

The area of break crops on farm: What farmers are doing compared to estimates based on maximising profit

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KEY MESSAGES

- Break crops increase farm profit, although in some cases the optimal area for break crops on the farm is small. There is an upper limit to break crop area beyond which whole-farm profit drops—i.e. more is not necessarily better.
- The response of whole farm profit to per cent of the farm allocated to break crops is relatively flat. This result highlights, at least in economic terms, why adoption of break crops is highly variable within one rainfall zone.
- The modelled area of break crops at maximum profit is higher than that found in farm surveys and can be explained in part by lower break crop yields being realised by farmers but also raises questions about farmer motivations for adoption of break crops.
- The scope for increased area of broadleaf break crops beyond 35 to 40% of the farm is limited, even if the yield boost they provide to cereals increases. There are risks to break crops dropping out of the system if yield boosts to cereals and yields of the break crops themselves are less than assumed in current whole-farm economic models.

AIMS

Break crops (pulses, lupins, canola, oats) have long been a fundamental component of cropping sequences in Western Australia. Profitable use of break crops has depended on biophysical, economic and social factors. Here we attempt, by modelling, to isolate the effects of agro-climatic region (i.e. soil types and rainfall), commodity prices and the interactions between break crop production and other enterprises run on a farm (e.g. sheep production). These estimates are compared to farm survey data collected by FARMANCO in the low and medium rainfall zones that show what area farmers are actually growing. We also sought to determine the relative importance in variation in the yield of break crops, their price, and the boost to the yield of following cereals in determining their area on farms?

METHOD

This paper used MIDAS bio-economic modelling to explore the biophysical and economic drivers likely to influence the area of break crops grown on mixed farms in the WA agricultural region. A consistent modelling approach was used in four agro-climatic regions with representative farms: Central wheatbelt (Cunderdin), Eastern wheatbelt (Merredin), Great Southern (Kojonup) and South Coast (Jerramungup). At the time of this analysis a fully-functioning version of MIDAS for the northern wheatbelt was not available. Regions vary in term of farm size, crop and pasture production, stocking rates, soil types and crop-pasture rotations (Table 1, Robertson et al. 2008). We tested variation in break crop area on farm in response to factors affecting break crop productivity, profitability and competitiveness with competing enterprises (e.g. sheep production) under a variety of scenarios.

Table 1 Characteristics of modelled representative farms used for break crop area modelling

	Central Wheatbelt	Great Southern	South Coast	Eastern wheatbelt
Farm Area (ha)	2 000	1 000	2 500	3 800
Annual rainfall (mm)	350–400	500–600	400–500	300–350
Representative crop yields (t/ha)	Wheat: 0.9–2.4 Canola: 0.8–1.1 Lupins: 0.5–1.5	Wheat: 1.2–2.2 Canola: 1.4–1.6 Lupins: 0.3–1.5	Wheat: 0.6–2.8 Canola: 1.2–1.8 Lupins: 0.7–1.1	Wheat: 0.9–1.8 Canola: 0.7–1.1 Lupins: 0.5–1.3

The modelling analyses are compared with and informed by statistics on area and yields of crops from farms from the low rainfall (250 to 350 mm MAR) and medium rainfall (350 to 450 mm MAR) regions obtained from the database of the farm management consultancy company, FARMANCO, for the seasons 2004, 2005 and 2006.

RESULTS AND DISCUSSION

Farm survey of break crop area and yield

In both low and medium rainfall zones, lupins are the most popular break crop (50–66% of growers) (Table 2). In the medium rainfall zone, canola was next most popular at 35–45% of growers, but in the low rainfall zone canola and field pea had similar popularity at 15–26% of growers. Faba beans were moderately popular in the medium rainfall zone (8–21%), but they along with chickpea was of minor interest in the low rainfall zone (< 4%). Oats for grain were grown by 30–40% of growers in both zones and oaten hay was moderately popular in both zones (18–34%). The popularity of fieldpeas, faba beans and canola fluctuated more than most of the other crops from season to season.

In the both rainfall zones between 2004 and 2006 the area attributed to wheat, barley, lupins and canola cropping enterprises was relatively stable (Table 3). In the medium rainfall zone, lupin crops and canola crops occupied 8–12% and 8–9% of farm area and other break crops occupied 4–10% of farms that grew them. In the low rainfall zone, lupin crops and canola crops occupied 6–8% and 7–10% of farm area and other break crops occupied 0–10% of farms that grew them. In both zones, farm-to-farm variation in lupin and canola area percentages formed an exponential distribution implying that a large number of farms grew very few or no break crops.

Table 2. Percentage of farmers in the low and medium rainfall zones that grew each crop

	2004	2005	2006	2004	2005	2006
	Low rainfall			Medium rainfall		
Number of growers	80	82	83	150	158	165
Wheat	100%	100%	99%	97%	97%	97%
Barley	75%	71%	63%	86%	82%	81%
Lupins	50%	55%	53%	64%	66%	64%
Canola	15%	13%	19%	35%	45%	42%
Field peas	16%	26%	17%	19%	25%	15%
Faba beans	1%	2%	2%	8%	21%	16%
Chickpeas	3%	4%	1%	2%	3%	2%
Oats	29%	30%	36%	41%	38%	42%
Oaten hay	18%	18%	19%	28%	27%	34%

In the medium rainfall zone, lupin yields varied markedly from season to season (Table 3). Average yields across the farms were: 1.19 t/ha (2004), 1.61 t/ha (2005) and 0.86 t/ha (2006). These yields varied markedly between growers. The top 25% produced more than 1.47 t/ha in 2004, 1.9 t/ha in 2005 and 1.12 t/ha in 2006. Canola yields also varied from season to season averaging 0.96 t/ha (2004), 1.26 t/ha (2005) and 0.73 t/ha (2006). The top 25% of growers produced at least 1.12 t/ha in 2004, 1.49 t/ha in 2005 and 0.95 t/ha in 2006. Canola and lupin yields were approximately 50% of the

corresponding yield of cereals, although there was considerable season-to-season variation in the lupin to cereal yield ratio for farms that grew wheat and lupins. In 2004 and 2006, lupin yields, on average, achieved 57% and 56% of cereal yield respectively. In 2005, when growing season rainfall was higher, lupin yields achieved 71% of cereal yield. In 2004 and 2006, canola achieved 46% and 44% of wheat yield, but in the better 2005 season, this ratio increased to 58%.

Lupin yields also varied with season in the low rainfall zone: 0.75 t/ha (2004), 1.15 t/ha (2005) and 0.53 t/ha (2006) (Table 3). The top 25% of lupin growers produced more than 0.98 t/ha in 2004, 1.43 t/ha in 2005 and 0.80 t/ha in 2006. Canola yields also varied with season and averaged 0.71 t/ha (2004), 1.04 t/ha (2005) and 0.54 t/ha (2006). The top 25% of growers produced at least 1.04 t/ha in 2004, 1.21 t/ha in 2005 and 0.69 t/ha in 2006. In the poorer seasons of 2004 and 2006, lupin yields achieved just 42% of cereal yield. This increased to 63% of cereal yield in 2005. In 2004 and 2006, canola achieved 45% and 42% of wheat yield, but in the better 2005 season, this ratio also increased to 50%.

Table 3 Characteristics of farms in the survey of break crop area and yields, for the low and medium rainfall regions over three seasons. Statistics are only for those farms that grew that crop

	2004	2005	2006	2004	2005	2006
	Low rainfall			Medium rainfall		
Farm size (ha)	3318	3365	3457	2924	3056	3136
Growing season rainfall (mm)	172	226	138	250	317	179
Average farm yield (t/ha)						
Wheat	1.47	1.77	0.99	2.05	2.27	1.51
Barley	1.58	1.89	1.33	2.12	2.33	1.67
Lupins	0.75	1.15	0.53	1.19	1.61	0.86
Canola	0.71	1.04	0.54	0.96	1.26	0.73
Field peas	0.51	1.07	0.56	0.70	1.13	0.66
Faba beans	0.58	1.27	0.91	1.02	2.35	1.60
Chickpeas	0.42	0.49	0.60	0.26	0.28	0.21
Oats	1.31	1.92	0.89	1.87	2.37	1.36
Percentage of farm under crops						
Wheat	63%	65%	51%	41%	40%	35%
Barley	11%	12%	12%	13%	12%	12%
Lupins	7%	8%	6%	12%	11%	8%
Canola	10%	10%	7%	8%	9%	8%
Field peas	4%	2%	0%	4%	4%	6%
Faba beans	2%	5%	7%	8%	8%	10%
Chickpeas	0%	6%	7%	7%	5%	9%
Oats	3%	3%	4%	3%	4%	4%
Oaten hay	6%	8%	9%	3%	4%	4%
Pasture	34%	34%	46%	37%	36%	42%

Relationship between break crop area and farm profit

Modelled optimal area of break crops for three farming systems, Central Wheatbelt, South Coast and Eastern Wheatbelt is around a quarter to a third of farm area and around 40 to 50 per cent of total crop area. For most of the models the curve of profit against area of break crops is flat around the optimum point, meaning the area of break crops can be increased or decreased by 5–10 percentage points with no impact on profit. The exception to this is the Great Southern, where an area of break

crops of more than 8% results in a sharp decline in profit. The optimal area of break crops in the Great Southern farming system is only 5%, out of a total crop area of only 13%, due to the superiority of pastures on 50% of the soils in the model.

Sensitivity of break crop area to variation in key factors

At high break crop prices relative to cereals (see Table 4 for prices used), break crops as a percentage of total crop area goes up from 23 to 36% in the Eastern wheatbelt, 38 to 46% in the Central wheatbelt, 27 to 36% in the South Coast and 5% to 9% in the Great Southern. This suggests that improvements in break crops prices can be a driver for greater adoption. With such changes there were interesting shifts in the composition of break crops. In the Eastern wheatbelt, canola area dropped at the expense of legumes, while in the Central wheatbelt more canola was selected.

In contrast to grain prices, changes in sheep prices (Table 4) have only a small impact on break crop area. In the Eastern Wheatbelt break crop area varied 18 to 23% depending on sheep prices, 30–40% in the Central wheatbelt, 27 to 32% in the South Coast and 6 to 8% in the Great Southern. This is because the impact of changing sheep prices is to shift total crop area, with the per cent of break crops within that total crop area remaining similar.

Table 4 Commodity prices used in sensitivity analysis

	Standard	Low grain	High grain	High break grains	Low sheep	High sheep
APW (\$/t)	300	200	400	300	300	300
Barley	300	200	400	300	300	300
Feed barley	250	150	340	250	250	250
Lupin	250	150	330	330	250	250
Canola	550	250	850	850	550	550
Field peas	250	200	380	380	250	250
Faba beans	250	200	450	450	250	250
Chick peas	300	200	500	500	300	300
Lamb (\$/kg)	3	3	3	3	2.25	3.75
Ewes (\$/hd)	40	40	40	40	30	50
Wethers (\$/hd)	50	50	50	50	37.5	62.5
Wool (¢/kg, WMI)	900	900	900	900	750	1050

An increase of 50% to the break crop boost (see Table 5 for model assumptions) to following cereal yield will increase break crop area because rotations based on break crops become more profitable than others due to greater profitability of the cereal phase. Changes in break crop area were 23 to 27% in the Eastern wheatbelt due to more lupins being selected and 38 to 39% in the Central wheatbelt due to more canola being selected. Similar small shifts were seen in the South Coast and Great Southern situations. Increasing the boost by a further 50% does not result in much extra area, for similar reasons that increasing break crop area beyond a certain point will not increase whole-farm profit any further. Interestingly, break crop area is more sensitive to a halving of the boost to cereal crops. For example, in the Eastern wheatbelt model, break crop area dropped from 23 to 15% with a halving of the boost, and from 38 to 23% in the Central wheatbelt. This suggests that maintaining yield boosts to cereals following break crops will be critical to retaining break crops in farming systems, although it also suggests that any improvements in the boost beyond what is assumed in Table 4 may not deliver greater break crop area.

Table 5 Per cent increase in wheat (W) after various break crops used in four MIDAS models

Crop sequence	Central Wheatbelt	Eastern Wheatbelt	South Coast	Great Southern
W after 3 yr pasture	25	20	20	9
W after 2 yr pasture	18	16	25	6
W after 1 yr pasture	15	8	25	6
2nd W after pasture	12	8	20	6
W after legume	20	20	25	27
2nd W after legume	12	12	0	9
W after legume and canola	25	24	25	27
2nd W after legume and canola	15	12	0	9
W after canola	20	4	5	27

Modelled area of break crops versus farm survey

The area of break crops at maximum profit is higher than that found in surveys of farm data. For example, at standard assumptions 23% of the Eastern wheatbelt, 38% of the Central wheatbelt, 27% of the South Coast and 5% of the Great Southern farms were occupied by break crops. The results of the farm survey (Table 2) showed in the medium rainfall region most farmers had between 8 and 12% area under lupin and between 8 and 9% area under canola. The sum of the areas at the upper end of this range is somewhat lower than the economically-optimal values generated by MIDAS for the Central wheatbelt region (closest to the medium rainfall zone). In the low rainfall zone, adoption of lupin (6–8%) and canola (7–10%) was below optimal values generated by MIDAS for the Eastern Wheatbelt region, although the sum of the upper range for both species (18%) is similar to the 21% from MIDAS. The possible reasons for such discrepancies are worth considering and may shed some light on motivations for farmer adoption of break crops. One possible explanation is that as profit vs. break crop area is quite flat around the optimum, farmers are choosing to operate at the lower end of that comparatively flat region (and maybe even slightly below that) because they perceive break crops to be more risky, more demanding in terms of management, or more difficult to market, so that they are willing to trade-off whole-farm profit.

Another possible explanation is that the yields being assumed in MIDAS are higher than what most farmers are achieving in commercial reality. For the medium rainfall region, this does not seem to be the case. The 2004–2006 average canola and lupin yields were 0.95 and 1.2 t/ha, which fall in the middle of the range of yields assumed in the Central wheatbelt MIDAS model (closest in farming systems and yield levels to the medium rainfall region) at 0.8–1.1 t/ha for canola and 0.5–1.5 t/ha for lupins. In contrast, in the low rainfall region, on-farm yields do seem to be lower than those assumed in the Eastern wheatbelt MIDAS. The 2004–2006 average canola and lupin yields were 0.71 and 0.74 t/ha compared to model assumptions of at 0.7–1.1 t/ha for canola and 0.5–1.3 t/ha for lupins. Model sensitivity analysis suggested that improving break crop yield in its own right may improve the profitability of rotations including those species and this result in those rotations being selected more frequently in optimal farm plans. When MIDAS runs were conducted with reduced canola and legume yields, these crops reduced in area (and even to zero area) in the optimal farm plans, particularly so for canola. Certainly when both break crop yields and the boost to cereals from break crops was reduced, break crop area reduces greatly. This reduction is mitigated somewhat when high grain prices (such as seen in 2008) are assumed with areas dropping back to around 30–50% of that found under standard settings.

CONCLUSIONS

Overall, the results show that break crops are an important component of the farming system, even where the optimal area is small. It is clearly costly to exclude break crops from farm plans. However, the fact that farmers are growing much smaller areas of break crops than would appear economically optimal suggests that a greater understanding is needed of what break crop yields and the boost to following cereals are being achieved on farms, as well as farmer perceptions of the role and performance of break crops in their farming system.

KEY WORDS

economics, MIDAS, canola, lupins, prices, costs, cereal

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