



Grain & Graze National Feedbase Project

Sacrificial grazing of wheat in the Western Australian wheatbelt

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In the 2006 season, with low yield expectations, many farmers were faced with a decision about the most valuable use of their wheat crops. While some farmers may have chosen to ‘open the gate and let the sheep in’, others finish livestock on their cereal crops more often, integrating the additional benefits of weed control.

This study aimed to investigate the frequency with which wheat crops have more value for grazing than for grain production in the northern wheatbelt of Western Australia. It was intended to identify circumstances where this commonly occurs and to provide some guidelines on the potential for strategic and tactical use of cereal crops as a forage source.

Methods

Simulation approach and assumptions

APSIM Wheat (version 5.2) was used to predict seasonal variability in wheat biomass and grain production based on 116 years of historical meteorological data. A full factorial was investigated of 3 soils differing in water-holding capacity (PAWC) (Fig 1), and 4 locations ranging from high to low rainfall environment in each of the Northern Agricultural and Avon regions in Western Australia (Table 1). Specific simulation details were: wheat cv. Wyalkatchem was sown between 15 May and 30 June after 10 mm of rain was received over 3 days to achieve 150 plants/m²; high rates of nitrogen (120 kg N at sowing and 100 kg N at 42 days after sowing) were applied to prevent N stress; and initial levels of soil water and mineral nitrogen were reset to crop lower limit and to base nitrogen levels on 1 January to ensure the same starting levels for each year of the simulation.

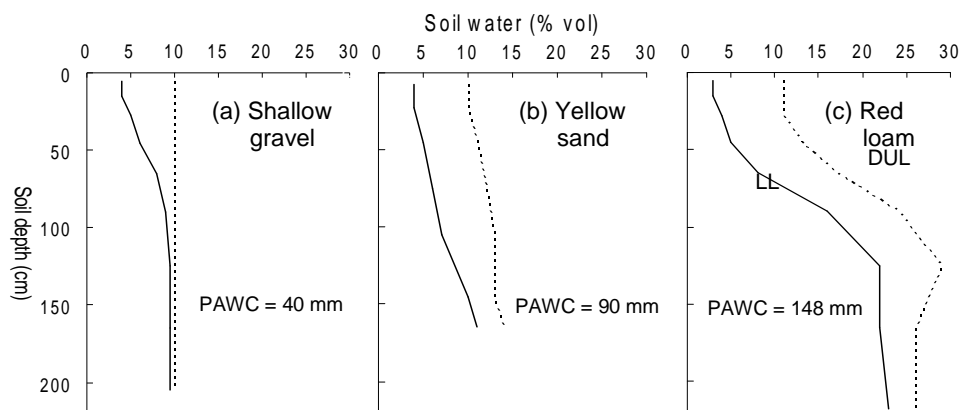


Figure 1: Soil water content at drained upper limit (DUL) and crop lower limit (LL) of the soils used in the simulations. (a) shallow gravel, (b) yellow sand, (c) red loam.

Table 1: Locations ranging in mean annual rainfall (MAR) used for simulations in each region.

Northern Agricultural region		Avon region	
Location	MAR (mm)	Location	MAR (mm)
Badgingarra	575	Bakers Hill	590
Mingenew	410	York	440
Binnu	360	Cunderdin	360
Dalwallinu	300	Merredin	320

Estimating grazing and grain value

The values of grain and grazing options were estimated (Equations 1 and 2) from the APSIM outputs for grain yield at harvest, green biomass at 100 days after sowing (approximately flowering), and expected maximum metabolisable DM. The standard assumption for grain price was \$220 per tonne (5 yr WA average for APW) and for harvesting cost was \$35/ha. Grazing value was calculated based on assumptions of utilization of the wheat crop, livestock production and price. Standard assumptions were a live weight price (LWP) of \$1.7/kg (3 yr WA average for trade steers or lambs), feed conversion rate (FCR) of 0.1 kg of liveweight/ kg of forage consumed and utilisation rate (U) of 50% of the standing forage at 100 DAS. Since the decision whether or not to graze the wheat crop was taken after sowing, costs for the grain or grazing options were assumed to be equal. Equal transaction and transport costs for grain and livestock were also assumed.

(1) Grain value (\$/ha) = (grain yield × price) – harvesting cost

(2) Grazing value (\$/ha) = biomass × U × FCR × LWP

Sensitivity analysis of different price scenarios was investigated for the two enterprises, expressed as the ratio of grain price per tonne to livestock price per 100kg LW (i.e. standard assumptions produce a relative price ratio of 1.3). Different animal feed conversion rates were also investigated to represent different livestock operations or forage qualities.

Results

As expected, higher grain yields were simulated in the higher rainfall environments and on the better soils with greater water holding capacity. Grain yields were most consistent but low on poorest soil, while variation in biomass at 100 days after sowing was largest on the poorest soils particularly in lower rainfall environments (Table 2). This indicates in these environments there are a number of years when large amounts of biomass are not effectively converted to grain yield.

Table 2: Mean, decile 1 and decile 9 grain yield (t/ha) and biomass at 100 days after sowing (t/ha) over 116 years of simulations by APSIM at 4 locations in the northern wheatbelt on 3 soils varying in PAWC.

Data	Location	Mean			Decile 1 – Decile 9		
		Red loam	Yellow sand	Shallow gravel	Red loam	Yellow sand	Shallow gravel
Final Yield (t/ha)	Badgingarra	4.1	5.6	2.0	3.2-4.9	4.7-6.5	1.4-2.7
	Mingenew	4.1	3.4	1.6	3.1-4.8	1.9-4.6	0.9-2.2
	Binnu	4.1	3.1	1.4	2.8-5.1	1.7-4.7	0.8-2.1
	Dalwallinu	3.5	2.3	1.2	2.8-4.7	0.8-3.8	0.6-1.8
Green biomass at 100 DAS (t/ha)	Badgingarra	5.7	5.3	3.7	4.8-6.6	4.5-6.2	2.6-4.8
	Mingenew	6.3	5.8	3.2	5.3-7.1	4.3-6.8	2.0-4.5
	Binnu	6.8	6.1	3.0	5.6-7.8	4.1-7.8	1.9-4.3
	Dalwallinu	5.7	4.8	2.8	4.7-6.6	2.7-6.3	1.4-4.2

Table 3 presents the proportion of years when grazing of crop biomass had greater value than carrying on to harvest grain. Grazing was less profitable than grain in the higher rainfall environments and on the better soil types. In situations where grain is most profitable in > 80% of years there is little economic penalty in focusing on grain production. Meanwhile, in the lower rainfall environments on poorer soil types, grazing had greater value quite frequently, especially at Binnu on shallow gravel and at Dalwallinu on yellow sand and shallow gravel (Table 3). In these circumstances there appears to be considerable merit in utilising cereal crops as a forage source. However, as grain production is still more profitable in 25-70% of years, the average profitability of employing either grain or grazing solely in these circumstances is significantly lower than the optimum case where the best choice is made each year (Table 4). Thus, an ability to make in-season tactical decisions about whether to graze or continue through to harvest would be valuable.

The relative value of grain and grazing was closely related to the final grain yield achieved, with grazing favoured in low yielding years (Fig 2). Below a certain final grain yield, grazing would be expected to be the most profitable option and greater value could be attained if farmers tactically graze their crops when their grain yield expectations are below this value. If a choice is made to graze the crop when final yield is known to be less than the critical yield then the average profitability can be improved (Table 4). In addition, in these dry and low yielding years, less forage from other sources is likely to be produced and cereal crops could add a valuable feed source for livestock. Obviously in-season decisions would not have perfect knowledge of final grain yield, as in this analysis, but the use of prediction tools, such as Yield Prophet®, could provide greater confidence in this decision.

Table 3: Proportion of years when grazing has greater value than grain production from wheat at 4 locations on 3 soils varying in PAWC in the Northern Agricultural and Avon regions of the Western Australian wheatbelt (using standard price assumptions).

Region	Site	Soil		
		Red loam	Yellow sand	Shallow gravel
Northern Agricultural Region	Badgingarra	0.00	0.00	0.21
	Mingenew	0.03	0.15	0.31
	Binnu	0.06	0.28	0.49
	Dalwallinu	0.11	0.47	0.69
Avon region	Bakers Hill	0.00	0.03	0.26
	York	0.01	0.12	0.42
	Cunderdin	0.06	0.38	0.62
	Merredin	0.11	0.46	0.66

Table 4: Average difference between the best option each year (\$/ha/year, using standard price assumptions) and a choice of grazing or grain production only, or tactical grazing in years when final grain yield is known to be less than the predicted critical yield for situations where grazing is frequently more profitable.

Region	Location	Soil	Graze only	Grain only	Tactically graze below critical yield	Predicted critical yield (t/ha)
Northern Agricultural Region	Binnu	Yellow sand	-159	-17	-7	2.11
	Dalwallinu	Yellow sand	-95	-34	-5	1.86
	Mingenew	Shallow gravel	-58	-18	-9	1.22
	Binnu	Shallow gravel	-40	-24	-7	1.24
	Dalwallinu	Shallow gravel	-18	-38	-12	1.45
Avon region	Cunderdin	Yellow sand	-145	-27	-6	2.04
	Merredin	Yellow sand	-80	-31	-5	1.81
	York	Shallow gravel	-51	-21	-5	1.28
	Cunderdin	Shallow gravel	-29	-33	-10	1.28
	Merredin	Shallow gravel	-17	-32	-8	1.21

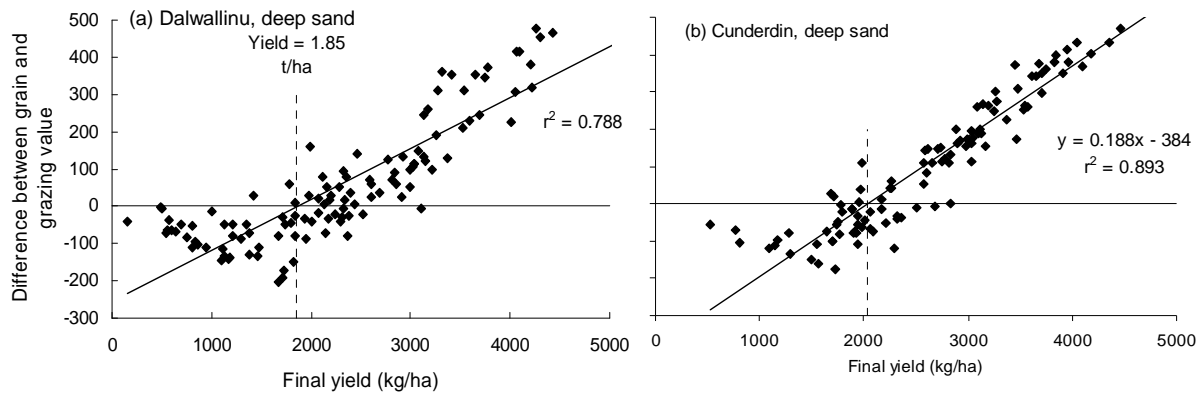


Figure 2: Effect of relative price between grain and livestock commodities on the proportion of years that grazing is more valuable than grain production from wheat at (a) Dalwallinu and (b) Mingenev on a shallow gravel (dotted line), yellow sand (dashed line) and a red loam (full line).

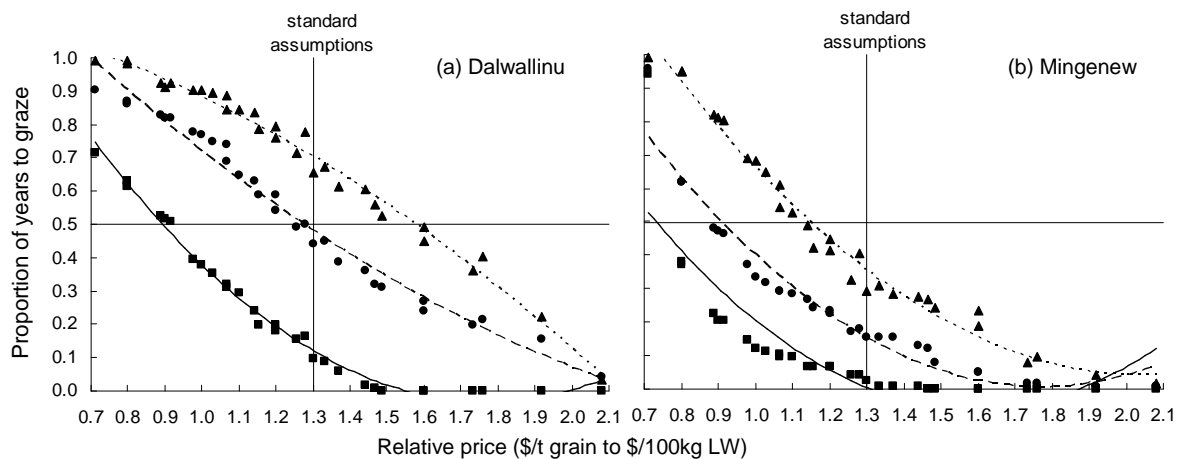


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In addition to seasonal conditions, the relative commodity prices for grain and livestock influence the proportion of years where either enterprise is most profitable (Fig. 3). Obviously as grain prices are relatively higher than livestock prices (i.e. ratio > 1.0) then grain production is more often profitable. Variation from the standard assumptions (i.e. a relative commodity price of 1.3) greatly impact on the frequency that grazing is most profitable. For example, a change to a relative commodity price of 1.0 (e.g. \$200/t grain and \$2/kg LW) adjusts the frequency that grazing is more profitable from < 3% to 12% of years on a red loam, from 15% to 34% of years on a yellow sand, and from 31% to 68% of years on a shallow gravel at Mingenev. Thus, the commodity prices are an important aspect of any decision to graze a cereal crop.

The standard assumptions for livestock performance or feed conversion rates in this analysis are based on typical growth rates of yearling cattle (300kg LW) on pasture (MLA More Beef from Pastures Manual). Figure 4 addresses the impact of variations of feed conversion rates, as this is likely to vary depending on class of livestock used and the phenological stage and quality of the forage.

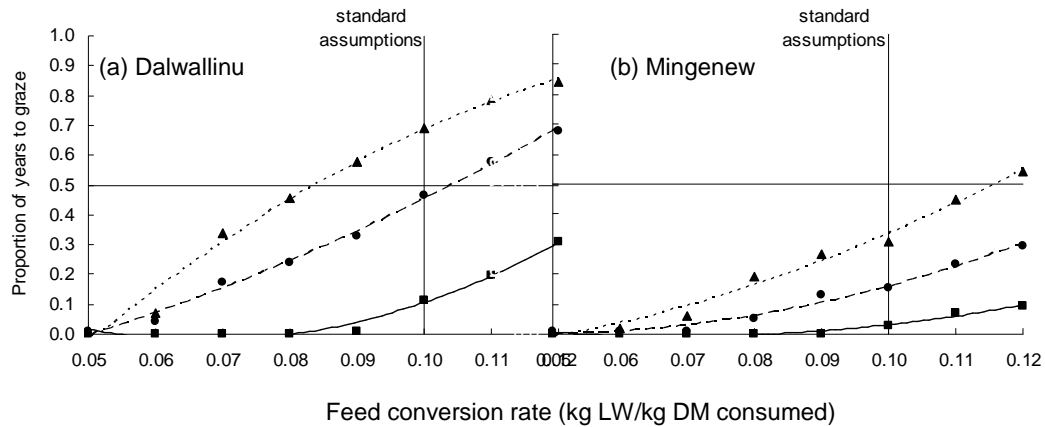


Figure 4: Sensitivity of the relative profitability of grain and grazing of wheat to different feed conversion rates that might be expected from different classes of livestock or forage qualities at Dalwallinu (a) and Mingenew (b) on a shallow gravel (dotted line), yellow sand (dashed line) and a red loam (full line).

Conclusions

While this analysis suggests there may be some capacity to profit from tactically grazing cereal crops, this may be limited by the capacity to obtain or manage livestock to utilise the additional forage. Issues regarding validation of livestock performance and grazing management remain.