



1990

Use of soil water measurements to assist crop management in low rainfall areas.

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TITLE: Use of soil water measurements to assist crop management in low rainfall areas.

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DATE: 1990

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Project Introduction:

A series of soil moisture monitoring sites have been established to provide long term measurements of the soil water balance under major cropping systems in the low rainfall Eastern Wheatbelt. Crop yields are largely determined by the water supply to the crop (seasonal rainfall and stored soil moisture). Knowledge about these can be valuable in crop management because it may assist with decisions about areas to sow or fallow, fertilizer use and herbicide application.

90M9 Trial Summary - 1990

Introduction: 90M9 was established as part of the long term monitoring system to obtain base information on water use from several different soils. A simple rotation experiment was established in T3 on the Merredin Research Station.

Methods: Rotations - 1990 : 1991
wheat : wheat
wheat : lupins
lupins : wheat
oats : lupins
cereal rye : lupins
volunteer pasture : lupins (crop of surrounding paddock)
serradella : serradella

Access tubes were drilled in the centre of each plot (5 m) before planting down to a depth of 3 m. These tubes were measured to 270 cm.

Seven treatments x four replicates.

Dates: Pasture - 15/6/90 Crop - 8/6/90.
Varieties - Serradella 14 kg/ha - Madeira + 100 kg/ha Super.
Lupins 100 kg/ha - Danja + 100 kg DAP.
Cereal rye 70 kg/ha -)
Wheat 50 kg/ha - Gutha) + 100 kg DAP
Oats 50 kg/ha - Winjardie)

Soil Type: Deep acid sand.

Location: Merredin Research Station.

Measurements: Plant numbers per m² (sampled 1 m rows x 10).

Anthesis dry matter cuts taken when majority of trial flowering (sampled 10 x 1 m rows).

Harvest dry matter cuts (sampled 6 x 1 m rows taken randomly).

Head numbers counted from each row.

Grain yield calculated from dry matter hand harvest and header.

Neutron moisture monitoring every two weeks during the season then monthly to a depth of 3 m.

Results:

Treatments

Measurements	Cereal Rye	Oats	Lupins	Wheat	Serradella	Volunteer Pasture
Plants/m ²	104.8	94.8	19.3	84		
Anthesis						
Dry matter (tonne/ha)	2.35	2.4	*	1.7		
Water use	105.3	96.48	*	91		
Harvest						
Water use	160.7	148.6	*	135.40	134	165
Total (mm)	11.39	4.7	*	11.8		
Depth (cm)	210	170	110-130	150	170	130
Dry matter						
Bulk (tonne/ha)	4.87	2.36	*	3.09 w/w 3.33 w/l		
Grain yield						
Hand	1.79	.698	*	1.5 w/w 1.6 w/l		
Machine (tonne/ha)	1.36	.655	*	1.09		
Head numbers/m ²	248.7	103.1	*	120.5	153.7	

Comments: Problems - Lupins died out. They were planted for the second time in that paddock therefore were effected by brown spot.

- Oats were eaten by locusts. Oats were the last crop to dry off.

- Access tubes placed wrongly between two planting rows. 1991 - only 2.5 m width down the middle of tubes.

- Volunteer pasture should have been sampled but was slashed off too soon! Serradella not established enough for sampling.

Total water use was the highest for volunteer pasture followed by cereal rye. Bulk weight produced by cereal rye was much higher than volunteer pasture and all the crops. Oats used the second largest amount of water and wheat the smallest (excluding lupins).

Serradella was planted very late therefore missing valuable summer and early rainfalls.

Depth of moisture absorption was deepest for cereal rye (210 cm). The serradella and oats at 170 cm were the next deepest. The volunteer pasture rooting depth (as gauged by depth of effective moisture absorption) was 40 cm shallower than serradella.

Bulk dry matter was highest for oats and cereal rye at anthesis at 2.4 and 2.35 t/ha respectively. By harvest cereal rye was almost double that of the oats and 1 tonne/ha ahead of the wheat.

Bulk matter of oats at anthesis mainly consisted of leaf material while cereal rye was more stemmy.

The wheat yield was very average and the oats would have been more successful if not attacked.

Deep Acid Sand - 90M9

Calibrations Used on 1990 Data

Devised by S. McKeague

Depth

$$0 - 20 \text{ cm} \quad 0 = \frac{(n - 0.15437)}{2.291}$$

$$20 - 290 \text{ cm} \quad 0 = \frac{(n - .3265)}{1.56}$$

standard count = 23570

90M9 Soil moisture at 20 cm intervals down the profile and totalled at each depth

treatment=cereal rye

depth cm	18/6/90	11/7/90	20/7/90	23/8/90	3/9/90	13/9/90	4/10/90	17/11/90	7/11/90	23/11/90
10	8.54	4.97	11.44	7.99	7.24	7.88	6.35	7.56	7.3	7.04
30	20.22	16.68	22.33	13.62	10.18	9.3	6.82	7.32	6.05	4.94
50	20.34	18.84	23.3	17.65	14.61	11.56	8.16	8.67	7.92	7.77
70	20.91	20.09	23.79	20.01	17.83	14.01	9.74	9.78	8.95	8.7
90	21.67	21.48	24.17	21.77	20.44	16.79	12.1	11.43	10.17	10.31
110	22.55	22.53	23.84	23.16	22.92	20.14	14.98	13.8	11.48	11.71
130	21.98	22.7	23.41	24.17	23.15	21.96	16.88	15.72	14.62	14.6
170	20.44	21.52	22.25	24.7	24.03	23.03	20.6	19.68	16.48	16.41
190	20.19	21.49	21.63	24.38	24.31	23.59	22.4	20.26	18.86	18.83
210	20.23	20.9	21.28	24.03	24.53	24.54	22.99	22.88	21.57	21.11
230	20.93	20.93	20.62	23.57	24.46	24.78	24.04	23.48	22.23	22.34
250	21.26	20.57	20.48	22.34	23.93	24.17	23.73	23.99	22.6	23.54
270	23.65	22.31	22.05	22.42	23.37	23.91	31.01	24.77	23.96	23.7
total	284.64	277.29	303.	293.78	284.6	268.26	239.41	227.31	204.61	204.02

Treatment=oats

depth cm	18/6/90	11/7/90	20/7/90	23/8/90	3/9/90	13/9/90	4/10/90	17/10/90	7/11/90	23/11/90
10	8.54	5.6	11.42	9.18	7.31	7.41	6.15	7.43	6.61	7.07
30	20.22	16.46	21.66	16.26	14.24	12.62	7.08	6.96	5.78	5.19
50	20.34	17.5	22.37	19.15	17.35	15.84	10.24	9.65	7.73	7.67
70	20.91	19.	23.07	20.09	19.2	18.45	14.36	11.41	9.47	8.9
90	21.67	20.5	22.78	22.45	20.05	19.86	18.09	16.65	12.48	12.41
130	21.98	22.66	22.28	23.82	23.27	23.23	21.95	21.36	19.8	18.89
150	21.73	22.21	22.94	23.94	23.49	22.94	21.74	20.6	19.65	18.83
170	20.44	20.57	21.46	23.49	23.52	23.17	22.56	21.97	20.98	20.63
190	20.19	18.49	20.19	24.08	23.58	23.12	22.69	22.37	21.38	21.62
210	20.23	18.41	19.47	23.27	23.33	23.1	23.2	23.36	23.18	22.18
230	20.93	18.51	20.31	22.07	23.43	23.76	24.17	23.82	23.19	22.9
250	21.26	19.4	20.93	20.73	22.08	22.96	23.96	24.45	23.76	24.26
270	23.65	20.52	20.73	21.28	21.89	22.63	26.24	24.22	24.71	24.44
total	284.64	261.2	292.92	292.72	285.37	281.08	262.31	253.25	235.27	231.2

90M9

Soil moisture at 20 cm intervals down the profile and totalled at each depth

2 plots per treatment
treatment=wheat

depth cm	18/6/90	11/7/90	11/7/90	20/7/90	20/7/90	23/8/90	23/8/90	3/9/90	3/9/90
10	8.54	4.83	4.96	10.24	9.8	8.75	8.44	7.65	7.04
30	20.22	17.28	16.63	21.55	22.7	16.22	17.5	12.78	13.69
50	20.34	18.89	18.52	22.65	23.04	17.91	20.21	16.42	18.74
70	20.91	19.51	19.4	22.87	23.85	20.45	20.62	18.74	20.21
90	21.67	20.98	20.69	23.24	23.86	22.08	23.01	20.74	21.7
110	22.55	22.32	22.18	24.02	23.97	23.95	23.62	22.57	22.79
130	21.98	22.22	21.98	23.13	22.94	24.39	24.36	23.49	23.79
150	21.73	22.37	22.33	22.15	22.34	24.53	24.43	23.69	23.98
170	20.44	22.5	21.42	21.81	22.51	24.63	24.66	23.31	24.49
190	20.19	21.87	21.37	22.22	22.47	25.1	25.33	25.1	25.33
210	20.23	22.68	21.73	22.33	22.53	25.66	24.51	25.13	25.21
230	20.93	22.73	21.2	22.32	22.89	25.64	26.29	26.24	26.54
250	21.26	21.95	21.74	21.79	22.78	25.41	24.34	26.42	25.95
270	23.65	22.72	22.61	22.84	23.02	24.16	24.04	25.59	25.66
total	284.64	282.85	276.76	303.16	308.69	308.88	311.36	297.88	305.12

	9/13/90	9/13/90	10/4/90	10/4/90	10/17/90	10/17/90	11/7/90	11/7/90	11/23/90	11/23/90
10	8.46	7.04	5.87	6.47	11.61	7.92	5.94	7.31	7.09	7.28
30	11.88	11.81	7.97	7.19	7.88	8.73	6.53	5.71	1.34	6.33
50	13.83	16.36	11.09	9.35	8.79	10.13	8.28	7.56	7.86	8.49
70	18.15	18.96	15.65	13.09	12.2	13.54	11.24	10.75	10.12	12.05
90	20.66	21.32	19.62	18.18	17.17	18.32	15.8	14.5	15.12	16.22
110	22.17	22.27	21.23	21.1	20.67	20.63	19.46	18.9	18.54	19.1
130	23.58	23.34	22.55	22.25	22.02	21.7	20.45	20.11	19.58	20.49
150	23.63	23.75	22.26	23.04	22.26	22.26	21.61	21.41	21.05	21.33
170	23.52	24.19	23.38	23.24	23.23	23.82	22.82	22.28	22.11	22.87
190	25.11	24.44	23.73	24.48	23.97	23.76	23.77	23.52	22.88	23.46
210	25.53	25.61	25.17	24.3	24.97	24.73	25.	24.58	24.26	24.28
230	26.89	26.68	26.09	25.8	26.79	26.74	25.04	25.76	25.2	24.88
250	26.75	27.13	26.3	26.77	26.65	26.67	26.29	25.97	26.71	26.09
270	25.67	27.28	25.16	26.46	27.53	26.9	27.67	27.11	27.16	25.29
total	295.83	300.17	276.07	271.73	275.74	275.86	259.9	255.45	249.01	258.15

90M9

treatment=lupins

	18/6/90	11/7/90	20/7/90	23/8/90	3/9/90	13/9/90	4/10/90	7/11/90	23/11/90
10	1.305753	6.868771	11.1939	12.54845	11.26801	13.84604	11.10682	9.248564	8.998449
30	12.57278	16.94024	22.6733	19.12821	17.3985	18.86304	16.4575	10.27297	9.741278
50	12.62563	17.68815	22.87047	19.71158	18.80729	19.19756	17.55624	12.76419	12.05164
70	12.88105	19.98899	23.43072	20.6893	20.55196	20.40373	18.60283	13.60321	14.31304
90	13.21998	20.59139	22.74673	22.38229	20.89871	21.50928	20.36294	16.41534	16.59076
110	13.61016	21.90499	23.17236	23.16556	22.8188	21.80028	22.73449	18.55708	18.79369
130	13.35797	22.52644	22.63114	24.42476	23.24579	23.94338	23.5939	20.29903	19.47361
150	13.24298	21.6847	21.35834	24.35269	23.72173	23.36273	23.08669	20.67978	20.3303
170	12.66962	21.48072	21.1462	24.35541	23.56127	23.86859	23.72309	21.49432	22.1416
190	12.55987	21.2142	21.3325	24.66001	24.11608	24.08616	23.78156	22.58083	22.80112
210	12.576	21.72549	21.55143	25.71932	23.84411	25.30458	24.9279	23.56943	23.75844
230	12.89113	21.82476	21.04014	25.71389	24.44108	36.40468	26.80447	24.87623	25.02853
250	13.03397	21.8438	20.92319	24.06713	24.31462	27.06148	26.67393	25.9029	25.16179
270	14.10161	21.78669	21.49432	23.50416	24.69129	26.39516	24.00049	26.33261	26.71472
total	170.6485	278.0693	297.5647	314.4228	303.6792	316.0467	303.0883	266.5965	265.899

90M9

treatment=serradella

	7/11/90	7/20/90	8/22/90	9/3/90	9/13/90	10/4/90	11/7/90
10	9.770099	12.74553	12.88893	13.43011	12.85484	9.481077	9.972969
30	31.84924	25.84307	21.32434	21.5256	19.71974	11.21534	9.446194
50	22.07769	25.86619	23.31188	22.80384	22.62162	13.39107	11.08887
70	23.72717	27.0438	25.39623	24.42612	24.38941	17.04359	12.27193
90	25.98177	28.09767	28.9318	27.16755	27.57142	21.49296	15.70687
110	29.28481	30.82822	31.75916	31.11107	33.09778	26.20343	22.49244
130	30.51818	31.8345	31.18042	31.80458	30.73439	29.75803	26.09464
150	29.29161	30.38763	30.77899	31.51766	30.76975	30.76959	28.64433
170	31.22393	31.69035	34.3385	33.97488	34.66431	32.7959	32.2778
190	31.81546	32.4981	38.00243	36.7163	35.64611	37.14465	35.42582
210	35.43398	34.77038	39.65816	39.17624	36.42666	42.90762	39.31902
230	35.13753	35.61755	39.31331	38.27331	35.6162	41.98838	39.19528
250	35.48837	34.41682	37.29641	35.82833	34.08502	38.13189	37.505
270	38.14549	37.29423	38.60076	37.95919	35.34423	40.54967	38.15364
total	399.7453	418.9341	432.7813	425.7148	413.5415	392.8733	357.5948

treatment=volunteer pasture

	11/7/90	20/7/90	22/8/90	3/9/90	13/9/90	4/10/90	7/11/90
10	11.04476	13.73765	11.03026	9.489415	9.97578	8.938237	9.910286
30	21.71597	24.94014	18.02675	12.93961	10.37496	9.512826	8.627121
50	24.24391	27.04516	22.78752	16.74986	12.86618	11.29965	10.59979
70	26.8847	29.79339	26.13951	21.68878	16.25216	14.14986	14.33117
90	30.03408	32.89109	29.8437	25.36305	23.36137	17.87664	18.71527
110	30.71127	32.85981	31.66452	27.99841	26.55698	23.37769	21.44219
130	29.07403	30.30332	30.06671	26.73648	28.04464	22.90991	20.668
150	28.66065	28.83606	30.08983	28.06776	30.6528	24.29966	23.44568
170	32.00312	32.73471	35.25992	31.20489	35.12665	29.27937	30.47874
190	35.32927	34.95804	38.75469	34.40458	40.18252	36.42666	37.43203
210	38.77237	37.77017	40.96034	37.36222	44.3708	40.16076	42.21502
230	39.04978	39.13137	39.78681	36.81285	39.55155	39.06745	40.00665
250	37.63011	37.40982	37.12833	33.39287	39.07017	35.59172	38.73928
270	41.49884	40.71421	40.8026	35.15113	40.61494	38.00678	41.33566
total	426.6528	443.1249	432.3415	377.3619	39.0015	351.8972	357.9469

89ME32 Rowspacing Summary - 1990

Introduction: 89ME32 was monitored as part of the long term monitoring system. Previous to 1990 two years of continued measurements had been done on the same soil type. Located on the CSIRO lease block above the Merredin Research Station on Crook's property.

Methods: Rotation - 1990 : 1991
wheat : lupins

Several rowspacing treatments were applied but were not separated for the course of my analysis. (Glen Riethmuller reported that very little difference occurred between the treatments.)

Dates: Planted - 14-20/5/90.
Varieties - Kulin and Aroona + Agras.

Soil Type: Duplex (sand over clay).

Location: Merredin Research Station.

Measurements: Anthesis and dry matter cuts were sampled and radiation intercepted by the crop recorded. Bob Belford has extra information gathered from the trial.

24 access tubes were monitored every two weeks during the season and on a monthly basis during the summer to a depth of 2 m.

Results:

Measurements	Wheat
Harvest:	
Water use (mm)	187.5
Dry bulk weight (t/ha)	4.88
Yield (t/ha)	2.2 t/ha
Water use efficiency	11.7 kg/ha/mm
Anthesis:	
Dry bulk weight (t/ha)	4.77
Water use (mm)	114.2
% water use before anthesis	60.9

Comments: Total water use on Crook's site of 187.5 mm was lower than on the heavyland but yields of 2.2 t/ha were considerably higher than the heavyland. The water use efficiency was highest on the duplex soil type at 11.7 kg/ha/mm. The higher yield may be partly due to the application of Agras.

N.B. When water stressed during the season the Aroona plants were the first to show signs of stress by curling their leaves.

Other Officers: Bob Belford, Glen Riethmuller.

Duplex Soil Type - 89ME32

Crooks.

Calibrations Used on 1990 Data

Devised by B. French

Depth

$$0 - 20 \text{ cm} \quad 0 = -0.003 + 0.7599 \frac{(n - .1957)}{3.2006}$$

$$20 - 40 \text{ cm} \quad 0 = -0.003 + 0.7599 \frac{(n - .5448)}{2.5222}$$

$$> 40 \text{ cm} \quad 0 = -0.003 + 0.7599 \frac{(n - 0.6054)}{2.1159}$$

$$n = \frac{\text{count}}{\text{standard count}}$$

$$\text{standard count} = 11670$$

To convert to mm, multiply by 200.

89ME32crooks

Soil moisture at 20 cm intervals down the profile and totalled for each date

all treatments combined

depth cm	1/11/88	14/2/90	20/3/90	24/4/90	5/6/90	22/6/90	4/7/90	23/7/90	3/8/90	15/8/90
10	1.06	28.57	-1.83	-2.63	9.06	12.5	12.73	15.45	17.36	15.91
30	3.26	35.82	26.31	27.16	24.7	31.89	29.48	35.84	34.65	31.11
50	29.16	52.98	39.94	37.77	42.2	44.78	43.4	45.02	44.5	46.9
70	50.4	45.15	44.84	45.46	45.42	47.6	46.16	45.81	47.05	50.46
90	52	43.28	42.38	45.17	43.26	43.55	43.65	41.47	43.86	46.04
110	49.72	43.89	45.06	44.17	43.51	44.52	43.66	42.74	45.45	46.04
130	48.94	41.6	44.99	46.4	40.18	41.5	42.27	42.4	43.02	44.92
150	49.3	47.52	42.65	40.93	43.93	44.76	45.89	42.86	43.55	45.63
170	50	53.48	47.77	46.03	54.05	49.68	48.42	48.41	48.18	50.61
total	311.44	392.28	332.1	330.47	346.	360.78	355.66	360.	367.62	377.63

depth cm	30/8/90	17/9/90	4/10/90	25/10/90	8/11/90
10	12.42	7.44	4.41	5.57	8.63
30	20.04	12.18	8.38	7.66	8.33
50	43.07	40.16	37.18	33.45	35.51
70	45.99	45.97	43.28	42.77	43.41
90	43.44	43.54	44.01	42.85	42.52
110	43.74	44.14	43.03	43.49	43.78
130	43.07	41.85	41.82	41.4	41.14
150	44.29	43.54	44.7	45.16	44.83
170	48.21	47.68	48.14	48.83	47.93
total	344.27	326.51	314.93	311.19	316.07

adjusted refers to the removal of the very high values obtained at the bottom of the profile probably due to a wet probe

87M71 Heavyland Rowspacing Summary - 1990

Introduction: The changes in the soil moisture down the profile were monitored in 87M71 as part of the long term monitoring network.

Methods: Rotation - wheat : wheat

Glen Riethmuller and Bob Belford imposed several rowspacing and stubble quantity treatments on the wheat crop however for my analysis I did not separate the treatments.

Eight treatments.

Each treatment had four replicates.

Dates: Planted - 18/5/90.

Soil Type: Clay loam - Merredin heavyland.

Location: Merredin Research Station.

Measurements: 32 access tubes were monitored every two weeks during the season and monthly over summer.

Doug McGinniss sampled numerous dry matter cuts and radiation interception values - Bob Belford has that information.

Results:

Measurements	Wheat
Harvest:	
Water use (mm)	220
Dry bulk weight (t/ha)	3.20
Yield (t/ha)	1.6
Water use efficiency	7.25 kg/ha/mm
Anthesis:	
Bulk weight (t/ha)	3.41
Water use (mm)	147
% water use before anthesis	67

Comments: The profile was holding approximately 65 mm at the beginning of the season. Water use up until anthesis was 147 mm which equated to be 67% of the total water use of 220 mm. This was the highest water use of any soil type, which was expected as it had the highest water holding capacity.

The crop yielded 1.6 tonne/ha with a water use efficiency of 7.25 kg/ha/mm (which is lower than what I would expect).

Other Officers: Bob Belford, Glen Riethmuller.

Heavyland Soil Type - 87M71

Clay loam.

Calibrations Used on 1990 Data

Supplied by D. Tennant

Cross calibration to fit Perth machine $y = a + bx$

$$0 - 20 \text{ cm} \quad y = 0.038828 + 0.77576 x$$

$$20 - 180 \text{ cm} \quad y = -0.0177 + 0.911194 x$$

Calibration equations

$$0 - 20 \text{ cm} \quad 0 = \frac{(n - 0.1692)}{2.492}$$

$$20 - 180 \text{ cm} \quad 0 = \frac{(n - 0.5548)}{1.5901}$$

standard count = 11670

87M71

Soil moisture at 20 cm intervals down the profile and totalled at each date

heavyland rowspacing
all treatments averaged

depth cm	5/6/90	20/6/90	11/7/90	24/7/90	6/8/90	14/8/90	3/9/90	13/9/90	26/9/90	16/10/90
10	29.91	33.71	32.71	51.81	47.15	48.45	42.61	38.8	37.96	35.77
30	63.93	73.	70.75	80.6	76.84	75.65	61.32	51.9	42.54	37.53
50	58.6	64.24	63.65	70.49	66.95	70.24	61.02	55.91	47.8	41.74
70	59.	60.64	60.14	64.76	63.29	65.47	60.77	58.89	56.	52.27
90	60.97	61.11	60.31	63.61	61.88	65.24	60.69	60.55	60.56	59.8
110	63.25	61.25	60.7	63.78	61.39	64.99	60.77	60.67	60.72	60.62
130	59.76	60.66	60.97	63.11	61.72	64.36	59.76	59.69	59.64	59.18
150	57.34	56.43	56.23	59.19	56.93	60.37	56.44	56.07	56.28	56.77
170	59.59	58.	57.97	59.57	58.77	60.98	57.37	57.31	57.09	56.73
total	512.36	529.03	523.43	576.92	554.9	575.76	520.74	499.78	478.58	460.42

depth cm	14/11/90	18/12/90	8/2/91	11/3/91
10	33.87	30.50	21.81	18.11
30	34.22	32.34	51.19	34.51
50	38.38	37.99	44.08	39.07
70	49.11	48.20	49.19	44.08
90	59.35	60.58	59.75	57.18
110	60.44	64.16	63.26	60.50
130	58.39	60.23	61.62	61.58
150	56.25	57.30	57.18	57.93
170	56.00	59.81	57.00	57.20
total	445.99	451.11	465.09	430.15

88ME83 Trial Summary - 1990

Introduction: As part of the baseline monitoring system access tubes were inserted in 88ME83 on existing trial on sandy clay loam on Robartson's farm, Merredin.

Methods: The rotations chosen for 1990 - 1:1 crop
1:1 pasture
continuous crop
continuous pasture.

Pasture variety - medicago.

Four replications of each treatment.

Dates: 18/5/90.
Variety - Spear.

Ally and Roundup - 1:1 crop and continuous crop - 27/4/90.

Soil Type: Sandy clay loam.

Location: Robartson's Farm (Merredin).

Measurements: Plant numbers/m² (10 x 1 m rows).

Anthesis dry matter cuts (6 x 1 m rows).

Harvest dry matter (6 x 1 m rows).

Grain yield hand and machine.

Head numbers.

Neutron moisture monitoring - every two weeks during the season and monthly during summer to a depth of 2 m.

Results:

Treatments

	1:1 Crop	1:1 Pasture	Cont. Crop	Cont. Past
Plant no's/m ²	97.78	-	177.7	-
Anthesis (tonne/ha)				
Dry weight	2.9	-	2.9-4.9	-
Water use (mm)	173	163	240	153
Harvest				
Water use (mm)	203	172	280	171
Depth (cm)	110	130-150?	110-130? or 70	110-130
Dry bulk weight (tonne/ha)	5.9 c.c. 3.3 d.d.	2.0 ungrazed	6.3 c.c. 5.1 d.d.	1.7 ungrazed
Grain yield	2.3 c.c.	-	2.4 c.c.	-
Hand	1.6 d.d.		2.03 d.d.	
Machine	1.3	-	1.7-2.18	-
Head numbers	38.4 c.c. 27.4 d.d.	-	42.2 c.c. 37.28 d.d.	-
Water use efficiency (kg/ha/mm)	7.9	-	7.25	-

Figures are for d.d. unless specified.
Rainfall from anthesis-harvest 26 mm.

Comments: All tubes were placed in the direct drilled section of the crop.

The continuous crop yield was higher than the 1:1 crop yield which may be attributed to the soil being better worked giving better seed soil contact in a marginal moisture planting situation and may also be due to the 1:1 crop losing some moisture to summer weeds and pasture.

Plant numbers of the continuous crop at 177/m² was almost double that of the 1:1 crop treatment at 98/m².

Water use increase from anthesis-harvest was less than rainfall (26 mm) for both pasture treatments. Pasture had begun to die back by then. Crop water use from anthesis-harvest was higher than rainfall therefore still absorbing from profile.

Other Officers: Clinton Revell.

Heavyland Soil Type - 88ME83

Sandy clay loam.

Calibrations Used on 1990 Data

Supplied by D. Tennant

Cross calibration to fit Perth machine $y = a + bx$

$$0 - 20 \text{ cm} \quad y = 0.038828 + 0.77576 x$$

$$20 - 180 \text{ cm} \quad y = -0.0177 + 0.911194 x$$

Calibration equations

$$0 - 20 \text{ cm} \quad 0 = \frac{(n - 0.1692)}{2.492}$$

$$20 - 180 \text{ cm} \quad 0 = \frac{(n - 0.5548)}{1.5901}$$

standard count = 11670

88ME83Robartsons

Soil moisture at 20 cm intervals then totalled for each date

treatment= 1:1 pasture

depth cm	29/5/90	21/6/90	24/7/90	6/8/90	4/9/90	12/9/90	3/10/90	25/10/90	8/11/90
10	17.25	30.44	36.67	29.2	25.54	21.98	24.47	32.3	33.41
30	60.96	71.6	70.53	70.77	59.87	49.61	51.48	54.49	53.85
50	66.5	71.65	71.69	71.12	67.86	58.24	59.23	60.49	60.95
70	67.08	67.06	70.3	67.2	71.39	60.65	60.99	61.92	61.6
90	67.34	66.66	66.09	66.94	65.55	63.16	63.35	63.17	63.93
110	64.56	64.18	63.13	64.91	65.01	62.6	63.79	62.46	61.86
130	65.42	64.68	63.5	64.76	61.48	61.06	62.93	63.25	63.51
150	66.33	66.42	66.9	67.43	64.66	65.98	65.82	66.03	65.9
170	63.28	62.61	62.95	63.46	56.48	59.55	61.29	61.06	60.21
total	538.73	565.28	571.76	565.79	537.85	502.83	513.34	525.14	525.21

treatment= continuous pasture

depth cm	29/5/90	21/6/90	24/7/90	6/8/90	4/9/90	12/9/90	3/10/90	25/10/90	8/11/90
10	16.50	29.07	35.81	31.82	24.85	23.21	21.80	26.75	27.74
30	42.82	56.09	56.70	58.81	48.37	42.36	41.95	43.82	42.50
50	54.23	61.45	64.65	64.20	56.82	52.05	50.26	50.98	50.35
70	58.54	60.24	61.67	64.05	58.47	54.94	54.36	54.40	53.92
90	61.76	60.56	60.37	61.14	59.14	56.72	58.45	57.83	57.65
110	59.28	59.09	59.24	59.90	59.16	56.62	57.37	58.10	58.63
130	61.36	60.18	60.65	60.40	60.87	57.33	60.60	59.54	59.92
150	71.42	66.39	66.82	66.79	66.58	63.46	65.96	65.98	65.99
170	62.73	60.41	60.87	60.91	60.16	58.05	60.08	60.30	60.02
total	488.64	513.47	526.77	528.01	494.42	464.75	470.82	477.71	476.72

88ME83 cont

treatment=1:1 crop

depth cm	29/5/90	21/6/90	24/7/90	6/8/90	4/9/90	12/9/90	3/10/90	25/10/90	8/11/90
10	15.60	25.85	34.46	28.13	20.07	18.85	16.84	20.26	22.73
30	58.57	69.45	74.97	67.85	50.80	44.25	39.97	36.77	37.23
50	73.12	75.56	75.02	76.04	71.59	65.28	60.54	55.74	53.98
70	68.40	69.38	70.89	70.37	68.80	65.24	64.31	62.94	60.58
90	64.18	63.59	65.79	64.15	63.84	61.10	61.84	61.35	61.14
110	60.60	61.27	63.98	61.39	62.07	56.89	59.59	59.90	60.73
130	59.40	58.20	62.77	58.10	57.85	56.26	57.79	57.91	57.03
150	62.64	64.73	66.53	61.90	61.09	57.95	60.75	57.79	63.83
170	69.66	63.79	66.00	69.36	69.00	66.68	69.58	70.22	70.39
total	532.17	551.83	580.42	557.30	525.12	492.50	491.20	482.87	487.64

treatment=continuous crop

depth cm	29/5/90	21/6/90	24/7/90	6/8/90	4/9/90	12/9/90	3/10/90	25/10/90	8/11/90
10	22.16	28.34	37.77	31.34	21.29	19.86	16.99	20.02	21.12
30	64.08	68.32	70.34	64.85	46.13	38.87	30.58	26.73	27.
50	76.19	73.23	78.19	73.72	62.3	58.21	52.68	45.85	44.35
70	85.51	81.03	79.21	80.32	73.01	74.28	72.26	67.51	68.64
90	76.15	71.45	68.56	72.92	72.33	68.39	68.93	66.61	65.63
110	69.52	64.95	61.47	67.16	66.07	63.99	64.62	65.03	70.61
130	69.17	63.28	61.28	63.8	67.48	59.73	62.09	62.34	62.35
150	71.58	63.65	59.27	64.93	68.31	61.7	64.32	63.26	63.19
170	75.58	64.69	59.02	65.43	72.3	62.42	64.32	64.54	65.28
total	609.94	578.95	575.12	584.48	549.22	507.46	496.77	481.91	488.17

82M47 Trial Summary - 1990

Introduction: Tubes were inserted in 82M47 an existing clover:wheat rotation to monitor the changes in the soil water balance. 82M47 is one of the trials in the long turn monitoring system.

Methods: Access tubes were inserted in the following rotations before the break of season.

Continuous crop - 60N
- 15N
- 0N

1:1 crop:pasture
1:1 pasture crop

Each treatment has four reps.

Pasture variety - sub.clover.

Dates: Crop planted 11/6/90.
Variety - Wheat - Gutha.

Soil Type: Light gravelly duplex - transitional, which varies over the trial markedly.

Location: Merredin Research Station.

Measurements: Plants/m² (counted 10 x 1 m rows).

Harvest - dry matter cuts (6 x 1 m rows) - counted head numbers/m².

Grain yield - hand and machine - dried all bags, weighed bag and sample, removed sample then weighed bags. Removed heads which were then threshed and weighed.

Neutron monitoring every two weeks during the season and monthly during summer to a depth of 2 m.

Results:

Treatments

Measurements	1:1 Pasture	1:1 Crop	Continuous 60N	(only one rep) Crop 0N	(only one rep) 15N
Plant no's/m ²	-	133	121	133	118
Harvest	from May 1				
Water use (mm)	70	153	170	153	147
Depth (cm)	110	150	130	130	130
Dry bulk weight (tonne/ha)	1.8 ungrazed	2.34	2.79 3.2 (ex 120)	1.6	3.3
Grain yield	-	.898	1.23 (exc. 120)	.5	1.1
Machine (kg/ha)	-	1.079	1.21	.73	1.54
Head	-	139	136.6	132.5	147.2
Head numbers/m ²	-				
Water Use Efficiency (kg/ha/mm)		7.05	7.11	4.7	10.47

Comments: Due to the early rain the pasture kicked off sooner than the crop which maybe the reason why it recorded less moisture use at 70 mm where all other treatments used up to 100 mm more.

The continuous crop treatment recorded a higher water use than 1:1 crop and a higher yield. This could be due to summer weeds and pasture removing some of the moisture before planting.

The difference in rooting depth may be explained through variation in soil type. The 1:1 crop maybe forced to search deeper due to less available moisture at shallower depths. The pasture had the shallowest rooting depth of 110 cm.

Continuous crop recorded a higher yield with approximately the same head numbers therefore I deduced the plants had more weight in the heads through grain number or weight.

Comparison of the 0N and 15N treatments would be incorrect as they only had one rep each.

Pasture production at 1.8 t/ha not all that impressive. Some grazing occurred late summer before the cages went on.

Other Officers: Clinton Revell, Ian Rowland.

Transitional Soil Type - 82M47

Calibrations Used on 1990 Data

Devised by S. McKeague

Depth

$$0 - 20 \text{ cm} \quad 0 = \frac{n - 0.2067}{3.0037}$$

$$20 - 40 \text{ cm} \quad 0 = \frac{n - 3.0615}{2.837}$$

$$40 - 60 \text{ cm} \quad 0 = \frac{n - 0.4312}{1.1149}$$

$$60 - 80 \text{ cm} \quad 0 = \frac{n - 0.3617}{3.2149}$$

$$80 - 100 \text{ cm} \quad 0 = \frac{n - 0.3844}{2.7355}$$

$$100 - 180 \text{ cm} \quad 0 = \frac{n - 0.3961}{2.4773}$$

$$n = \frac{\text{count}}{\text{standard count}}$$

$$\text{standard count} = 23570$$

treatments 82m47 Soil water contents at each depth down the profile and total for each date-Merredin Research Station 1990-1991

cont crop	dates													
depth														
cm	1.5.90	20.6.90	12.7.90	20.7.90	6.8.90	14.8.90	30.8.90	3.10.90	17.10.90	8.11.90	18.12.91	8.2.91	11.3.91	
10	-6.54	2.47	2.19	4.46	4.25	3.92	4.76	1.99	3.18	2.42	2.18	-2.69	-3.58	
30	31.16	35.89	34.85	36.59	35.91	15.36	14.67	29.64	30.12	28.49	28.24	29.84	27.71	
50	19.52	23.47	21.49	25.2	24.47	23.81	22.15	14.38	12.5	9.36	8.45	10.87	10.33	
70	13.16	15.22	14.53	15.51	14.72	14.66	14.43	12.96	12.15	10.52	11.84	11.28	11.81	
90	14.62	17.65	16.52	18.64	18.56	28.1	28.1	16.81	16.46	15.71	16.29	15.07	15.91	
110	16.74	20.28	20.13	20.74	19.23	20.12	20.31	18.92	19.04	17.73	18.06	17.69	17.8	
130	18.8	21.3	21.67	22.03	18.09	22.09	21.58	21.01	20.16	19.96	19.99	19.57	19.34	
150	20.32	22.6	22.4	22.97	17.95	23.17	22.71	21.84	21.11	17.31	20.76	20.41	20.82	
170	19.71	23.25	24.26	23.75	22.91	24.14	23.51	23.23	23.25	23.07	22.49	22.2	22.26	
total	147.5	182.13	178.05	189.88	176.09	175.38	172.23	160.79	157.96	144.57	148.31	144.25	142.39	

1:1 crop

depth														
cm	1.5.90	20.6.90	12.7.90	20.7.90	6.8.90	14.8.90	30.8.90	3.10.90	17.10.90	8.11.90	18.12.91	8.2.91	11.3.91	
10	-6.84	0.67	-0.04	2.44	3.02	2.92	4.67	3.16	4.81	4.4	3.42	-4.06	-4.94	
30	31.38	37.07	36.4	38.43	37.53	17.42	16.69	32.29	32.76	31.36	30.07	32.37	29.58	
50	25.17	24.78	23.17	26.07	25.78	24.73	23.96	16.95	14.84	13.3	12.36	12.65	11.87	
70	15.57	15.19	14.76	15.63	15.74	15.14	14.99	13.22	12.47	11.95	12.28	12.25	12.36	
90	18.28	18.31	17.78	18.54	18.73	28.1	28.1	16.34	16.03	14.59	15.39	15.84	15.89	
110	19.85	19.36	18.88	19.46	19.86	19.19	19.23	18.71	17.52	16.78	17.23	16.99	17.62	
130	20.1	19.33	19.54	19.58	20.2	20.22	19.82	18.61	18.75	18.01	18.69	17.77	17.76	
150	20.1	20.38	20.06	20.23	19.86	19.82	19.42	18.96	18.5	18.21	18.44	17.87	17.83	
170	22.29	22.92	23.37	23.01	23.21	23.25	22.36	22.14	21.72	21.6	21.43	20.95	20.77	
total	165.88	178.01	173.93	183.39	183.94	170.79	169.24	160.37	157.41	150.2	149.31	142.62	138.75	

pasture

depth														
cm	1.5.90	20.6.90	12.7.90	20.7.90	6.8.90	14.8.90	30.8.90	3.10.90	17.10.90	8.11.90	18.12.91	8.2.91	11.3.91	
10	-8.36	2.13	0.26	5.41	5.45	5.35	6.59	5.68	8.96	7.46	3.82	-1.01	-2.49	
30	31.79	35.88	32.36	37.34	36.5	15.06	15.15	32.45	34.02	31.77	27.51	32.64	28.18	
50	20.28	18.81	16.8	25.92	24.93	23.44	17.58	17.19	18.51	16.91	7.61	15.83	12.85	
70	14.46	12.02	11.47	13.44	12.9	12.61	11.44	11.44	12.	11.75	10.28	11.51	11.12	
90	18.29	12.68	11.26	11.21	11.25	28.1	28.1	10.16	10.23	10.31	11.73	11.37	10.58	
110	20.34	12.78	10.22	10.38	10.36	10.75	12.88	10.16	10.21	10.54	12.66	10.53	10.38	
130	20.38	14.97	12.37	12.63	12.62	12.61	15.06	12.13	12.62	12.07	15.37	12.58	12.7	
150	24.18	18.7	17.25	16.4	16.25	16.4	18.32	15.71	16.73	16.84	18.82	16.48	16.78	
170	24.7	19.88	18.75	18.78	18.54	18.74	19.41	17.68	18.62	18.39	19.69	18.5	18.35	
total	166.05	147.85	130.73	151.51	148.8	143.06	144.54	132.61	141.91	136.05	127.51	128.41	118.45	

ON													
depth													
cm	1.5.90	20.6.90	12.7.90	20.7.90	6.8.90	14.8.90	30.8.90	3.10.90	17.10.90	8.11.90	18.12.91	8.2.91	11.3.91
10	-7.18	1.41	0.04	1.98	2.37	2.47	3.44	2.46	3.5	2.38	1.38	-4.77	-4.39
30	31.46	34.41	34.59	37.32	36.33	15.35	15.04	30.37	30.22	29.88	28.52	29.97	27.5
50	19.54	21.19	19.1	23.23	21.17	20.27	17.08	8.51	7.76	7.9	9.89	8.89	9.25
70	12.09	12.19	11.62	13.48	12.3	12.31	11.03	10.25	9.53	8.47	10.18	9.58	9.51
90	13.42	13.91	14.22	15.23	15.16	28.1	28.1	13.15	13.59	12.18	12.74	12.47	12.89
110	16.89	16.54	16.1	16.65	17.2	16.02	16.14	15.06	15.81	14.94	15.15	14.98	14.13
130	16.46	16.93	16.98	17.53	17.42	16.85	16.84	15.7	15.83	15.48	15.72	14.23	15.54
150	18.67	18.96	18.48	18.67	18.53	18.61	18.7	17.91	17.77	18.07	17.77	16.99	17.58
170	21.54	22.08	21.75	21.36	22.42	21.14	21.28	21.23	20.61	19.93	19.92	20.52	19.87
total	142.89	157.62	152.86	165.46	162.91	151.12	147.65	134.65	134.62	129.22	131.28	122.86	121.89

15N													
depth													
cm	1.5.90	20.6.90	12.7.90	20.7.90	6.8.90	14.8.90	30.8.90	3.10.90	17.10.90	8.11.90	18.12.91	8.2.91	11.3.91
10	-6.05	4.88	4.18	6.05	6.5	6.14	9.02	6.26	7.33	7.05	4.7	-1.19	-3.01
30	37.62	38.93	37.79	40.17	39.01	18.09	16.62	31.34	31.87	30.4	28.09	32.87	29.44
50	29.94	35.81	32.51	34.89	36.04	35.64	31.46	24.77	20.99	23.48	18.88	20.99	19.09
70	19.92	19.74	19.63	20.75	20.29	19.73	19.11	17.24	15.85	15.2	16.23	16.56	17.47
90	20.61	19.91	18.57	20.29	20.07	28.1	28.1	16.8	15.5	14.59	16.08	16.49	17.48
110	19.02	17.66	18.08	18.67	17.57	17.62	17.52	16.86	16.17	14.57	15.19	15.27	15.23
130	17.49	17.91	17.41	16.75	17.64	16.86	17.16	16.94	16.07	15.64	16.19	15.68	14.62
150	19.95	21.09	20.06	19.51	19.93	18.93	19.72	18.65	19.4	18.7	18.85	17.5	17.58
170	23.83	23.53	23.06	22.75	23.02	22.66	21.83	22.13	21.01	21.41	21.97	21.57	20.92
total	182.34	199.46	191.29	199.84	200.08	183.79	180.54	170.98	164.19	161.05	156.17	155.74	148.83

86M79 Trial Summary - 1990

Introduction: The long term moisture monitoring network was established in 1990. 86M79 was monitored as part of this network.

Methods: The trial was established in 1986 by Ron Jarvis. Only a few of the treatments were continued for 1990 and 1991.

Two fallow treatments - chemical
- chemical + scarification
and one control - nil.

Each treatment has four reps.

1990 - fallow treatments were applied to a medic pasture.

1991 - plans to be cropped to wheat.

Dates: Scarified July 13 and 19, 1990.
Sprayed (Spray.seed) June 27, 1990.

Soil Type: Clay loam.

Location: Merredin Research Station.

Measurements: Soil moisture was monitored every two weeks during the season and monthly over summer.

Results:

Stored soil moisture in the profile.

Treatments	29/8/90	12/9/90	16/10/90	7/11/90	17/12/90	4/2/91	11/3/91
Chemical	63.5	83	73	72	70	58	46
Chemical + Scarification	76	102	84	94	81	74	42
Nil	5	9	4	5	8	0	0

General - all treatments.

24/4/90 18 mm

21/6/90 38 mm

Comments: Although preliminary, results show chemical and chemical + scarification treatments were holding 40 mm in the soil profile in March 1991 following fallow treatments applied in 1990.

Very little difference occurred in moisture conservation patterns of the two fallow treatments although the scarification + chemical did appear to hold moisture for longer, earlier on.

Comparing readings down the profile for all intense purposes the two are the same. The ground cover of the chemical alone maybe preventing some wind erosion. The ground is very hard on the chemical alone plots which may effect seed establishment in 1991.

Other Officers: Ron Jarvis.

Heavyland Soil Type 86M79

Clay loam.

Calibrations Used on 1990 Data

Supplied by D. Tennant

Cross calibration to fit Perth machine $y = a + bx$

$$0 - 20 \text{ cm} \quad y = 0.038828 + 0.77576 x$$

$$20 - 180 \text{ cm} \quad y = -0.0177 + 0.911194 x$$

Calibration equations

$$0 - 20 \text{ cm} \quad 0 = \frac{(n - 0.1692)}{2.492}$$

$$20 - 180 \text{ cm} \quad 0 = \frac{(n - 0.5548)}{1.5901}$$

standard count = 11670

treatment=chemical

depth cm	5/2/90	14/2/90	24/4/90	11/7/90	18/8/90	29/8/90	12/9/90	3/10/90	16/10/90	4/2/91	11/3/90	19/4/90
10	43.37	51.17	9.94	23.73	35.05	38.53	37.75	38.29	43.48	22.11	16.58	8.23
30	71.82	31.7	47.94	53.39	65.85	62.59	64.51	62.44	61.86	64.05	53.08	35.00
50	62.49	69.97	47.12	51.64	58.92	55.63	57.08	56.16	55.12	60.28	57.62	52.00
70	58.28	61.5	52.7	59.94	59.05	56.8	59.47	58.09	58.94	59.68	59.13	53.81
90	59.1	59.04	55.88	61.71	59.05	55.75	58.16	56.82	57.18	57.88	57.89	57.52
110	58.14	59.28	56.52	59.32	57.35	55.01	57.03	55.74	56.21	56.21	57.12	56.23
130	58.53	57.2	56.16	59.14	55.01	53.33	55.72	56.26	54.68	53.24	55.16	54.91
150	64.5	58.7	59.84	60.74	59.2	55.87	57.42	57.9	58.45	57.32	57.73	53.28
170	67.66	64.13	64.45	66.45	68.51	62.64	68.33	60.00	60.00	60.00	64.47	58.24
	543.9	512.71	450.55	496.05	518.	496.14	515.47	501.7	505.93	490.78	478.78	429.42

treatment=scarification+chemical

depth cm	5/2/90	24/2/90	24/4/90	29/8/90	12/9/90	3/10/90	16/10/90	4/2/91	11/3/91
10	43.37	51.17	9.94	34.03	33.76	33.82	39.52	21.03	15.63
30	71.82	31.7	47.94	61.76	64.93	62.09	60.64	62.64	49.9
50	62.49	69.97	47.12	56.46	60.67	58.1	58.59	61.47	56.7
70	58.28	61.5	52.7	59.02	63.31	60.27	59.93	60.91	60.03
90	59.1	59.04	55.88	58.54	61.66	58.92	59.17	59.92	59.76
110	58.14	59.28	56.52	58.47	61.01	59.5	59.2	59.65	59.28
130	58.53	57.2	56.16	56.72	59.58	59.12	58.25	59.34	60.64
150	64.5	58.7	59.84	58.46	61.31	60.25	61.45	61.38	61.35
170	67.66	64.13	64.45	65.36	68.33	60.	60.	60.	50.86
	543.9	512.71	450.55	508.8	534.56	512.06	516.76	506.33	474.15

treatment=nil

general general

depth cm	5/2/90	24/2/90	24/4/90	11/7/90	18/8/90	29/8/90	12/9/90	3/10/90	16/10/90	4/2/91	3/11/91
10	43.37	51.17	9.94	20.91	29.26	26.58	23.95	24.24	32.34	14.66	11.09
30	71.82	31.70	47.94	46.39	49.16	36.58	31.25	29.37	30.71	43.17	29.57
50	62.49	69.97	47.12	39.79	44.22	38.65	40.05	37.93	37.65	37.95	37.01
70	58.28	61.50	52.70	47.70	47.69	47.41	49.21	48.24	47.53	46.41	47.47
90	59.10	59.04	55.88	54.21	52.46	53.28	54.53	53.87	54.07	53.12	54.51
110	58.14	59.28	56.52	56.19	55.46	55.63	56.67	55.75	55.11	55.06	56.54
130	58.53	57.20	56.16	57.18	58.15	55.91	57.61	57.54	57.79	57.14	56.78
150	64.50	58.70	59.84	62.54	61.07	60.57	63.34	60.59	61.40	61.07	62.77
170	67.66	64.13	64.45	64.51	68.11	62.99	65.35	65.00	60.00	60.00	65.80
total	543.90	512.71	450.55	449.43	465.58	437.60	441.94	432.53	436.61	428.59	421.53