RIM 2013
Default settings

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Introduction

RIM, or Ryegrass Integrated Management, is a model-based decision support system for testing the biological and economic performance of integrated ryegrass management strategies for dryland broadacre systems of the Southern Australian grainbelt.

The first version of RIM is described in the following publications:

> Pannell, D., Stewart, V., Bennett, A., Monjardino, M., Schmidt, C. and Powles, S. (2004). RIM: a bioeconomic model for integrated weed management of Lolium rigidum in Western Australia. *Agricultural Systems* 79:305-325.
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> Pluske, JM, Pannell, DJ and Bennett, AL (2004) RIM 2004 Reference Manual. A decision tool for integrated management of herbicide-resistant annual ryegrass. *School of Agricultural and Resource Economics, University of Western Australia, Crawley.*

RIM 2004 was evaluated during a series of workshops which results are presented, along with a brief history of the model, in:

> Lacoste, M., Llewellyn, R., Powles, S.B. and Pannell, D.J. (2013) RIM 2004 workshops: evaluation – Farmers and consultants surveys. *Australian Herbicide Resistance Initiative & School of Agricultural and Resource Economics, The University of Western Australia, Perth.*

In 2013 an upgraded version of RIM was released (www.ahri.uwa.edu.au/RIM). A succinct and illustrated user guide presented the main mechanisms and options modelled, some of the default values, and where to customise them in the model:

> Lacoste, M. (2013) RIM, Ryegrass Integrated Management – User guide. *Australian Herbicide Resistance Initiative, The University of Western Australia, Perth.*

The present document expands on this user guide by presenting the detail of the default settings used in RIM 2013.

Default values and parameters were obtained from expert advice and published literature, and are meant to be customised to the particular situations of users. They were therefore chosen to represent best assumptions based on long-term considerations valid for the dominant conditions encountered in the dryland cropping systems of the southern Australian grainbelt. Please refer to the website of the Australian Herbicide Resistance Initiative (AHRI) for further information about RIM's revised assumptions and options.

The core of RIM, including baseline data, results from the collective effort of many scientists within various institutions. We thank them for their contributions to RIM. Please refer to RIM's credits and modelling references for more information.

Addendum 2015: The new version of RIM was described, with examples of application, in:

Lacoste M. & Powles S. (2014) **Upgrading the RIM Model for Improved Support of Integrated Weed Management Extension Efforts in Cropping Systems.** *Weed Technology* 28(4): 703-720

Lacoste M. & Powles S. (2015) **RIM: Anatomy of a Weed Management Decision Support System for Adaptation and Wider Application.** *Weed Science* 63(3): 676–689

Citing this document: Lacoste, M. (2014) RIM 2013: default settings. *Australian Herbicide Resistance Initiative & School of Agricultural and Resource Economics, The University of Western Australia, Perth.*

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Table 1. Default values for the crop characteristics and rotational impacts

Enterprise type	*Cereals*		*Oilseed*		*Legume*	
Default*	Wheat	Barley	Canola		Lupin/Lentil	
Crop characteristics						
Long-term average weed-free grain yield (t/ha)	2.0	2.2	1.0		1.0	
Seeding rate (kg/ha) - standard rate	60	70	3		100	
- high rate	90	100	5		125	
Harvest index (%)	40	40	40		30	
Fodder index (grain yield/harvest index)	80	80	80		80	
Average kernel weight (mg)	37	35	3		150	
Expected seedling establishment (% of seeds) - standard rates	75	75	0.6		80	
- high rates	70	70	55		75	
Maximum proportion of yield lost at high weed density (%)	60	45	60		60	
Competitiveness to ryegrass**	medium	high	low		low	
Restrictions	All four crops: no grazing possible					
Impact of a given crop on the 1st and 2nd subsequent crops	*1st*	*2nd*	*1st*	*2nd*	*1st*	*2nd*
Nutrient savings after a legume crop or pasture[a] ($/ha)	20	7[b]	20	n.a.	n.a.	n.a.
Nutrient savings after a volunteer pasture[a] ($/ha)	8	7	8	n.a.	n.a.	n.a.
Yield benefit after a legume-based pasture[a] (%)	20	10	0	0	n.a.	n.a.
Yield benefit after a volunteer pasture[a] (%)	10	5	10	n.a.	n.a.	n.a.
Yield benefit after a canola crop (%)	5	5	n.a.	n.a.	n.a.	n.a.
Yield penalty if crop break is one/two years (%)	n.a.	n.a.	10	3	5	n.a.
Prices (2012)						
Farm-gate grain prices ($/t)	200		550		250	
Seed cost, incl. dressing, cleaning, inoculum, etc. ($/ha)						
- standard rate	20		8		35	
- high rate	30		13		44	
Fertiliser costs[c] ($/ha)						
- standard (every year)	70		95		40	
- following a legume	50		65		n.a.	
Additional costs (insecticides, fungicides, non-ryegrass weed control, insurance, etc.) ($/ha)	40		30		30	

* *Triticum aestivum* L., *Hordeum vulgare* L., *Brassica napus* L., Lupinus spp./*Lens culinaris* Medik. Note that saved from the crop characteristics, the parameters of wheat and barley are shared.

** The two core equations of the ryegrass population dynamics, i.e. yield loss by competition and ryegrass seed production, depend on the relative competiveness and densities of the crop and of ryegrass (Pannell et al. 2004).

[a] If the pasture phase lasted only 1 year, benefits are 2-3% lower and nutrient savings are halved.

[b] Mostly based on nitrogen savings, 20 $/ha corresponding to approx. 30 kg N /ha.

[c] Additional input to compensate for residue removal or exporting hay and baled residues: 5 $/ha.

Adapted and integrated from: Goggin et al. 2012; Seymour et al. 2012; Planfarm and Bankwest 2012; Chauhan et al. 2007.

Table 2. Default values for the pasture characteristics and rotational impacts

Enterprise type	*Non improved (spontaneous growth)*	*Improved with an annual legume, hard to semi-hard seeded*	*Improved with an annual legume, soft seeded*
Default*	Volunteer	Sub-clover	Cadiz
Pasture characteristics			
Seeding	Never	If not grown for the past 3 years (high regeneration abilities)	The first year of every run (poor regeneration abilities)
Production levels[a]	Low	Medium-high	High
Production trends - grazing	↗ (limited and plateaued potential)	↗↗ (robust, higher tolerance to grazing)	↗↗ (productive but fragile: lesser tolerance to high grazing intensity)
Production trends - haying	↘ (seedbank depletion)	↗ (prostrate growth: hard to pick up)	↘ ↘ (aerial growth: easily picked up)
Ryegrass control, standard grazing	Standard	High (ryegrass stands out above prostrate pasture)	Low (difficult discrimination of ryegrass protected by aerial pasture)
Ryegrass control, high intensity grazing	For all, much higher than standard grazing: higher grazing pressure occurs mostly at the end of winter, impacting moderately the average yearly stocking rates but specifically targeting the weed seed set.		
Relative effects on following crops (nutrient savings, yield benefits)	+ (break benefit)	++ (nitrogen fixing)	++ (nitrogen fixing)
Restrictions	One seeding rate only, no swathing, no harvest options except burning all residues		
Prices (2012)			
Sheep gross margins ($/DSE[b])	for all: 30		
Fodder gross margins ($/t)	for all: Hay: 50 Silage: 40 Bales: 45		
Seed cost ($/ha)	n.a.	40	30
Fertiliser costs[c] ($/ha)	0	35	35
Additional costs ($/ha)	0	20	25

* Respectively: various grass and broad-leaf species, dominated by subterranean clover (*Trifolium subterraneum* L.), dominated by French Cadiz serradella (*Ornithopus sativus* Brot. cv. Cadiz)
[a] A production boost is counted if nothing was done the previous year (better establishment), default: +10%
[b] Dry Sheep Equivalent, a standard Australian measurement for a single stock unit
Adapted and integrated from: Planfarm and Bankwest 2012; C. Revell pers. com. 2012.

Table 3. Timing options of seeding and default characteristics

Option	*Timing related to the break of season**	*Impact on ryegrass control*	*Yield impact: default values for*				*Other impacts*
			Wheat	*Barley*	*Canola*	*Legumes*	
Dry	Before	None	Benefit (better competition from early seeding):				Decreased pre-emergent efficiency (default: 10%) Increased erosion risk (additional cost)
			+5%	+2%	+10%	+5%	
Wet	Shortly after (default option)	Only the few plants that germinated before the break (i.e. first cohort)	None (default)				-
Delayed	1-2 weeks later	The first important emergence flush (i.e. 1st and 2nd cohorts)	Penalty (late finish): Half the values of "+Delayed"				Only timing options allowing for tickle, mouldboard plough, knock-down and double-knock options
+Delayed	2 weeks or more later	Most of the ryegrass that will germinate that year (1st, 2nd, 3rd cohorts)	Penalty (late finish):				
			-10%	-5%	-20%	-10%	

* Defined as the first rains sufficient to allow acceptable crop germination.
Adapted and integrated from: Goggin et al. 2012; Walsh and Powles 2007; Doole 2008.

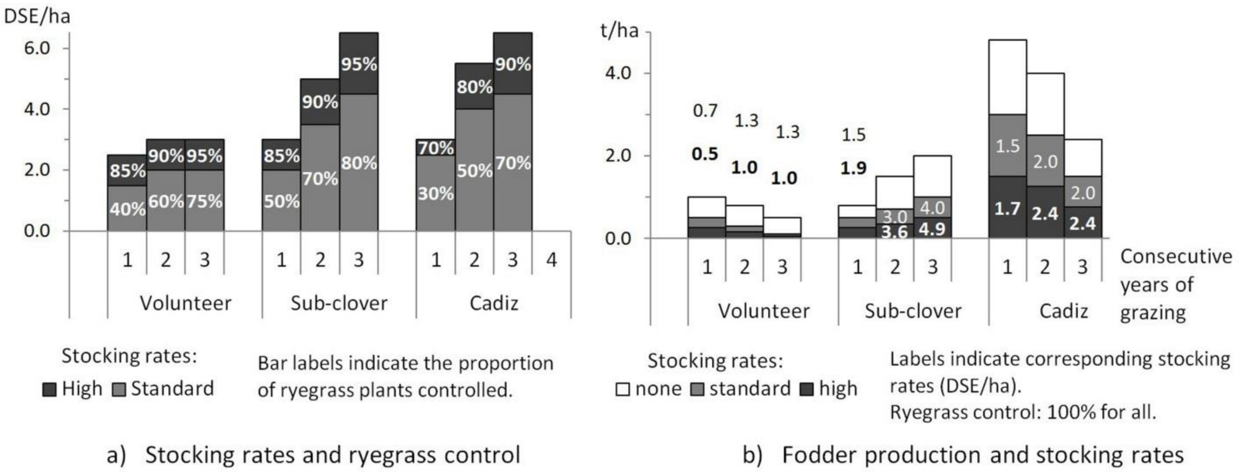

Figure 1. Default values for pasture production levels and ryegrass control

Adapted from: C. Revell pers.com. 2012.

Table 4. Field operations and default values of the control options available prior to seeding until post-emergence spraying

Category - Options	*Description*	*Impact on germination*	*Ryegrass control, default values*	*Other impacts*	*Average costs, default ($/ha, 2012)*
Soil preparation - Tickle	Early shallow cultivation (scarification)	5% increased, skewed earlier	None	Increased erosion risk	6[1]
- Mouldboard plough	Complete soil inversion	5% increase	100% Also controls 95% seed bank or 30% if <3 years gap between two.	Increased erosion risk Permanent yield benefit (default: 15%[3])	120[1]
Non-selective herbicide(s) - x2: Knock-down	One application	-	95%	-	12[2]
- x1: Double-knock	Two sequential applications	-	100%	-	25[2]
Establishment system (one pass seeding operation) - No-till seeding (default option)	Knife/narrow points resulting in low soil disturbance	-	20%	-	11
- Full-cut seeding	Arrow/wide points resulting in some soil disturbance	5% increase	80%	Increased erosion risk (additional cost)	13[1]
Crop seeding rate - High seeding rate	Leads to higher crop density and better competition against ryegrass	-	Crop-dependent	Reduced ryegrass fecundity[2]	Cereals & legume: +9 Canola: +5
Pre-emergence herbicide - 1 out of 5 selectives	Control ryegrass as it germinates, effective until post-emergence spraying	-	50%-90%	Phytotoxic effect on yields (default: -2% for each application) Reduced ryegrass fertility (default: 33%)	10 to 40[2]
Post-emergence herbicide(s) - 1 to 3 out of 5 selectives	Control ryegrass after emergence. Several applications possible.	-	40%-85%		15 to 20[2]

[1] Includes cost of increased erosion risk: 3 $/ha (default)
[2] Includes cost of application (spray with boom), default: 5 $/ha
[3] A one-off increase if removing pre-existing sub-soil constrains. If it is done again, the program recognises that it was already done and the increase is not applied another time.
Adapted and integrated from: Goggin et al. 2012; Doole, 2008; Walsh and Powles 2007; Chauhan et al. 2007; Chauhan et al. 2006; Gill and Holmes 1997; Cirujeda and Taberner 2009.

Table 5. Default values for the cost and control efficacies for various herbicide options

Herbicide control options	*Default denomination*	*Cost, excluding application ($/ha)*			*Ryegrass control (%)*		
		Wheat & Barley	*Canola / Legumes*	*Pastures*	*Wheat & Barley*	*Canola / Legumes*	*Pastures*
Knock-down	Glyphosate	6	6	4	95	95	95
	Paraquat	8	8	6	95	95	95
Double-knock	Glyphosate + Paraquat	12	12	10	100	100	100
Pre-emergence	Trifluralin	12	12		70	70	
	Group 2/B	5			85		
	Sakura®	35			90		
	Boxer Gold®	30			85		
	Triazine		15	5		70	50
Post-emergence	Group 1/A	18	10	10	70	60	40
	Triazine		8			70	
	Triaz. + Group 1/A		14			80	
	Glyphosate		8			85	
	Group 2/B			12			65

Adapted from: Walsh et al, 2011; Chauhan et al. 2007; S. Powles pers. com. 2013.

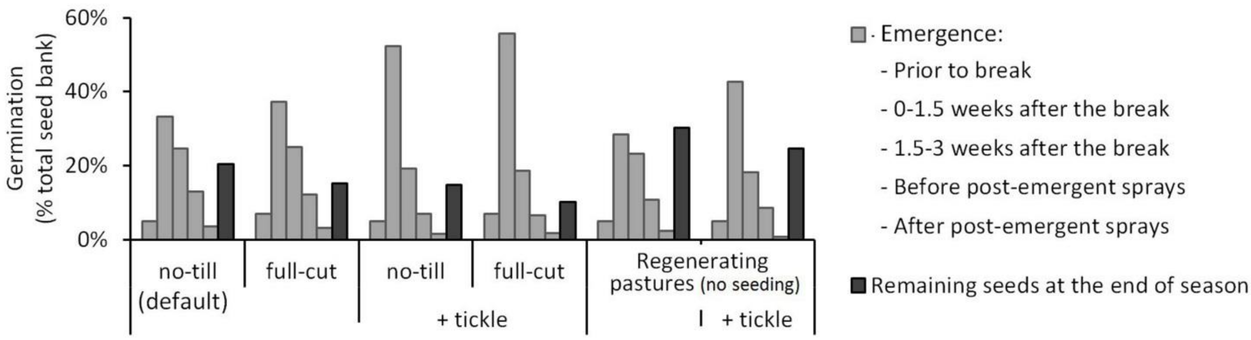

Figure 2. Impact of establishment options on the ryegrass germination pattern and residual seedbank

Adapted from: Goggin et al. 2012; Doole 2008; Chauhan et al. 2006; Gill and Holmes 1997.

Table 6. Field operations and default values for the spring control options

Option	*Description*	*Followed by non-selective spray*[1]	*Ryegrass control, default values*	*Yield impact: default values for*				*Average total*[2] *costs, default ($/ha, 2012)*
				Wheat	*Barley*	*Canola*	*Legumes*	
Green manuring	Soil incorporation of live crop or pasture	-	100%	Crop sacrifice but benefits the subsequent crop (saved nutrients and moisture): 10% for all crops				13 (incl. 3 for erosion risk)
Brown manuring	High rate spray in spring	1.2	100%	Crop sacrifice but benefits the subsequent crop (saved nutrients and moisture): half the values of "green manuring"				12
Mowing	Cut then spray; no residue removal		100%					46
Hay & Silage	Cut before maturity (earlier for silage), removal then spray		100%	Crop sacrifice, increased costs (residue removal, less for silage) but fodder income; for pastures, incurs lower stocking rates				50 to 58
Topping	Late spray	Cereals & canola: 0.5 Legumes & pastures: 0.25	Crops: 75% Pastures: 90%	Penalty (phytotoxicity): -5%	-5%	-5%	-5%	7
Swathing with spray	Late cut, followed or not by a spray; for crops only		90%	Penalty if not done (uneven finish):				33
Swathing without spray		-	Cereals : 45% Legumes & pastures: 35%	-2%	-3%	-10%	0%	25
User-defined	Two options for which name, ryegrass control and cost per enterprise are specified by the user			n.a.				User-defined

[1] Numbers indicate costs (and hence rates) relative to the average of the user-specified knock-down options. Also impacts ryegrass fertility (default: -50%).

[2] Not including harvest savings in case of crop sacrifice: 17 $/ha

Adapted and integrated from: Goggin et al. 2012; Walsh and Powles 2007; Steadman et al. 2006; Gill and Holmes 1997.

Table 7. Field operations and default values for the harvest control options

Option	*Description*	*Ryegrass seed control, default values*	*Residue removal[3] and relative amounts*	*Other impacts and relative costs*	*Average total costs default ($/ha, 2012)*
Chaff cart, burning dumps	Localised high heat burns of chaff collected and dumped by a cart towed behind the harvester	85%[2]	Burn +	Fire risk +	6[4]
Narrow windrow burning	Localised high heat burns of chaff and straw concentrated by harvester rear chute(s) into narrow windrows (50 cm)		Burn & Re-distribution ++	Fire risk +	7[4]
Harrington Seed Destructor (HSD)	Crushed chaff sprayed back onto field by self-powered unit towed behind harvester		-		6
Chaff-tramlining	In a controlled traffic system context, chaff concentrated by harvester rear chutes onto wheel tracks, localised herbicide spray compensates for different widths of machinery wheels		Re-distribution +		5
Bale Direct System (BDS)	Chaff and straw baled by baler attached to rear of harvester		Export ++	Income from bales	17
Whole field burning[1]	Low heat burn over all field residues (chaff, straw, stubbles)	60% for cereals, 45% for other crops & pastures	Burn +++	Fire risk ++ Erosion risk +++	12[4]
User-defined[1]	Two options for which name, ryegrass control and cost per enterprise are specified by the user				

[1] Only harvest options also available for pastures.
[2] Ryegrass captured at harvest: 90% (75-100%, combination of ryegrass seed retention and header height); proportion of seeds in chaff: 95%, closer to 100% if straw as well; kill all methods in good conditions: 95-100%.
[3] Residue removal impacts moisture and nutrients retention. When exporting residues, both the nitrogen (N) and the potassium (K) are lost to the system. Conversely, when burning residues, most of the N is lost to the atmosphere however the K remains in the ash. In potassium-limited environments, the subsequent re-distribution in concentrated areas can affect following yields. Moving windrows compensates for these effect, otherwise higher inputs may be required.
[4] Include cost of erosion risk: 3 $/ha and/or fire risk: 2 to 1 $/ha (default)
Adapted and integrated from: Walsh and Powles 2007; Walsh and Newman 2007; Walsh et al. 2012; Gill and Holmes 1997; M. Walsh pers. com. 2013.

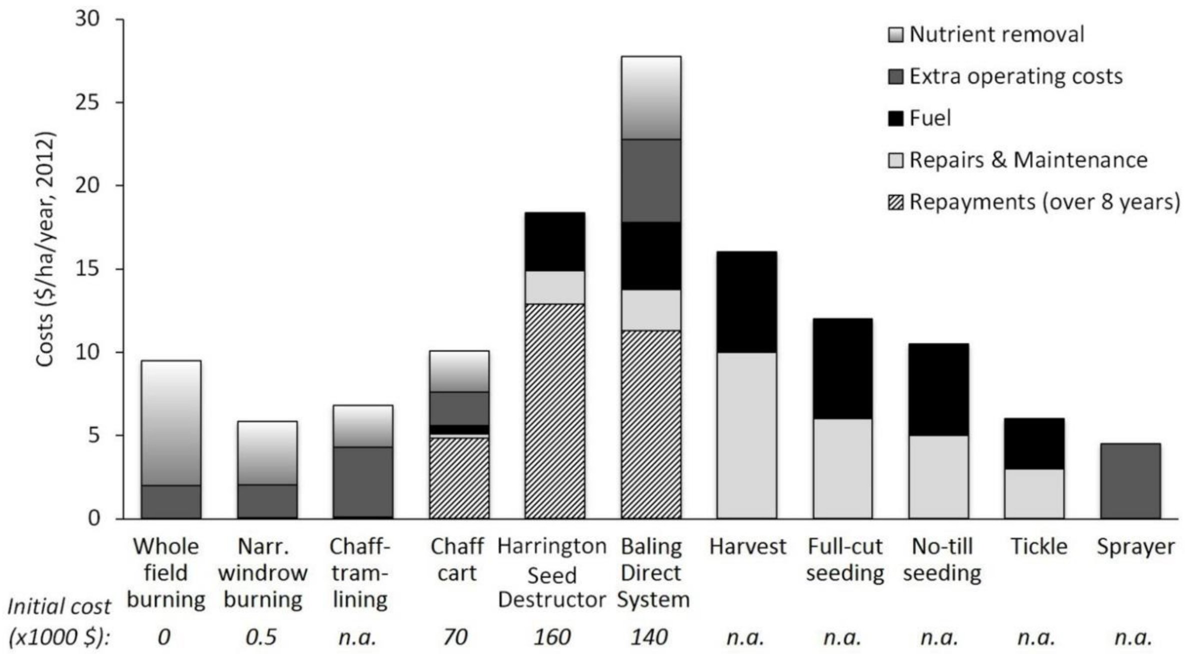

Figure 3. Default values for the machinery costs

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