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1975 Fallow re-assessment and soil physical data accumulation

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This report summarises progress and data available for the following investigations.

1. Fallow Re-assessment

2. Soil Physical Data Accumulation

   (a) Evaluation of methods of bulk density measurement.

   (b) Water holding capacities and mechanical analyses of wheatbelt soils.

   (c) Water holding capacities of metropolitan sands.

1. Fallow Re-assessment - 72 M 29

The fallow investigation initiated at Merredin Research Station on Merredin clay loam in 1972 has continued. Treatment establishment years were followed by assessment years under crop at adjacent sites. The following treatments were imposed.

1. Long fallow — Maximum water conservation treatment. Cultivated at first rains and subsequently when necessary for weed control.

2. Crop - Crop — Minimum water conservation treatment. Sown to wheat during establishment and assessment years.

3. Chemical fallow — Sprayed to kill pasture before seed set.

4. Mechanical fallow — Cultivated after seeding operations. Standard practise for area.

5. Pasture - crop — Left in pasture during the establishment year.

6. Short fallow — Left in pasture during establishment year and cultivated after summer rain, if any.

Yields after three successive assessment years are presented in Table 1.

Comments on Results:

1. Yields in 1973 were associated with levels of soil water storage which developed over the relatively dry growing season of 1972.

2. Measurement of soil moisture after treatment establishment in 1973 showed greater treatment responces by December, but were overwhelmed by high pre-seeding rainfall in 1974. Differences in stored soil water were minimal by planting in 1974. Yields were significantly higher in 1974 than 1973 as a consequence of high levels of stored soil water at planting and high growing season rainfall. Yields were little different between treatments.

3. Yields were low in 1975 but as with the 1973 data were associated with levels of soil water storage.

4. Reasons for low water storage in 1975 after high rainfall in 1974 not easily explicable. High waterlogging and ponding noted in the winter of 1974. Conditions did not favour weed control.

5. Lowest yields in 1975 significantly lower than those of 1973. Low growing season rainfall and late June than late May planting will have contributed.

TABLE 1

Available water at seeding, growing season rainfall and yields in 1973, 1974 and 1975

	1973		1974		1975	
	Available soil water at seeding (cm)	Yield kg ha^{-1}	Available soil water at seeding (cm)	Yield kg ha^{-1}	Available soil water at seeding (cm)	Yield kg ha^{-1}
Continuous Crop	2.59	1055.6	12.99	3444.4	2.81	590
Short fallow	4.49	1381.9	12.67	3166.7	2.96	613
Pasture - crop	4.67	1546.4	13.16	3866.7	3.12	637
Chemical fallow	5.18	1444.4	13.61	3511.1	4.53	1063
Mechanical fallow	6.01	1569.4	13.86	3433.3	5.88	1410
Long fallow	7.97	1791.6	14.63	3166.7	9.13	1540
Rainfall Seeding to October	274 mm.		307 mm.		198 mm.	

6. When differences were recognisable, mechanical fallow gave greater water storage and higher yields than chemical fallow.

2. Soil Physical Data Accumulation

(a) Evaluation of methods of soil bulk density measurement

Detailed soil bulk density measurements are necessary when estimating soil water. Measurements of bulk density are largely obtained from pushing/knocking a cylinder of known dimensions into the face of a pit and from weighing the resultant core samples. The procedure is laborious and where soil bulk density determinations are required to maximum depths of root penetration, these are usually restricted to locations where mechanical trenching equipment is available or is easily available.

To overcome this limitation, several methods of obtaining undisturbed aggregates were compared with conventional core sampling at the Merredin Research Station on Merredin sandy clay loam.

1. Bulk densities were obtained from conventional 5 cm diameter core samples from one face of a pit.

2. Aggregate densities using a standard kerosene saturation technique were obtained from:

(a) large clods from one face of a pit,

(b) 2.5 cm and (c) 5.0 cm diameter core samples from bases of 10 cm diameter auger holes, and,

(d) undisturbed aggregates from soil broken up by a 25 cm diameter tractor mounted post hole auger.

Means of 8 replicable measurements at 10 cm intervals down the soil profile to 80 cm are presented in Table 2.

TABLE 2

Effect of sampling technique on soil bulk density/aggregate density - ($g.cc^{-1}$)

Sample Depth (cm)	Bulk densities / aggregate densities - $g.cc^{-1}$				
	Conventional 5cm diameter cores	2.5cm diameter cores from 10cm diameter auger holes	5cm diameter cores from 10cm diameter auger holes	Aggregates from 25 cm diameter auger holes	Large clods from face of pit
0-10	1.74	1.80	1.77	1.71	1.77
10-20	1.34	1.75	1.65	1.59	1.67
20-30	1.30	1.85	1.61	1.66	1.61
30-40	1.39	1.74	1.58	1.58	1.58
-50	1.54	1.68	1.66	1.74	1.67
50-60	1.69	1.73	1.75	1.64	1.66
60-70	1.73	1.78	1.73	1.76	1.69
70-80	1.76	1.87	1.79	1.81	1.82

Comments on results:

1. The conventional bulk density measurements were significantly lower than the aggregate densities over the 10 to 50 cm sample depths.

2. Aggregate densities were highest with the 2.5 cm diameter core samples over the 10 to 40 cm sample depths. These differences are believed to follow from soil wetting to 50 cm only. Lower densities for the conventional method can be argued from expected soil swelling, while the high values with the 2.5 cm core samples possibly follow from sample compaction - each as a consequence of sampling in wet soil.

3. The easily obtained 5 cm diameter cores give good agreement with the large clods, especially if the high value for the 50 to 60 cm sample depth is allowed for. Inspection of the data shows two measurements g 1.9 and higher. Averaging the remainder gives a figure of 1.70.

4. Due presumably to shear effects, aggregate densities from the 25 cm diameter auger holes showed unaccountable swings in relative magnitudes.

Conclusion:

At this point it would seem that aggregate densities from the 5.0 cm diameter core samples from 10 cm diameter auger holes will provide suitable estimates of bulk densities, at a considerable saving in effort. Investigations are continuing.

(b) Water holding capacities and mechanical analyses of wheatbelt soils.

To date, fourteen sands ranging from poor white sands with 1 to 2% silt and clay content in the profile to sands which at times had as much as 20% silt and clay content have been sampled to establish water holding capacities and clay-silt-fine sand-coarse sand contents to maximum depths of wheat root penetration. Similar measurements are being made on fourteen heavy soils from the Merredin district. Sampling is to continue to cover as a big a range of soils as practicable.

(c) Water holding capacities of metropolitan sands.

Current recommendations on watering of metropolitan lawns and gardens are based on maintaining adequate supplies of soil water to 60 cm depths. It is assumed that root activity is largely located within these depths. Apart from meteorological considerations, frequency of watering and amounts applied are influenced by soil water holding capacities. Specific data were obtained for several locations. These are listed in Table 3.

TABLE 3

Water holding capacities (1/10 - 15 Atmosphere water contents) of metropolitan sands (mm of water). Bulk density of 1.6 assumed

	Sampling Depths 0-15cm	15-30cm	30-45cm	45-60cm	Total (0-60 cm)
1. Medina Research Station	7.7	7.2	5.5	4.8	25.2
2. Morley White Sand	4.3	2.9	2.6	2.9	12.7
3. Karrakatta Sand	6.0	3.3	3.0	4.0	16.3
4. Bassendean Sand	7.4	3.4	3.1	3.6	17.5
5. South Perth Lawn	4.8	4.8	2.6	2.4	14.6
6. South Perth Scrub	5.0	3.6	2.4	2.6	13.6
7. Underwood Avenue Research Station	9.2	6.9	5.9	5.7	27.7
8. Floreat Park sand	7.6	5.0	4.8	4.6	22.0
9. Tuart Sand	4.2	2.2	2.4	2.0	10.8

Highest values were obtained at the Medina and Underwood Avenue Research Stations. Generalised recommendations can be aimed at the 15 to 22 mm range of water storage to 60 cm depths. Water storage to 60 cm soil depth can be as low as 10 mm.