip		0.0055	6

Location information:

Podzolic, Heales Road, Bundaberg (furrows).

Black Earth, Wallaville via Gin Gin (furrows) (Ladewig 1972) western part of the Bingera mill area near Delam at Gin Gin.

Kraznozem, Promisland Road, Cordalba (furrows). Site was beside main Childers-Bundaberg Road east of dinner hill reservoir (some doubt as to location).

Kraznozem, Portion 1056 Parish Childers (contour banks) (beside Noakes Hill reservoir)

Kandosol, Farnsfield (P217 Parish Gregory) (furrows)

Kandosol, Portion 118, Parish Bingera, (some doubt as to location) (furrows) Portion 123 Parish Isis (contour banks)

Prairie, Wallingford via Mackay (Nabilla Soil) (furrows) (Holz and Shields 1985).

Bundaberg soils from Glanville *et al.* (1991).

Green and Ampt infiltration parameters

Treatments:

ZB Consolidated, trash raked off
ZC Consolidated, trash left on
CB Cultivated, bare
CC cultivated then trash blanket replaced
INC trash from green cane harvest incorporated
LAB laboratory rainfall simulation
CH conventional hill up bare
DH delver board hill up bare

WEPP parameters:

KI initial conductivity of surface seal (mm h^{-1})
Kf final conductivity of surface seal (mm h^{-1})
Kb conductivity of lower layer (mm h^{-1})
Ma volumetric moisture deficit upper layer (mm mm^{-1})
Mb volumetric moisture deficit lower layer (mm mm^{-1})
Md volumetric difference – field capacity to saturation upper layer (mm mm^{-1})
Za depth upper layer (mm)
B fraction of soil surface exposed
Sa matrix potential upper layer (mm)
Sb matrix potential lower layer (mm)
EO' cum rainfall energy required to reduce initial conductivity to twice final conductivity ($\text{J m}^{-2} \text{mm}^{-1}$)
RR random roughness (cm)
Gradient (m m^{-1})
R rainfall rate (mm h^{-1})

Soil	Podzolic					
Treatment	ZB	ZC	CB	CC	INC	LAB
Ki	20	50	80	35	25	140
Kf	10	5	10	25	12	8
Kb						
Za						
Ma	0.22	0.22	0.18	0.25	0.25	0.17
Mb						
Md						
B	70	1	90	1	50	100
Sa	150	150	150	150	150	250
Sb						
RR	1.2	1.25	1.15	1.4	1.25	0.5
EO'	8		2		5	1
Gradient	0.033	0.018	0.052	0.04	0.038	
R	115	115	115	115	115	100

Soil	Podzolic				
Treatment	GCZT	BRH	INC	BZT	CC
Ki	50	80	25	20	35
Kf	5	10	12	10	25
Kb	5	10			
Za	150	150	150	150	
Ma	0.22	0.18			0.25
Mb	0.22	0.18	0.25	0.22	
Md	0.03	0.03			
B	0.01	0.9	0.5	0.7	0.01
Sa	150	150			150
Sb	250	250			
RR	1.25	1.15	1.25	1.2	1.4
EO'	7	200	50	80	5
Gradient	1.8	5.2	3.8	3.3	

Soil	Black Earth						
Treatment	ZB	ZC	CB	CC	INC	LAB	Pasture
Ki	100	30	120	65	100	120	60
Kf	10	5	25	20	15	25	2
Kb							
Za							
Ma	0.4	0.37	0.33	0.38	0.52	0.07	0.2
Mb							
Md							
B	50	5 1	80	5	50	100	5
Sa	150	150	150	150	150	250	
Sb							
RR	0.05	0.5 1	1.65	1.9	2	0.5	1
EO'	1	1	4	1	2	4	
Gradient	0.025	0.037	0.016	0.024	0.018		
R	135	135	135	135	135	100	135

Soil	Podzolic					
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Treatment	ZB	ZC	CB	CC	INC	LAB
Ki	20	50	80	35	25	140
Kf	10	5	10	25	12	8
Kb						
Za						
Ma	0.22	0.22	0.18	0.25	0.25	0.17
Mb						
Md						
B	70	1	90	1	50	100
Sa	150	150	150	150	150	250
Sb						
RR	1.2	1.25	1.15	1.4	1.25	0.5
EO'	8		2		5	1
Gradient	0.033	0.018	0.052	0.04	0.038	
R	115	115	115	115	115	100

Soil	Kandosol					
Treatment	ZB	ZC	CB	CC	INC	LAB
Ki	200	150	70	75	150	70
Kf	50	35	20	10	45	15
Kb						
Za						
Ma	0.18	0.12	0.15	0.15	0.15	0.3
Mb						
Md						
B	80	1	80	5	80	100
Sa	150	150	150	150	150	250
Sb						
RR	1.7	1.3	1.7	1.7	1.3	0.5
EO'	4		4	1	9	1
Gradient	0.028	0.02	0.012	0.017	0.053	
R	181	181	181	181	181	100

Soil	Kraznozem					
Treatment	ZB	ZC	CB	CC	INC	LAB
Ki	110	140	150	180	140	170
Kf	60	70	70	85	70	40
Kb						
Za						
Ma	0.11	0.08	0.05	0.14	0.1	0.07
Mb						
Md						
B	70	5	90	5	50	100
Sa	150	150	150	150	150	250
Sb						
RR	1.8	1.4	1.4	1.1	1.35	0.5
EO'	1	1	2	2	1	2
Gradient	0.029	0.014	0.026	0.022	0.016	
R	235	235	235	235	235	100

Soil	Prairie					
Treatment	ZB	ZC	CB	INC	CH	DH
Ki	2000	50	2000	65	200	11
Kf	20	10	47	20	40	5
Kb						
Za						
Ma	0.034	0.034	0.32	0,32	0.32	0.32
Mb						
Md						
B	95	5	95	25	95	95
Sa	350	350	350	350	350	350
Sb						
RR	1.03	1.4	1.21	2	1.72	1.48
EO'	1	1	2	4	2	4
Gradient	0.034	0.034	0.016	0.028	0.035	0.02
R	104	104	104	104	104	104