1979

Fallow re-assessment

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SUMMARY OF RESULTS

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FALLOW RE-ASSESSMENT

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FALLOW RE-ASSESSMENT

I. 72M29

Location Merredin Research Station

Treatments

1. Twelve month fallow - Maximum moisture storage treatment. Cultivated at first rains in treatment establishment year and subsequently when necessary for weed control.

2. Nine to ten month fallow - Cultivated late July early August in treatment establishment year after completion of seeding operations and then cultivated when necessary for weed control.

3. Chemical fallow - Sprayed with weedicide to kill pasture before seed set in the treatment establishment year.

4. Non-fallow - Left in pasture during the treatment establishment year and cropped in the treatment assessment year.

5. Short summer fallow - Left in pasture during the treatment establishment year and cultivated after summer rains if any.

6. Continuous crop - Minimum moisture storage treatment. Cropped in establishment and assessment years.

Crop Gamenya wheat.

Results

The short summer fallow treatment was again effective in 1979 following late February cultivation after heavy mid February rainfall (25 mm).

1. Although growing season rainfall was similar for 1978 and 1979 yields were significantly higher in 1978 (Table 1). Much of this difference was due to greater water storage (Table 1) from higher January to April rainfall in 1978 (157 mm) than 1979 (65 mm).

2. Yields were generally higher with fallow than non fallow, except with chemical fallow. As indicated in previous reports, time at which herbicide is applied for chemical fallow usually post dates cultivation for 9 to 10 month fallow by two to four weeks. Incidence of rainfall for soil moisture recharge falls off rapidly after mid July.

3. There was some suggestion in the 1978 data that the loose surface of the short summer fallow can serve to increase infiltration from early winter rains. This did not occur with the 1979 short summer fallow. Moisture storage with the non fallow and short summer fallow treatments was similar (Table 1).

4. Yields were significantly related to soil moisture storage at planting (R^2 = 0.95). There was a yield increase of 11.6 $kgha^{-1}$ for each additional mm of stored soil water from fallowing.

II. OTHER FALLOW RESULTS

As part of the fallow re-assessment project, a study was made of results from all trials done since the early 1920's which either compared fallow with non fallow or examined other aspects of fallowing.

Analysis of these data has led to an update of some of the rainfall - soil water storage - yield relationships presented in previous reports.

1. Regression analyses done on the data suggest that 100 - 120 mm of growing season rainfall are needed before any grain is set at all.

2. Beyond this base level of rainfall, each additional mm of rainfall gave yield increases of the order of 7 - 10 $kgha^{-1}$.

3. Each additional mm of stored soil water at planting from fallowing gave yield increases of the order of 10 to 16 $kgha^{-1}$.

Other points arising from an inspection of data obtained at Merredin Research Station describe rainfall conditions for best value from fallow (Table 2).

1. In those years in which non fallow yields were below 1000 kg/ha, 12 month and 9 to ten month fallow yields were significantly higher than with non fallow. Average yields were 93 and 52 per cent higher respectively.

2. When non fallow yields exceeded 1500 kg/ha, there was no consistent benefit to fallow.

3. Growing season rainfall in years in which fallow had greater effect averaged 175 mm, growing season rainfall in years in which fallow had least effect averaged 226 mm.

4. High January to April rainfall reduced yield responses to fallow. In three dry years when non fallow yields exceeded 1500 kg/ha, crops were favoured by high January to April rainfall.

5. Fallow gave consistently better yields than non fallow in those years in which annual rainfall was less than 300 mm.

6. In years in which January to April rainfall was below 100 mm, yield responses to fallowing were evident up to 280 to 300 mm growing season rainfall or 325 to 350 mm annual rainfall.

On the basis of these rainfall-yield relationships and of relevant rainfall statistics we can make an assessment of the probable value of fallow at different locations.

Merredin

Annual rainfall at Merredin was below 300 mm in 72 per cent of all years for which records are available. Over the same period, growing season rainfall was below 225 mm in 5 to 6 years in 10. On average, January to April rainfall exceeded 100 mm in one of these years. We can expect the following for crops grown on heavy land in the Merredin area.

1. Fallow yields to exceed non fallow yields in 7 years in 10.

2. Fallow yields to be markedly higher than non fallow yields in 4 to 5 of these years (Table 3).

3. On average, fallow yields to exceed non fallow yields by 30-40 per cent with 12 month fallow or 5-10 per cent with 9 to 10 month fallow.

Higher yields with fallow than non fallow confer a significant economic risk benefit relative to conventional cropping. As an example, yield frequencies computed for Merredin (Table 4) show that yields with 12 month fallow were below 1000 kg/ha in only 1 year in 10 if at all. Yields with conventional non fallow cropping were below 1000 kg/ha in 4 years in 10. Benefit from 9 to 10 month fallow was marginal.

Chapman

Rainfall frequency data for the Chapman Research Station suggest little value from fallow in that area. Annual and growing season rainfall were below 300 mm and 225 mm respectively in only 1 year in 10. Trials on fallowing at Chapman over the periods 1929 to 1937 and 1948 to 1958 gave yields which support this conclusion. Average yield benefits ranged from 12 per cent (1948-58) to 22 per cent (1929-37). Yield responses to fallowing were evident to 375 mm growing season rainfall or 450 mm annual rainfall. All trials were done on a medium textured sandy loam soil.

Wongan Hills

Rainfall conditions at the Wongan Hills Research Station are more favourable than at Merredin. Annual and growing season rainfall were below 300 mm and 225 mm respectively in 3 to 4 years in 10. On average, January to April rainfall exceeded 100 mm in one of these years.

Average yield responses to fallowing at Wongan ranged from 2 per cent (1929-31) to 48 per cent (1948-58). Much of the difference in the post war trials was due to poor weed control with non fallow and a preponderance of years with lower than average growing season rainfall.

Although all the fallow trials at Wongan were on coarse textured soils, some of these soils at Wongan Hills are capable of storing up to 125 mm of moisture to maximum depths of crop root penetration. Overall, there was no evidence to suggest a consistent yield - rainfall relationship for Wongan Hills.

Salmon Gums

Although total growing season rainfall at the Salmon Gums Research Station was below 225 mm in 6 to 7 years in 10, high incidence of greater than 100 mm of January to April rainfall (2 - 3 of these years) raised annual rainfall to 300 mm and beyond for 6 - 7 years in 10. On this basis, a lesser benefit from fallowing may be anticipated for Salmon Gums than Merredin. Short summer fallow would appear to be the preferred operation. Results to test this conclusion are limited.

TABLE 1 YIELDS, SOIL MOISTURE STORAGE AT PLANTING AND GROWING SEASON RAINFALL AT MERREDIN

	YIELDS ($KGHA^{-1}$) AND SOIL MOISTURE STORAGE AT PLANTING* (MM)							
	1972+	1973	1974	1975	1976	1977	1978	1979
Establishment Year								
First year of two year crop treatment	662	1398	1699	516	387	533	1416	
Assessment Year								
Second year of two year crop treatment	-	1056(26)	1722(130)	590(28)	533(22)	243(46)	1734(51)	940(38)
Non fallow	-	1547(47)	1933(132)	637(31)	506(31)	323(46)	1786(74)	1019(46)
Short summer fallow	-	≠	≠	≠	≠	≠	2012(102)	1058(45)
Chemical fallow	-	1445(52)	1756(136)	1063(45)	740(49)	407(49)	1917(83)	993(47)
9 to 10 month fallow	-	1570(60)	1717(139)	1410(59)	730(50)	439(57)	1885(86)	1272(63)
12 month fallow	-	1792(80)	1583(146)	1540(91)	1043(77)	637(67)	1881(95)	1344(75)
Growing Season Rainfall	174mm	270mm	307mm	245mm	165mm	154mm	181mm	182mm

* Soil moisture results in parentheses

\+ Trial established 1972

≠ Short fallow treatment not effective

TABLE 2 RAINFALL AND FALLOW YIELDS WHEN NON FALLOW YIELDS WERE

(A) BELOW 1000 KGHA^{-1}

(B) BETWEEN 1000 AND 1500 KGHA^{-1}

(C) ABOVE 1500 KGHA^{-1}

YEAR	FALLOW		NON-FALLOW	RAINFALL (MM)		
	12 MONTH	9-10 MONTH		JAN-APRIL	MAY-OCT	ANNUAL
(A) NON FALLOW YIELDS BELOW 1000 KGHA^{-1}						
1926	1179	570	717	72	210	292
1928	1198	814	538	50	165	222
1935	1240	1251	576	60	194	260
1937	1107	1040	815	24	165	215
1975	1540	1410	637	57	245	355
1976	1043	730	506	65	165	255
1977	637	439	323	28	154	212
	1135 (193%)	893 (152%)	587 (100%)	51	185	259
(B) NON FALLOW YIELDS BETWEEN 1000 AND 1500 KGHA^{-1}						
1929	1305	896	1082	73	236	366
1931	1692	1270	1456	63	232	311
1933	2066	1613	1197	14	199	246
	1688 (136%)	1260 (101%)	1245 (100%)	50	222	308
(C) NON FALLOW YIELDS GREATER THAN 1500 KGHA^{-1}						
1927	1856	1667	1707	155	170	346
1930	1871	1351	1931	119	209	339
1932	2691	1487	1810	42	283	332
1934	1752	1622	1833	162	164	342
1973	1792	1570	1547	29	270	325
1974	1583	1717	1933	134	307	480
1978	1881	1885	1786	157	181	410
	1918 (107%)	1614 (90%)	1792 (100%)	114	226	368

TABLE 3 RAINFALL - YIELD RELATIONSHIPS AT MERREDIN RESEARCH STATION

A. Yields in those years in which growing season rainfall was below 225 mm and January to April rainfall did not exceed 100 mm. Frequency of occurrence 4 - 5 years in 10.

	Range ($kgha^{-1}$)	Mean ($kgha^{-1}$)
12 month fallow	1240-637	1067(184%)
9-10 month fallow	1251-439	807(139%)
non fallow	815-323	579(100%)

B. Yields in those years in which either growing season rainfall exceeded 225 mm or January to April rainfall exceeded 100 mm. Frequency of occurrence 5 - 6 years in 10.

	Range ($kgha^{-1}$)	Mean ($kgha^{-1}$)
12 month fallow	2691-1305	1825(109%)
9-10 month fallow	1885-896	1496(89%)
non fallow	1933-1082	1676(100%)

TABLE 4 YIELD FREQUENCIES AT MERREDIN RESEARCH STATION - NUMBER OF YEARS IN TEN IN WHICH SPECIFIED YIELDS WERE ACHIEVED.

YIELDS	TWELVE MONTH FALLOW	NINE TO TEN MONTH FALLOW	NON FALLOW
500	10	9-10	9-10
750	9-10	8-9	6-8
1000	9-10	6-7	6
1250	6-7	5-7	4-5
1500	5-6	4-5	4
1750	3-5	2-4	2-3
2000	1-2	0	0

Yield Frequencies derived from data obtained with

(a) Fallow vs non fallow trials

1925 - 1937
1973 - 1978

(b) Time of fallowing trials

1924 - 1937
1973 - 1978

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