CWFS Central West Farming Systems

NSW DEPARTMENT OF PRIMARY INDUSTRIES

EVALUATION OF SUMMER FALLOW EFFICIENCIES DURING THE 2007/08 SUMMER FALLOW PERIOD IN THE PARKES & FORBES DISTRICTS

Colin McMaster, NSW DPI Farming Systems Agronomist, Parkes Ph 02 6816 3300
Ken Motley, NSW DPI District Agronomist, Forbes Ph 02 6850 2926

Key points

- *The efficiency that summer fallow rainfall was stored for the following winter crop was measured at 9 sites in the Parkes and Forbes district during the 2007/08 summer fallow period.*
- *Summer fallow efficiencies at these sites were generally found to be within the range of 20% to 30%.*
- *The 2007/08 summer fallow period was wetter than average for most sites across central west NSW.*
- *These wet conditions resulted in a significant proportion of the soil plant available water being stored deeper in the soil profile than might otherwise happen in summer fallow seasons more characterised by low and less frequent rainfall. In such years fallow efficiencies may be below that recorded in the 2007/08 summer fallow period.*

Background

The efficiency that summer fallow rainfall is stored for the following winter crops is an important factor to consider when making decisions regarding the benefit of spending money on summer fallow maintenance. In this paper the summer fallow period is generally defined as being from November to April. Increasing costs of summer fallow maintenance, due to the increased cost of fallow herbicides such as Glyphosate has placed increased emphasis on evaluating the economics of summer fallow maintenance. Conventional theory used in water use efficiency (WUE) models is that 20% to 30% of summer fallow rainfall is stored and available for the following winter cop.

This report details soil moisture testing results taken over the summer of 2007/08 where the plant available water (PAW) status of various sites across the Parkes and Forbes district were monitored so that the efficiency of fallow rainfall storage for the following winter crops could be calculated. The data cannot be used to compare management practice effects on fallow efficiency between sites as differences in soil types, rainfall distribution and rainfall intensity confuse such comparisons. These type of comparisons need to be made on a common site with the only variable being the management practices under investigation. However, the results in this report help to provide local data on the level of fallow efficiencies that were obtained in the summer fallow of 2007/08 so as to check to the theoretical values derived from other locations.

Table 1. Site details and fallow description

Site name	Cooperator	Apsoil No	GPS coordinates		Location and site comments	Previous crop	Fallow description
Gooloogong A	Norrie	196	S33^0 34' 49"	E148^0 14' 50"	15km west of Goologong Chocolate clay cloam Sloping paddock	Wheat	2 fallow herbicide sprays Intermitted grazing Sown into stubble
Gooloogong B	Grey	195	S33^0 55' 48"	E148^0 22' 18"	10km west of Gooloogong Alluvial loam Alluvial soil beside local creek	Wheat	1 fallow herbicide spray Grazed No Cultivation
Peak Hill	Mitchell	197	S32^0 40' 38.4"	E147^0 59' 31"	20km west of Peak Hill Red clay Saline constraints in sub soil	Wheat	Several fallow herbicide applications Fallow kept clean of weeds No Grazing. No cultivation
Gunningbland	Rhodes	189	S33^0 08' 08"	E147^0 56' 26"	3km NW of Gunningbland Self mulching chocolate clay Sloping	Wheat	Several fallow herbicide applications Fallow kept clean of weeds Light grazing. No cultivation
Back Yamma	Field	192	S33^0 12' 79"	E148^0 08' 45"	10km south of Parkes Red sandy loam Flat	Wheat Cut for hay	3 fallow sprays (Dec, Feb, April) Grazed Nov, lightly grazed March No Cultivation
Bogan Gate A	Hodges	187	S33^0 14' 29.5"	E147^0 44' 44"	15km south of Bogan Gate Grey clay (little sodicity) Flat	Wheat	1 fallow herbicide spray Grazed Cultivated 1 time
Bogan Gate B	Coombs	188	S32^0 12' 02"	E147^0 48' 42"	12km south of Bogan Gate Sand over sandy clay Western slopes of the Gunning Range	Wheat	1 fallow herbicide spray (early Jan) Grazed no cultivation
Marsden	Duff	204	S33^0 40' 17.7"	E147^0 32' 34"	10km north of Marsden Heavy grey clay Edge of Lake Cowal	Wheat failed and not harvested	2 fallow herbicide sprays No Cultivation No Grazing
Fifield	Larking	199	S32^0 29' 57"	E147^0 10' 26"	15 km NW of Fifield Red Sandy clay loam	Wheat	No cultivation Grazed Herbicide application to fallow

Methods

In the spring of 2007 a series of soil types in the Parkes and Forbes district were characterised in terms of plant available water capacity as part of a larger Grains Research and Development Corporation (GRDC) funded project coordinated by CSIRO. This characterisation involved establishing the drained upper limit (DUL) and the crop lower limit (CLL) as well as detailed textural and chemical analysis. The results of these classifications are available on the APSRU web site (www.apsru.gov.au/apsru/), where the APSoil database of soil classifications can be downloaded. The appointed APSoil number for each site studied for the fallow efficiency work is described in Table 1.

The classification of these sites represented an opportunity to monitor the recharge of soil moisture at some of these sites over the summer fallow of 2007/08. Nine sites in the Parkes and Forbes district were chosen so as to provide a geographic and soil type spread. The fallow period for all sites except Gooloogong A was defined as the period from November up to and including April. The fallow period for the Gooloogong A site was defined as from November to March, as this site was sown to dual purpose wheat in early April. The location of each site is described in Table 1. Soil classification characteristics such as the layer bulk density and crop lower limit (CLL) were taken from the APSoil soil classification results.

The soil core testing conducted at the end of the fallow period occurred to a depth of 130cm. The soil cores were broken into 6 sub-sections being 0-10cm, 10-30cm, 30-60cm, 60-90cm, 90-120cm and 120-130cm. Soils sections were weighed wet and then dried in an oven at 110^0C until the weights had stabilised.

The following calculations were used to work out the PAW content of each depth section;

Gravimetric water content (%)
= water content as a % of dry soil weight

Volumetric water content (%)
= Gravimetric water content **X** bulk density

PAW content (per 10cm depth)
= Volumetric water content (%) – CLL (%)

Total PAW (mm)
= sum of the PAW at each depth section

Five cores were sunk at each site except for the Gooloogong A, Gunningbland and Fifield sites. The total PAW results for each core are presented in Table 3.

Rainfall over the summer fallow period was taken from nearby farmer gauges. In most cases these gauges were several kilometres from the soil test site, and there may well have been some differences between what fell at the soil test site and what the local farmer recorded. The fallow efficiency was calculated as PAW as a % of total fallow rainfall. Rainfall and the calculated fallow efficiencies are presented in Table 3.

Results and discussion

Seasonal Conditions

Rainfall during the fallow period of 2007/08 was generally above the long term median (i.e. decile 5) within the local region that the soil testing occurred within. Table 2 provides a summary of the November to April rainfall for five long term rainfall stations in the local region. At the top of the rainfall range for the 2007/08 summer fallow period was Parkes with 425mm, very similar to the Back Yamma site (see Table 3) with 424mm. This amount of rainfall represented a decile 8.5 event at the Parkes gauge and was the wettest fallow event since 1990. At the other end of scale were Tullamore and Peak Hill, receiving 218mm and 215mm respectively. However, these fallow rainfalls still represented above median events, being decile 5.5 and 5.4 events respectively and were the wettest fallow events since 2004.

A summary of the November to April rainfall at each soil test location is provided within Table 3. Interestingly the soil test site receiving the lowest amount of rainfall over the fallow period was the most eastern site of Gooloogong B which recorded 283mm. The fallow period at the Gooloogong A site only included up to the end of March, as this paddock was sown to dual purpose wheat in early April. Using the records from the nearby long term gauge at Eugowra, 283mm from November to April at the Gooloogong B site still represents an above median event, calculating out to be a decile 6.1 event (Data from Eugowra rainfall station not included in Table 2).

Table 2. Summer fallow rainfall at nearby rainfall stations

Location	Nov to Apr Rainfall			Last summer fallow that more rainfall fell
	Long term median	07 / 08 fallow season		
		Rainfall	Decile rank*	Year at end of fallow period
Parkes	267 mm	425 mm	8.5	1990
Forbes	237 mm	317 mm	7.5	1993
Bogan Gate	229 mm	291 mm	7.1	2000
Tullamore	207 mm	218 mm	5.5	2004
Peak Hill	207 mm	215 mm	5.4	2004

*note, calculation of the long term median and decile rank of the 07/08 fallow season came from long term analysis of rainfall since 1900

Plant available water and fallow efficiency

The plant available water (PAW) status results presented in Table 2 show a wide range of PAW at the end of the fallow period. The two sites with the highest PAW figures were Bogan Gate B (110mm) and Marsden (108mm). These sites also had the highest calculated fallow efficiency of 34% and 33% respectively. The two sites with the lowest PAW figures were Fifield (41mm) and Gunningbland (60mm). These sites also had the lowest calculated fallow efficiency of 14% and 19% respectively. All the other sites fell with the theoretical fallow efficiency range of 20% to 30%.

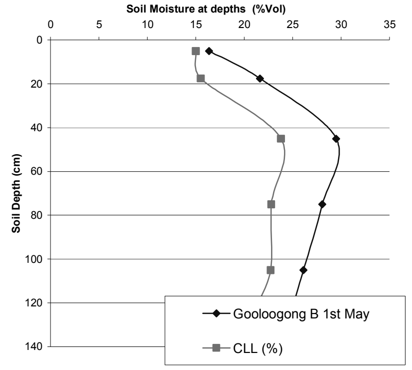
Depth of wet soil

Graphs 1 to 8 show the location of soil moisture within each soil profile. Soil texture (i.e. the proportion of sand, silt and clay) and structure (i.e. the arrangement of sand, silt and clay) is well know to influence the potential for water storage in each of the soil depth profiles. This is commonly known as the shape of the “bucket”. These graphs show that the sites with heavier clay top soils such as Peak Hill, Gunningbland and Bogan Gate A had “V shaped buckets” where a greater proportion of the total PAW was stored in the topsoil. Sandier topsoil sites such as Gooloogong B, Back Yamma and Gunning Gap B had a more parallel shaped bucket, with a greater proportion of the total PAW being stored at depth than the soils with clay top soils.

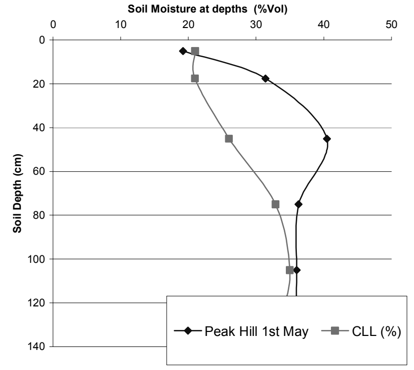
Management Practice

Table 3. Plant Available Water (PAW) measurements and calculated Fallow Efficiencies - Parkes and Forbes district 2007/08 Fallow

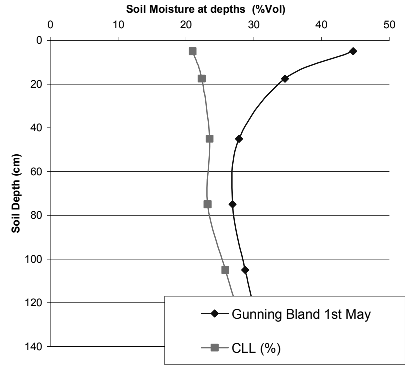
Location	Date measured	PAW (mm) Core 1	Core 2	Core 3	Core4	Core 5	Av	Fallow rainfall (mm) Nov	Dec	Jan	Feb	Mar	Apr	Calculations	Nov - Mar / Nov - Apr
Gooloogong A Norrie	28-Mar	44	87	85	-	-	**72**	59	115	31	40	41	NA	Rainfall Total (mm) / **Fallow Efficiency**	286 (Nov - Mar) / **25%**
Gooloogong B Grey	1st May	66	43	63	56	75	**61**	55	102	48	37	31	10	Rainfall Total (mm) / **Fallow Efficiency**	283 (Nov - Apr) / **21%**
Peak Hill Mitchell	1st May	100	135	83	59	40	**83**	96	135	54	46	30	9	Rainfall Total (mm) / **Fallow Efficiency**	370 (Nov - Apr) / **23%**
Gunningbland Rhodes	1st May	55	42	92	52	-	**60**	93	104	40	55	19	7	Rainfall Total (mm) / **Fallow Efficiency**	318 (Nov - Apr) / **19%**
Back Yamma Field	1st May	110	43	92	73	108	**85**	119	140	72	45	23	25	Rainfall Total (mm) / **Fallow Efficiency**	424 (Nov - Apr) / **20%**
Bogan Gate A Hodges	1st May	122	62	93	68	30	**75**	87	94	63	32	22	8	Rainfall Total (mm) / **Fallow Efficiency**	306 (Nov - Apr) / **25%**
Bogan Gate B Combs	1st May	106	102	91	117	132	**110**	73	106	66	46	23	9	Rainfall Total (mm) / **Fallow Efficiency**	322 (Nov - Apr) / **34%**
Marsden Duff	1st May	75	98	179	115	74	**108**	51	93	33	92	36	20	Rainfall Total (mm) / **Fallow Efficiency**	325 (Nov - Apr) / **33%**
Fifield Larking	1st May	70	25	29	-	-	**41**	32	130	58	33	33	4	Rainfall Total (mm) / **Fallow Efficiency**	290 (Nov - Apr) / **14%**



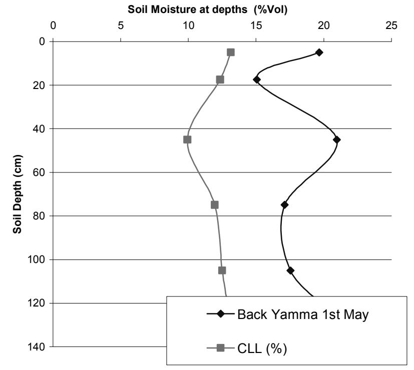
Graph 1. Soil moisture content at various depths of the soil profile on the 1st May at Gooloogong B compared to the crop lower limit (CLL).



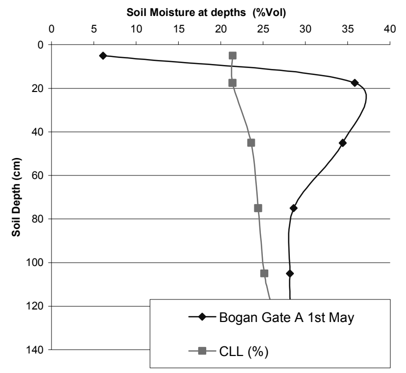
Graph 2. Soil moisture content at various depths of the soil profile on the 1st May at Peak Hill compared to the crop lower limit (CLL).



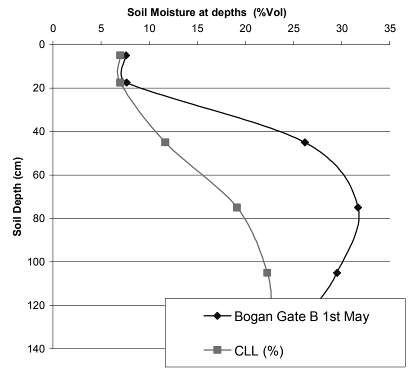
Graph 3. Soil moisture content at various depths of the soil profile on the 1st May at Gunningbland compared to the crop lower limit (CLL).



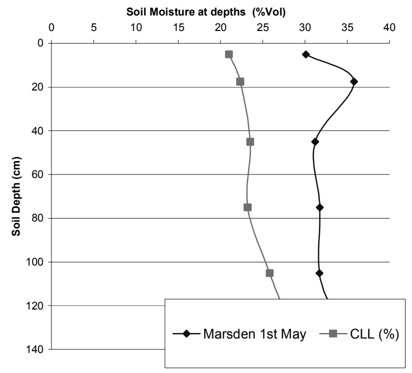
Graph 4. Soil moisture content at various depths of the soil profile on the 1st May at Back Yamma compared to the crop lower limit (CLL).



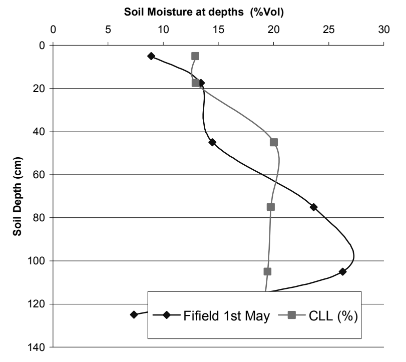
Graph 5. Soil moisture content at various depths of the soil profile on the 1st May at Bogan Gate A compared to the crop lower limit (CLL).



Graph 6. Soil moisture content at various depths of the soil profile on the 1st May at Bogan Gate B compared to the crop lower limit (CLL).



Graph 7. Soil moisture content at various depths of the soil profile on the 1st May at Marsden compared to the crop lower limit (CLL).



Graph 8. Soil moisture content at various depths of the soil profile on the 1st May at Fifield compared to the crop lower limit (CLL).

The potential for evaporation is reduced when soil moisture is stored deeper in the soil profile. It is likely that the wet summer conditions in the fallow of 2007/08 helped to push water deeper into the soil profile than would have happened in a drier summer fallow period. For this reason it is postulated that the fallow efficiency figures obtained for the 2007/08 fallow period could be above that which might be achieved in drier summers where less and more sporadic rainfall occurs. Such summers would not facilitate the movement of soil moisture into the sub soil, where it is less prone to evaporation.

Conclusion

The PAW status of nine sites was monitored and measured over the 2007/08 fallow period. PAW at the beginning of May 2008 varied from 41mm at Fifield to 110mm at Bogan Gate B. The 2007/08 fallow period at most sites was generally wetter than the long term average across central west NSW. In these conditions, the calculated fallow efficiencies generally fell within the accepted theoretical range used in WUE calculations of 20% to 30%. Some sites such as at Bogan Gate B had a high fallow efficiency of 35%, while other sites such as Fifield were found to have a low fallow efficiency of 14%. However, the fact that the on farm rainfall gauges used to calculate these fallow efficiencies were located at nearby houses and not right beside the soil testing site is a potential error in the calculated fallow efficiency results.

The wet summer conditions of the 2007/08 fallow period resulted in a significant proportion of the total PAW being pushed down into the sub soil. This effect was particularly evident on the soils with sandy top soils such as Gunning Gap B, Gooloogong B and Back Yamma. However, even on the soils that had a heavy clay top soil, PAW was still found in the sub soil. It is postulated that the good rainfall conditions over the summer fallow of 2007/08 and thus greater proportion of PAW being moved and stored in the sub soil, resulted in higher fallow efficiency figures than what might otherwise occur in drier summer fallows.

The high fallow efficiency of 35% recorded at Bogan Gate B is thought to be due to its unique soil type that consists of a very sandy top soil over a clay sub soil. The sandy top soil is likely to have allowed good infiltration into the sub soil where the moisture is less susceptible to evaporation, while the clay sub soil provides good water holding capacity.

These results do not answer the important question of how management practices can improve fallow efficiency. To answer this question, management comparisons need to be done on common sites where differences in soil type and rainfall are eliminated. Maintaining ground cover, minimising top soil compaction and controlling summer weeds are thought to be the key management issues that can improve fallow efficiency. It is hoped to pursue these issues more thoroughly as part of the new GRDC funded water use efficiency project.

Acknowledgements

This work was funded by the Lachlan Catchment Management Authority (CMA) Healthy Soils Healthy Landscapes project and the GRDC. The support and guidance provided by Neal Dalgleish, Brett Cox and Steve Henry from the CSIRO was an important part of this project. Greg Gibson (NSW DPI, Forbes) provided technical assistance. The cooperation of the landholders was greatly appreciated. The GRDC funded water use efficiency project is being jointly partnered by Central West Farming Systems, NSW DPI and Ag-n-Vet Services.

DISC VERSE TINE SOWING SYSTEMS COMPARISON AT "JEMALONG STATION"

Ken Motley,
NSW DPI
Dianne Whitty,
Twynam Pastoral Company
Andrew Rice,
CWFS Eastern Regional Sites Coordinator (WHK Ivey)

Background

The recent run of dry years has highlighted the benefits of conservation farming / direct drill techniques for moisture conservation and more reliable grain yields. The value of disc planters in particular has been highlighted and has resulted in growing enthusiasm in their use. Disc planters are claimed to offer improved moisture conservation over tine equipment resulting in higher yields in dry years.

The Wirrinya/Jemalong Central West Farming Systems (CWFS) Regional Site sought to evaluate crop performance with a comparison of both of tine and disc planters. The idea was to run a very simple comparison over several years where the same type of planter is used in consecutive years on the same area, there by allowing the cumulative effects of both systems to be assessed. A long term time frame is important for evaluating the system attributes of disc and tine sowing systems to allow agronomic issues such as ease of sowing, moisture conservation, weed control, disease prevalence and crop performance to become apparent. This paper reports on the first years results in a very "trying" year.

Methods

Sowing:

A tine planter was used to sow strips through the western side of paddocks 'Linear 2C' and 'Linear 2D' on "Jemalong Station". 5 strips of the disc planter were sown with 5 alternating strips of the tine planter. The rest of the paddock was sown using a disc planter. The tine planter strips totalled 14ha with the remaining 152ha of the paddock sown with disc. This paddock is an irrigated field but has not had irrigation water applied since 2001.

Both the tractors pulling the tine and disc planters were equipped with GPS guidance allowing precise placement of the alternating tine and disc strips within the paddock.

The disc planter used in the evaluation (a John Deere) was set up at 25cm row spacing and the tine planter (a Moris) was at 30cm spacing. The tine planter had a spreader plate which spread the sowing row over a width of approximately 5cm. The press wheels on the disc planter had to be released due to the field pea stubble wrapping around them. This resulted in the sowing slot not being fully closed. All other agronomic aspects of the paddock were exactly the same and are summarised below. "Jemalong Station" made the decision to use higher sowing rates (60 kg/ha instead of 50 kg/ha) to compensate for a low germination % for seed used and the late timing of sowing.

Paddock History:	2006= Field peas 2005= Wheat 2004= Wheat 2003= Canola
Crop & Variety 2007:	Wheat, H45
Sowing rate:	60kg/ha
Fertiliser:	DAP @ 50kg/ha
Sowing date:	16/6/07
Herbicides:	*Summer fallow*: - 3 knockdown applications of Glyphosate / phenoxy mixes *Incrop*: - 17/8/07, Axial + Dimethoate + adjuvant. - 24/8/07, Broadside + adjuvant.

Monitoring and Harvest:

Plant counts were taken on the 23rd July, tiller counts on the 31st August and head counts on the