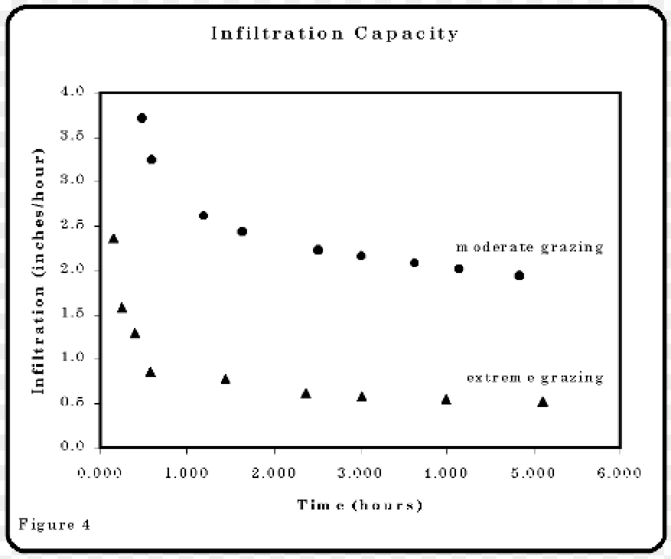
Collection Brochures Agronomiques

Edition **2017**

ALGERIE: gestion des chaumes.

Des observations venues d'Australie.

Etude de l'effet du pâturage des chaumes sur l'humidité du sol James Hunt. CSIR0.au



Effet de la quantité de chaume laissée après pâturage (grazing) sur les infiltrations de la pluie. James Hunt (Australie)

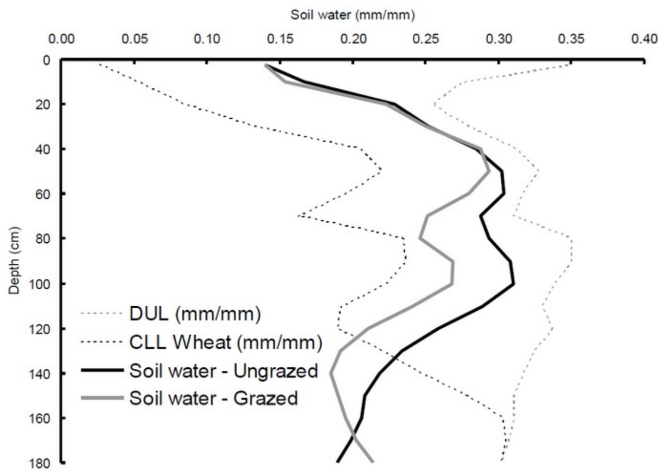


Figure 3. Volumetric soil water content down the soil profile at Temora of the No graze (black solid line) and combined grazed treatments (grey solid line) from Table 6 on 16 March 2010 relative to drained upper limit (grey dashed line) and crop lower limit for wheat (black dashed line). It clearly shows that the additional ~50 mm of water stored in the no-graze treatment is present at depth, implying the difference is due to improved infiltration rather than reduced evaporation.This is a caption underneath the image. Replace the image with a Sitecore media item.

Evolution de l'eau dans le sol durant l'été

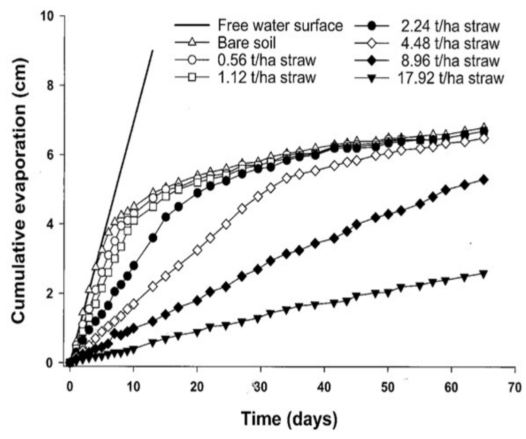


Figure 4. The effect of rate of applied wheaten straw on the cumulative evaporation from moist soil columns at an evaporative potential of 7 mm/day over 65 days (Source: Bond and Willis 1970 © Soil Science Society of America, 2 Sep 2009 reproduced from Scott *et al.* 2010).

Evolution de l'évaporation de l'eau du sol en fonction de la quantité de paille laissée au sol après récolte.

En Algérie, la culture de céréales est majoritairement suivie de l'élevage du mouton. L'étude qui suit vise à mener correctement ces 2 activités.

Djamel BELAID.

مهندس زراعي

L'ESSENTIEL

12 Bonnes raisons

de mieux gérer les chaumes de céréales.

Médaille

James Hunt a reçu une médaille pour son travail. Nous ne manquerons pas de revenir sur ce genre de travaux.

Profondeur de sol

Cette étude concerne des sols relativement profonds.

Desherbage d'été

Un des résultats est la nécessité d'éliminer très tôt les mauvaises herbes dans les chaumes.

Pâturage/mauvaises herbes

Attention, si le pâturage permet d'éliminer les mauvaises herbes ; il est connu que les moutons ne consomment pas tout.

Compaction du sol

L'auteur semble dire que la compaction liée au piétinement des moutons n'a pas d'effet en profondeur.

Paille

J. Hunt montre bien que les chaumes permettent une meilleure infiltration des pluies.

Pâturage

J Hunt ne déconseille pas le pâturage des chaumes, mais indique que ce pâturage doit être modéré.

Profil hydrique

En analysant l'humidité du sol J Hunt montre bien le dessèchement du sol lié au pâturage.

Régime des pluies d'été

Les chaumes peuvent permettre de ralentir l'évaporation suite à des épisodes pluvieux. Mais sur une longue période, leur effet est nul.

Rentabilité herbicide d'été

Le contrôle des mauvaises herbes représente le facteur principal d'amélioration de la période d'interculture. Pour 1$ investi en herbicides le gain est de 3,53$.

Paille et semis

Pour semer, l'auteur conseille d'utiliser un semoir pour semis direct et semer entre les rangs.

Azote

L'infiltration des pluie influence également la dynamique de l'azote du sol.

Roulage des chaumes

Rouler les chaumes ne semble pas permettre une meilleure conservation de l'humidité du sol.

Recherche

Ce thème de recherche pourrait être repris pas des étudiants dans leur cadre de leur mémoire.

For every 1t/ha of grain yield
about 1.5t/ha of cereal stubble

will be left as residue.

GESTION DES CHAUMES

Quels résultats?

De multiples résultats parfois inatendus.

Grains Research and Development.au

Summer fallow management
09.02.2011 James Hunt, CSIRO

James Hunt sur la plate-forme d'essais avec en main 4 niveaux de croissance du blé selon la gestion des chaumes avant semis.

Introduction

A major research focus of the GRDC National Water-use Efficiency Initiative during the first two years of the project has been on better capturing and storing rain falling during the summer fallow period and using it for winter crop production. Six of the projects within the initiative have experiments investigating the impact of weeds, stubble, grazing and/or cultivation on summer fallow efficiency (defined as the proportion of rain falling during the summer fallow period that is made available to a subsequent crop), and subsequent crop yield. These experiments have been complemented by simulation studies to determine the marginal value of summer fallow rain to winter crop production across the southern region, and to investigate the likely effects of grazing livestock on water storage and crop yield. A conceptual framework has also been developed which will allow better prediction of the effects of summer fallow management on fallow efficiency using simple rules of thumb. Work is continuing on the potential to better capitalise on stored soil water by adapting in-crop management. This article describes the experimental and simulation findings across the initiative to-date.

The potential value of summer fallow rain to winter crop production

Un modèle de simulation du rendement

The crop production model Agricultural Production Systems sIMulator (APSIM) was used to determine the value of summer fallow rain to winter crop production across the southern region.

Locations for simulation were chosen based on the coincidence of APSoil characterisations and measured historic rainfall data. A sowing rule for wheat was used where a cultivar of appropriate maturity length was sown at 150 plants/m2 in all locations if more than 15 mm fell over a three day period during a sowing window from 25 April to 1 June. If the minimum amount of rain had not fallen, the crop was sown dry on 1 June such that a crop was sown in every year of the simulation.

Deux simulations

Two continuous wheat simulations (1889-2008) for each location were paired, with one simulation resetting plant available water (PAW) to zero at harvest, and accumulating soil water from out-of-season rainfall, the other resetting PAW to zero at harvest and again at the start of the sowing window. This mimicked a situation where poor management of weeds used all the water that would otherwise have been available for storage during the fallow. Soil nitrate in the top three soil layers was continuously maintained above 100 kg/ha so as not to limit yield, and yield differences presented here are water limited attainable yields i.e. yields attainable by growers under optimal agronomic management. Stubble from crops was fully retained (50% left standing) and no summer weeds were allowed to grow during the out-of-season fallow period. Grain yields were calculated at 12% moisture.

Table 1. Mean (1889-2008) additional PAW at sowing, grain yield and water-use efficiency attributable to summer fallow rain for southern locations within the GRDC WUE initiative. Years with no return on investment are defined as years in which sufficient rain fell to germinate weeds (25 mm in a single event) but additional yield was less that 0.1 t/ha. Locations with summer fallow experiments are shaded in grey.

On average, summer fallow rainfall makes a significant contribution to winter crop water-use and grain yield, particularly in the regions within the initiative studying summer fallow management (Table 1). This is particularly true in southern and central-west NSW, where near equi-seasonal rainfall distribution combined with moderate to high soil plant available water capacity (PAWC) and variable growing season rainfall results in summer fallow rain being a particularly important resource for winter crop production (e.g. Condobolin, Tottenham).

The ability for out-of-season rainfall to be stored and made available to a crop as PAW is dependent on both seasonal rainfall patterns (small number of large falls vs. large number of small falls) and soil type. Heavy soil types in which rainfall events of greater magnitude are required to penetrate below the evaporative layer (e.g. comparison of soils at Morchard, Hopetoun and Bogan Gate) tend to have low fallow efficiencies (Table 1).

The value of additional PAW to a subsequent wheat crop is seasonally dependent on subsequent growing season rainfall (GSR). Yield increases from good fallow management are greatest when out-of-season rainfall is high and subsequent GSR low. Because crops are often able to access stored subsoil water during critical growth periods (flowering/grain fill) additional PAW at sowing not only increases water-use, but also improves harvest index, which in turn increases water-
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use efficiency (Table 1).

The average figures presented here tend to disguise the variable nature of summer fallow rain as a resource and the farming systems benefits that flow from having PAW at sowing (e.g. reduced risk etc). See the section below on adaptive management for further discussion of these issues.

CONSEILS

The simulations here describe the potential yield rewards from 'perfect' fallow and subsequent crop management (no summer or in-crop weeds, nutrients not limiting, no disease or frost) relative to a complete loss of out-of-season rainfall.

In the real world, most paddocks are somewhere between these two extremes, depending on how they are managed. The simulation also ignores the nutrition and disease benefits of summer weed control, which are discussed further in the next section.

Z O O M

Lien : https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2011/02/Summer-fallow-management

nb : certains paragraphes sont une traduction google.

GESTION DES CHAUMES

Quel effet des adventices au sein des chaumes?

Une plus grande perte en eau du sol.

The effect of summer weeds on fallow efficiency and subsequent crop yield

Evaporative losses from fallows are restricted to the top 20-30 cm of soil, but fallow weeds are able to extract water from much deeper in the profile. Therefore, controlling weeds represents the most effective way of maximising fallow efficiency.

In the regions of the study, controlling summer weeds is one of the most profitable cropping input investments that can be made, on average returning $3.53 for every $1 invested (Table 2).

The simulation study described above indicates that the risk of losing money by adopting a zero-tolerance summer weed strategy is very low, with rainfall events large enough to cause summer weeds to emerge but not result in a yield increase greater than 0.1 t/ha occurring in less than 20% of years at all locations (Table 1).

CONSEILS

Priorité aux contrôle des mauvaises herbes dans les chaumes

If money or time is limited, greatest return on investment will come from controlling weeds on soils with highest fallow efficiencies (lighter textured surface soils) or where stored soil water is already present e.g. long fallows or pulse stubbles.

Table 2. Experimental results from across the WUE Initiative to-date showing the additional pre-sowing plant available water and nitrogen, crop yield and return on investment due to summer weed control.

Figures in bold are statistically significant ($p<0.05$), figures in plain text are non significant ($p>0.05$) and figures in italics were un-replicated paddock-scale demonstrations. Return on investment assumes chemical and grain prices in the year of the experiment.

ZOOM

Summer weed density does appear to be important – higher densities use more water (Figure 1) and nitrogen .

and subsequent crop yield is reduced proportionally (Figure 2).

Line graph showing Soil water depletion vs heliotrope density

Figure 1. Soil water depletion by different densities of common heliotrope (Heliotropium europaeum) during the 2009/2010 summer fallow period at Jil Jil, Vic. November-April rain at the site was 151 mm, error bars are the LSD (p=0.05). Data courtesy BCG & Australian Weeds Research Council project AWRC08-86 'Summer weeds: counting the costs for a climate-changed future'.

Scatter graph showing Yield vs Total summer weed density (downward trend)

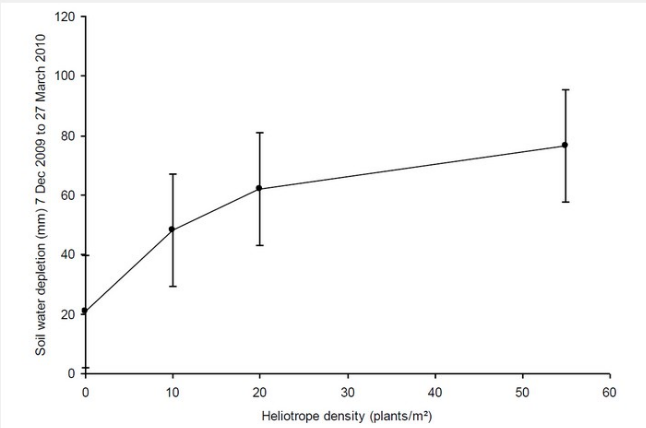

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Figure 2. The relationship between summer weed density (common heliotrope and volunteer cereals) on 11 February 2008 and subsequent wheat grain yield in 2008 at Curyo, Vic (R^2=0.72).

GESTION DES CHAUMES

Quel effet de la présence des chaumes?

Une meilleure infiltration des pluies.

The effect of stubble on fallow efficiency and subsequent crop yield

Of the 13 experiments in the initiative studying the effects of stubble, only one found a significant effect of stubble on fallow efficiency (Table 3, Figure 3 stubble removed by grazing), one has found an effect on canola dry-matter at flowering (Table 5), and one a significant effect on wheat yield (Table 8, stubble removed by grazing). Where fallow efficiency was increased by stubble (FarmLink and CSIRO trial at Temora, NSW) it resulted from improved infiltration rates and decreased water loss through run-off during large, intense rainfall events (Table 3 and Figure 3.)

No significant effect of stubble orientation (standing vs. flattened or slashed) on fallow efficiency, crop growth or yield has been found in any experiments.

Table 3. Mean plant available water from 10 to 180 cm depth at FarmLink and CSIRO's Temora field site during the 2009/2010 fallow period. Total fallow rainfall during that period was 310 mm with significant individual events of 43 mm late Nov/early Dec, 48 mm at Christmas, 18 mm early Feb, 104 mm mid Feb and 82 mm early Mar.

Treatment	Plant available water (mm)			
	16 Dec 09	13 Jan 10	23 Feb 10	16 Mar 10
No graze (5.4 t/ha wheat stubble)	13	14	105a	155a
Stubble graze (0.8 t/ha wheat stubble)	14	14	77b	110b
Stubble & winter graze (0.8 t/ha wheat stubble)	15	16	66b	99b
LSD (P=0.05)	NS	NS	13	19

Note: Values that are followed by different superscript letters are significantly different at a 5% confidence level according to least significant difference (LSD) statistical analyses.

Line graph showing Soil water vs. Depth

Figure 3. Volumetric soil water content down the soil profile at Temora of the No graze (black solid line) and combined grazed treatments (grey solid line) from Table 6 on 16 March 2010 relative to drained upper limit (grey dashed line) and crop lower limit for wheat (black dashed line). It clearly shows that the additional ~50 mm of water stored in the no-graze treatment is present at depth, implying the difference is due to improved infiltration rather than reduced evaporation.This is a caption underneath the image. Replace the image with a Sitecore media item.

These results are supported by the findings of many experiments conducted in Australia during the 60s, 70s and 80s and reviewed in detail in the EH Graham Centre monograph on stubble retention cropping in southern Australia (Scott et al. 2010).

In summary, the major effect of stubble on fallow efficiency is through improved infiltration rather than reduction of evaporative losses, and thus stubble is of greatest benefit where summer rainfall intensity is high and soil infiltration rates low, and on sloping country.

The presence of stubble minimises the physical impact of raindrops on the surface soil, meaning that soil surface structural integrity and consequently infiltration rates are maintained, resulting in less run-off.

It also slows down the flow of water on the soil surface, allowing more time for infiltration. The minimum amount of cereal stubble required to minimise run-off (and hence water erosion) on all soil types is thought to be around 2 t/ha or 70% cover on slopes up to 8%. This level of stubble cover is also thought sufficient to prevent wind erosion, and is more effective at doing this if standing rather than flattened.

Stubble can slow soil evaporation following rainfall events, but if conditions remain dry for an extended period total evaporation will be the same whether residues are retained or not (Figure 4).

Also, unlike weeds which can extract water from depth, evaporative losses from fallows are restricted to the top 20-30 cm of soil and hence the total amounts of water involved tend to be small. It is for these reasons that increases in fallow efficiency and subsequent crop yield attributable to surface residues decreasing evaporation tend to be minor and only occur when large amounts of residue are present (e.g. header trails, added stubble) and rainfall patterns favourable. The presence of stubble on the soil surface during the growing season theoretically results in greater net reductions in evaporation as evaporative demand at that time is lower and rainfall events more frequent (Verburg et al. 2010). This effect can lead to improved establishment following marginal planting rain, and is also thought to be the reason for the observed increase in canola dry matter production at the clay site of the BCG and CSIRO trial site at Hopetoun in 2010 (Table 5).

Figure 4.The effect of rate of applied wheaten straw on the cumulative evaporation from moist soil columns at an evaporative potential of 7 mm/day over 65 days (Source: Bond and Willis 1970 © Soil Science Society of America, 2 Sep 2009 reproduced from Scott et al. 2010).

Table 5. Mean canola dry-matter at 70% flowered in grouped treatments with and without stubble at BCG and CSIRO's Hopetoun clay soil field site in 2010.

Treatment	Canola dry matter at 70% flowered (t/ha)
4.0 t/ha barley stubble	3.9
No stubble	3.3
P-value LSD (p=0.05)	0.01 0.5

In central-west NSW in 2009, wheat yield measured by NSW I&I at different positions across the header trail of the previous year's crop showed a very clear relationship with trash distribution (Figure 5), but it is unclear by what mechanism (improved infiltration, reduced evaporation, faster emergence or all some or all of the above) this was brought about.

Figure 5. Impact of trash distribution from harvest of the previous years crop on wheat grain yield of the subsequent crop in central-west NSW in 2009. Bars with different letters are significantly different from each other ($P<0.05$).

The effect of grazing on soil physical properties and subsequent crop yield

There are two experiments within the initiative studying the impact of grazing, one managed by FarmLink and CSIRO at Temora and the other by NSW I&I and CWFS at Condobolin. At Temora, removal of stubble by sheep caused a reduction in infiltration rate as measured at the end of the 2009/2010 fallow using a drip infiltrometer (Table 6). Lack of cover rather than damage from grazing is thought to have been the cause, as infiltration rates in the un-grazed, drought-affected canola stubble (low cover) surrounding the trial were as low as the grazed treatments. The reduction in infiltration rates were detrimental to fallow efficiency (Table 3), but a very wet growing season meant that there were no significant effects on crop yield in the 2010 growing season (Table 7). However, as of 12 November 2010 the differences in PAW were still present at depth, and may affect yield in the 2011 growing season.

Table 6. Infiltrometer measurements under different grazing treatments and the surrounding canola stubble at the FarmLink and CSIRO site at Temora in early 2010.

Treatment	Amount of water to ponding (mm)	Steady-state infiltration rate (mm/h)
No graze (5.4 t/ha wheat stubble)	19a	36a
Stubble graze (0.8 t/ha wheat stubble)	8ab	20b
Stubble & winter graze (0.8 t/ha wheat stubble)	6ab	16b
Un-grazed canola stubble (~1.6 t/ha)	5b	11b
LSD (P=0.05)	14	11

Note: Values that are followed by different superscript letters are significantly different at a 5% confidence level according to least significant difference (LSD) statistical analyses.

Table 7. Grain yield of the canola crop (Tawriffic TTA sown 15 April 2010) sown over grazing treatments at the FarmLink and CSIRO site at Temora, and differences in PAW at canola maturity on 12 November 2010.

Treatment	Canola grain yield (t/ha)	PAW at canola maturity (mm)
No graze (5.4 t/ha wheat stubble)	4.1	116
Stubble graze (0.8 t/ha wheat stubble)	4.2	86
Stubble & winter graze (0.8 t/ha wheat stubble)	4.0	78
P-value LSD (P=0.05)	0.62 NS	0.01 25

At Condobolin, wheat yield was significantly reduced by heavy stubble grazing (Table 8), but this could not be attributed to less stored water at sowing (Table 8) or to poorer crop establishment (data not shown) and further possible causes are being investigated.

Table 8. Available water prior to sowing and subsequent wheat yield under different grazing and stubble treatments at NSW I&I and CWFS site at Condobolin applied during the summer of 2009/2010.

Treatment	***Available water 4 May 2010 (mm)***	***Grain yield (t/ha)***
Ungrazed (2.6 t/ha stubble)	127	4.6
Ungrazed stubble added (5.6 t/ha stubble)	135	4.7
Light graze (1.7 t/ha stubble)	123	4.7
Heavy graze (1.0 t/ha stubble)	122	4.4
LSD (P=0.05)	NS	0.2

Effects of livestock on soil structure and crop yields

Literature describing effects of livestock on soil

structure and crop yields have been recently reviewed and will be published shortly (Bell et al. 2011).
To summarise, stock apply similar pressures on the soil as unloaded vehicles.

Treading by livestock can reduce soil porosity and infiltration rate, and increase soil bulk density and soil strength, although these effects are mainly in the soil surface (top 5-10 cm).

Despite these effects, rarely have reductions in crop performance following grazing been observed in the literature, possibly because effects are too small in magnitude or depth to influence plant growth significantly.

Crop simulations with reduced root growth and surface conductivity suggest average grain yield would be reduced by < 10% in all but the most severe cases of soil damage (Table 9).

The risk of compaction can be reduced by removing stock during wet conditions and maintaining soil organic matter. Because compaction from livestock is shallow it is not long-lasting and is rectified by natural processes or tillage.

Toutefois, les opérations de travail du sol sur des sols compactés par le bétail peuvent nécessiter un travail supplémentaire, ce qui augmentera la consommation de carburant.

Table 9. Simulated changes in average grain yield (kg/ha) relative to baseline scenarios due to increasing severities (mild, moderate, severe) of damage caused by livestock, including reduced root growth in surface layers, reduced surface conductivity and when both effects are combined at six locations across Australia's mixed crop-livestock zone (Source: Bell et al. 2011).

Location
Emerald Roma Moree Condobolin Temora Kerang Baseline
2359 2909 3712 2815 4032 3066
Reduced root growth
Mild +20 -2 -50 -22 -48 -68
Moderate -6 46 -83 -28 -123 -266
Severe -991 -222 -832 -384 -554 -1044
Reduced surface conductivity
Mild -30 -57 -117 -43 -31 -15
Moderate -77 -143 -250 -113 -91 -46
Severe -172 -278 -479 -222 -167 -87
Combined effects
Mild -15 -59 -141 -67 -77 -78
Moderate -77 -89 -304 -145 -204 -306
Severe -1018 -458 -1131 -555 -697 -1140

The effect of tillage on fallow efficiency and subsequent crop yield
The largest and most reliable effect of tillage on summer fallow efficiency and subsequent crop yield is through control of weeds.

Experiments by UNFS, BCG and CSIRO have found no difference in fallow efficiency or subsequent crop yield between chemical or mechanical control of weeds by cultivation. Relative to a soil with good residue cover, destruction of soil structure by cultivation obviously exposes soil to wind and water erosion. However relative to a bare soil (e.g. drought-affected pulse stubbles, pastures etc.) cultivated soil may be preferable as the increased micro-relief can improve infiltration and reduce wind erosion. An experiment by FarmLink and CSIRO at Temora found that tillage improved summer fallow efficiency relative to a sprayed-out lucerne pasture coming out of lucerne (Table 10), but in the wet growing season of 2010 this had no effect on subsequent crop yield.

Table 10. Change in soil water content and plant available water in response to different tillage treatments applied at the start of the summer fallow (30 November 2009) to a lucerne pasture sprayed-out on 18 August 2009 (i.e. bare and compacted surface soil) and subsequent wheat crop yield (EGA GregoryA sown 15 April 2010).

Tillage treatment
Change in soil water Nov 2009 - Apr 2010 (mm)
PAW at 6 Apr 2010 (mm)
Grain yield (t/ha) Nil 26a 75a 6.7a
Renovate (knife points) 61b 116b 6.3a
Cultivate (sweeps) 47b 101ab 6.6a
LSD (P=0.05) 17 29 NS
Note: Values that are followed by different superscript letters are significantly different at a 5% confidence level according to least significant difference (LSD) statistical analyses.

Predicting likely outcomes of management on soil water storage – the pulse paradigm

Stubble will only improve fallow efficiency by reducing evaporation if overlapping 'pulses' of soil water penetrate beyond the evaporation zone (soil depth from which water is lost to evaporation in the absence of plants). Similarly, weed control will only improve fallow efficiency if the soil is wet beyond the evaporation zone
Rather than simply considering total fallow rainfall, one approach is to consider different sequences of rainfall events – which create 'pulses' of soil water – to assess whether soil water will actually accumulate in the fallow period. Figure 6 indicates how different rainfall events cause pulses of soil water.

This framework is being investigated to determine whether it can produce rules of thumb that allow growers and advisors to predict the likely outcomes of management on soil water storage as affected by evaporative demand, stubble cover, soil type and the sequence of rainfall. For instance if the maximum evaporative loss for a given soil type during a long dry spell is known, this essentially equates to the threshold amount of rainfall required before summer weed control will result in additional water storage.

Figure 6. Rainfall events (black bars) cause pulses of soil water that endure for different amounts of time in the presence (dark gray lines) or absence of stubble (light grey lines). When pulses overlap, more water infiltrates beyond the evaporation zone in the presence of stubble, and fallow efficiency is increased. (Source: Verburg et al. 2010)

Adaptive management – making the most of summer fallow rain

While the focus in the first two years of the WUE initiative has been on interventions to improve capture and storage of summer fallow rainfall events, work is also proceeding on management adaptations which may allow the stored PAW to be used more effectively. Complicating decision making in this area are the implications of risk and uncertainty impacting on expected outcomes.

There are two areas which need to be addressed:

How important to final yield outcome is stored moisture at seeding in comparison to rainfall received during the growth stage of the crops? Many of the cropping areas have generally low but often erratic summer rainfall patterns and the ability to capture summer rain varies. Can seasonal uncertainty be reduced by reference to PAW at seeding? This will define the management focus necessary on summer fallow soil water capture.

Can flexibility in management in response to the presence (or absence) of PAW actually achieve improved outcomes?

Importance of Stored Moisture on Final Yield Outcomes

The main focus of this research has been on lower rainfall cropping areas with highly variable crop yields. It is commonly accepted that cropping businesses in these environments incur financial losses in two to three years in ten with substantial profits also occurring in the two to three years in ten when seasonal circumstances allow good crop yields. In these districts, production risk historically has been much more important than price risk. Figure 7 shows an example of the importance of PAW at seeding on crop yields at Port Germein in the Upper North of SA. This APSIM simulation of crop yields from 1900 to 2009 on a loamy Mallee soil in a low rainfall cereal cropping environment assumed full summer weed control, direct drilling wheat at the break of the season and no nitrogen restrictions to crop growth. Simulated crop yields are effectively water limited yields- no allowance was made for potential yield impacts of other factors such as weeds, diseases or frost.

Modelled data indicates that under a zero tolerance summer weed control policy, differences in plant available water at seeding would have had an important influence on historical crop yields. The combination of low PAW (and late seeding) rarely produces a favourable outcome with most yields in the lower tercile. At the other extreme, poor crop yields (in the lowest tercile) are rare when PAW at seeding is categorised as high.

Importance de l'humidité stockée sur les résultats finaux

L'objectif principal de cette recherche a été de réduire les zones de culture pluviale avec des rendements très variables. Il est communément admis que les entreprises de culture dans ces environnements subissent des pertes financières de deux à trois ans sur dix, avec des bénéfices substantiels également survenant dans les deux à trois ans sur dix lorsque les circonstances saisonnières permettent de bons rendements des cultures.

Dans ces quartiers, le risque de production est historiquement beaucoup plus important que le risque de prix. La figure 7 montre un exemple de l'importance de la PAW lors de l'ensemencement sur les rendements des cultures à Port Germein dans le Nord Supérieur de SA. Cette simulation APSIM des rendements des cultures de 1900 à 2009 sur un sol de Mallee argileux dans un environnement de cultures céréalières à faible précipitation a supposé le plein contrôle des mauvaises herbes en été, le blé de semis direct à la pause de la saison et aucune restriction d'azote à la croissance des cultures. Les rendements simulés des cultures sont effectivement des rendements limités en eau - on n'a pas tenu compte des effets potentiels sur le rendement d'autres facteurs tels que les mauvaises herbes, les maladies ou le gel.

Les données modélisées indiquent que, dans le cadre d'une politique de tolérance zéro de lutte contre les mauvaises herbes en été, les différences d'eau disponibles au moment de l'ensemencement auraient eu une influence importante sur les rendements historiques des cultures. La combinaison de faible PAW (et de semis tardif) produit rarement un résultat favorable avec la plupart des rendements dans le tercile inférieur. À l'autre extrême, les rendements médiocres

a) Low Modelled Plant Available Water at seeding (PAW <38 mm)

b) Moderate Modelled Plant Available Water at seeding (PAW 38-78 mm)

c) High Modelled Plant Available Water at seeding (PAW >78 mm)

Figure 7. Effect of variations in PAW and seeding opportunity on percentage of modelled yields in upper tercile (white), middle tercile (grey) and lower tercile (black)-loamy mallee soil at Port Germein, SA (Source: Mudge & Whitbread 2010).

While this loamy Mallee soil type is quite efficient in the capture and storage of summer rainfall, analysis of simulations conducted on less responsive soils provides similar results. Table 11 shows results from a simulation on a heavily textured, constrained clay loam at Quorn in SA's Upper North. Again it demonstrates the poor odds (about 1 year in 10) of achieving good crop yields (above 2 t/ha) when starting with below median PAW at seeding versus odds of better than 6 years in 10 when starting with above median PAW.

Table 11. Modelled effects of PAW at seeding (categorised as above or below median simulated levels) against simulated yields at Quorn- 1900 to 2009

Site and Soil Type	All Years	Years with above median PAW at seeding	Years with below median PAW at seeding
Quorn- clay loam			
-Number of observations	110	55	55
-Median Yield (t/ha)	1.3	2.6	0.4
-No. of years < 0.7 t/ha	39 (35%)	6 (11%)	34 (62%)
-No. of Years > 2.0 t/ha	49 (45%)	37 (67%)	12 (22%)

Important conclusion

The important conclusion from this analysis is that seasonal outcome can, at least to some extent, be predicted early in the season based on available indicators. The analysis can provide important information on local 'trigger points' to drive responsive or flexible decision making. The trigger points will change for different locations and soil types and analysis of localised data is required to ensure robust outputs.

Improving long-term outcomes by flexible or responsive management

The project is working with a number of other initiatives to study the benefits of flexible management in response to increased knowledge of the storage of summer rainfall events. Areas of adaptive management include:

-Varying crop area and type. Different crops have different response curves to the presence or absence of PAW at seeding. Complexity is added by considerations of local environment, rotations, management capabilities and constraints, longer term seasonal variability etc.

-Adjusting the ratio of crops and livestock within season. Implicit to altering livestock levels is the development of feed-lots or robust exit strategies for livestock enterprises in the face of adverse seasonal conditions.

-Changing varieties. The presence of PAW provides the option to use shorter growing season varieties to reduce the possible effects of spring heat shock on final yields.

Implications to frost risk need to be assessed.

-Time of seeding. As with changing to a shorter growing season variety, earlier seeding may allow better utilisation of stored soil moisture. In any event, timeliness of seeding and crop establishment is critical. Closely related are methods to improve crop establishment under marginal (or deep) soil moisture levels in autumn. A novel approach to this is the use of long coleoptile wheat varieties to allow deeper planting (110mm) into stored soil moisture (Kirkegaard and Hunt, 2010).

-Changing crop nutrition and pest and disease management in response to PAW. Techniques are already well covered by conventional agronomy.

-Tactical fallow in the absence of PAW. Involves accepting the seasonal risk in the current year and trading this off against the seasonal uncertainly of the following year.

-Sowing of crops with multi-purpose uses e.g. hay, graze or grain. Allows PAW to be assessed at a more advanced stage of the season before locking in outputs

The project aims to refine local and/or general 'rules of thumb' to guide decision making in adaptive management.

References & further reading

Bell LW, Kirkegaard JA, Swan A, Hunt JR, Huth NI, Fettell NA (2011) Impacts of soil damage by grazing livestock on crop productivity. Soil and Tillage Research, in press.

Browne C, Hunt JR, Craig S, Whitbread A, Mowat D (2010) Improving winter crop productivity through increased capture and storage of summer fallow rain. In 'Food Security from Sustainable Agriculture: Proceedings 15th Australian Agronomy Conference', Lincoln, New Zealand, November 2010 (http://www.regional.org.au/au/asa/2010/crop-production/soil-water/7005_brownec.htm)

Kirkegaard JA and Hunt JR (2010) Increasing crop productivity by matching farming system management and genotype in water-limited environments. Journal of Experimental Botany 61, 4129-4143 (http://jxb.oxfordjournals.org/content/61/15/4129.full).

Lawson C, Sadras VO, Hooper P, McDonald G (2010) What influence does summer rainfall and stubble retention have on wheat production in Southern farming systems? In 'Food Security from Sustainable Agriculture: Proceedings 15th Australian Agronomy Conference', Lincoln, New Zealand, November 2010 (http://www.regional.org.au/au/asa/2010/crop-production/soil-water/7337_lawsoncs.htm).

Mudge B and Whitbread A (2010) Making better decisions about crop rotations in low-rainfall environments: should stored moisture and the timing of the seeding opportunity influence this decision? In 'Food Security from Sustainable Agriculture: Proceedings 15th Australian Agronomy Conference', Lincoln, New Zealand, November 2010 (http://www.regional.org.au/au/asa/2010/crop-production/sequence/6994_mudgeb.htm).

Scott BJ, Eberbach PL, Evans J and Wade LJ (2010) Stubble Retention in Cropping Systems in Southern Australia: Benefits and Challenges. EH Graham Centre Monograph Series Monograph No. 1 (http://www.csu.edu.au/research/grahamcentre/research/publications/stubble-retention-SA.htm)

Verburg K, Bond WJ, Hunt JR (2010) Variable soil water accumulation under fallow management: Explanation using a pulse paradigm. In 'Food Security from Sustainable Agriculture: Proceedings 15th Australian Agronomy Conference', Lincoln, New Zealand, November 2010 (http://www.regional.org.au/au/asa/2010/crop-production/soil-water/7177_verburgk.htm).

Newsletters and presentations from meetings of the GRDC National Water-use Efficiency Initiative are available at www.csiro.au/resources/National-Water-Use-Efficiency.html

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GESTION DES CHAUMES

Pour quel profit?

1,5 t/ha de chaumes assure un gain de 1T/ha de grains.

Graze and retain stubble for profit
Author: Ellen McNamara

Outgoing research lead and La Trobe University lecturer Dr James Hunt says grazing stubble can be of big benefit to growers

Grains Research and Development Corporation (GRDC) trials in the north are answering growers' questions about stubble management in no-till and zero-till controlled traffic farming systems in southern NSW.

Part of the GRDC flagship stubble initiative, Maintaining Profitable Farming Systems with Retained Stubble, the past six years of trials conducted by FarmLink Research and CSIRO at Temora have shown that grazing and retaining stubble (not burning) is the most profitable treatment, conserving water, speeding up nitrogen (N) cycling and reducing N tie-up by the stubble.

Outgoing research lead and La Trobe University lecturer Dr James Hunt says when the amount of N available is dictating the yield they've seen a positive change in yield and quality by manipulating the N available.

"The reason we did this trial was because farmers were wondering if the full potential of no-till and controlled traffic could be realised if sheep are grazed on cropping country," Dr Hunt said.

"Sheep remove residue cover and trample soils, but there was little contemporary research to show what affect that might have on crop yields.

"By averaging results across the six years that the trial has run we see that the grazing and then retaining without burning stubble treatment had the highest gross income.

"Even if no value is placed on grazed stubble, the stubble-graze stubble –retain treatment still grossed $45/ha per year more than the nil graze stubble retain treatment. Assuming grazed stubble is valued as a feed source, this economic advantage can be raised to $178/ha."

«La raison pour laquelle nous avons procédé à ce procès était parce que les agriculteurs se demandaient si le plein potentiel de la culture sans labour et du trafic contrôlé pourrait être réalisé si les moutons sont broutés sur les terres cultivées», a déclaré le Dr Hunt.

«Les moutons retirent les résidus et piétinent les sols, mais il y a peu de recherche contemporaine pour montrer quel effet pourrait avoir sur les rendements des cultures.

"En faisant la moyenne des résultats au cours des six années que l'essai a exécuté, nous voyons que le pâturage, puis le maintien sans brûler le traitement des chaumes ont le revenu brut le plus élevé.

"Même si aucune valeur n'est placée sur le chaume écroulé, le traitement du chaume à graviers - rétention a continué de grossir 45 $ / ha par an plus que le chaume de graminées nil conserver le traitement. En supposant que le chaume soit apprécié comme source d'alimentation, cet avantage économique peut être porté à 178 $ / ha.

Since 2013 the trials show that the graze and retain treatment consistently delivered higher yields, whereas burning was only of benefit due to frosts in 2013 and the wet growing season of 2015.

"Burning stubble decreased the amount of water stored over the summer fallow that was used by crops by 8 – 21mm, but this didn't always decrease yield due to frost damage, N limitation or adequate subsequent recharge," Dr Hunt said.

"There are several benefits to mixed farming systems, including diversification, offsetting production and price risk and increasing resilience.

"Nitrogen fertilizer inputs may be able to be reduced and grain yields increased if measures are taken to ensure that stubbles are grazed thoroughly and evenly down to threshold levels.

"Our research shows that a well-managed livestock enterprise can complement conservation farming practices such as no-till seeding with stubble retention and controlled traffic to increase crop yields and water-use efficiency."

Depuis 2013, les essais montrent que le traitement de pâturage et de retenue a constamment généré des rendements plus élevés, alors que la combustion n'a bénéficié que des gelées en 2013 et de la saison de croissance humide de 2015.

«La chaume brûlante a diminué la quantité d'eau stockée au cours de la jachère estivale qui a été utilisée par les cultures de 8 à 21 mm, mais cela n'a pas toujours diminué le rendement en raison des dommages causés par le gel, la limitation du N ou une recharge subséquente adéquate».

«Les systèmes d'agriculture mixte présentent plusieurs avantages, notamment la diversification, la compensation de la production et le risque de prix et l'augmentation de la résilience.

«Les apports d'engrais azotés peuvent être réduits et les rendements en grains augmentés si des mesures sont prises pour s'assurer que les chaumes sont bien G2R2S et uniformément à des niveaux seuils.

«Notre recherche montre qu'une entreprise d'élevage bien gérée peut compléter les pratiques agricoles de conservation telles que l'ensemencement sans labour avec la rétention des chaumes et le trafic contrôlé pour augmenter les rendements des cultures et l'efficacité de l'utilisation de l'eau

Dr Hunt says while the results show mixed farmers can safely continue grazing stubbles under these practices, there are some basic rules that should be followed in order to avoid yield penalties.

"This includes controlling all summer weeds promptly with herbicides prior to grazing as weed control by livestock is unreliable, and not grazing below 70% ground cover to prevent water run-off and soil erosion," he said.

ZOOM

"70% cover is equivalent to 2-3t/ha of cereal stubble cover, and to estimate initial stubble load, for every 1t/ha of grain yield about 1.5t/ha of cereal stubble will be left as residue.

"Ultimately the message is that grazing stubble after harvest will have benefits which far outweigh any negative effects in a well-managed mixed farming enterprise."

Selon le Dr Hunt, alors que les résultats montrent que les agriculteurs mixtes peuvent continuer en toute sécurité à paisser les chaumes dans le cadre de ces pratiques, il ya certaines règles de base qui doivent être suivies afin d'éviter les pénalités de rendement.

"Cela inclut le contrôle de toutes les mauvaises herbes d'été rapidement avec des herbicides avant le pâturage, car la suppression des mauvaises herbes par le bétail n'est pas fiable et ne pas paisser sous la couverture du sol de 70% pour empêcher l'écoulement de l'eau et l'érosion des sols.

"70% de couverture équivaut à 2-3 t / ha de chaume de céréales, et pour estimer la charge de chaume initiale, pour chaque 1 t / ha de rendement de grain, environ 1,5 t / ha de chaume de céréales sera laissé comme résidu.

«En fin de compte, le message est que le pâturage après la récolte aura des avantages qui l'emportent de loin sur les effets négatifs dans une entreprise agricole bien gérée.

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GRDC Project Code CSP00174 Region North

For every 1t/ha of grain yield about 1.5t/ha of cereal stubble will be left as residue.

CONSEILS

En Algérie, l'utilisation de la paille par les moutons méritent donc d'être rconsidérées.