Ryegrass in stubble

Managing annual ryegrass in stubble retained systems

- Annual ryegrass causes the greatest financial loss of any weed nationally
- When retaining stubble, manage weeds using the WeedSmart 'Big 6'
  1 - Rotate crops & pastures and incorporate double breaks where possible
  2 - Double Knock to preserve glyphosate
  3 - Mix & rotate herbicides
  4 - Stop weed seed set, eg. crop topping, hay, brown manure, fallow
  5 - Increase crop competition
  6 - Adopt harvest weed seed control (capture weed seed survivors at harvest)
- Keep the weed seed bank at very LOW numbers
- Test the resistance status of your ryegrass regularly
- Be flexible in your approach to manage stubble and weeds
- Remember, don't let stubble compromise the IMPORTANT issues (weeds, disease or timeliness)!

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Managing annual ryegrass in stubble retained systems: a proactive approach

Introduction

Managing weeds, especially herbicide resistant weeds involves all aspects of crop management, including tillage and harvest methods, crop sequence choices, seeder types, herbicide options and strategies to manage stubble throughout Australia (Llewellyn 2016). Resistance or partial resistance of annual ryegrass (ARG) is widespread across south eastern Australia with 64% of ARG resistant to Group A's 'fops', 56% to Group B's and SU's and 48% resistant to Imi's across NSW (Broster 2017). However, in the FarmLink region, the levels of herbicide resistance in ARG are even higher (Table 1). Nationally, ARG is ranked as having the highest level of resistance.

National studies show that > 8Mha were affected by ARG with a yield loss of 0.35M tonnes of grain at a cost to growers of $93.1M annually, not including weed control costs (Llewellyn 2016). The study also indicated that most growers believed that weed costs would be higher under stubble retention compared to one cultivation, and that pre-emergence herbicides were less effective in no-till, stubble retain farming systems. With an average of 90% of growers nationally using no-till seeding systems, there has been a rapid adoption of a range of integrated weed management (IWM) practices that includes "The big 6".

Link to the "BIG 6": https://weedsmart.org.au/the-big-6/

To successfully manage ARG in stubble requires considerable planning to incorporate a diverse range of crop choices, greater crop competition and early sowing, effective use of herbicides at full rates using different groups within the same herbicide mix and rotating between herbicide groups, incorporation of baling or harvest weed seed methods and ensuring there are no ARG survivors over a succession of years.

Table 1: Number and percentage of ARG samples resistant to each herbicide group (Data courtesy of Dr John Broster, CSU)

	Slopes	Plains	High Rainfall	Average resistance
A 'fop'	90	71	84	84%
A 'dim'	18	5	17	14%
B 'SU'	70	47	77	67%
B 'Imi'	50	44	87	62%
D	25	3	2	10%
J	0	0	0	0%
K	0	0	0	0%
M	3	1	0	1%
Samples	115	111	64	

FACT: **Annual ryegrass is a prolific seeder, so keeping ARG seedbank numbers low is extremely important. Typically, 85% of the ARG seedbank will germinate within 2 years and 99% within 3 years. Therefore, it requires at least a 3 year timeframe to reduce seed bank to low populations.**

Crop diversity and double breaks

In a series of experiments in the South West slopes undertaken in paddocks where there were medium to high ARG populations (1800 seeds/m2), crop sequences that included a break crop were both more profitable and effective at reducing the ARG seedbank than continuous wheat, even when expensive herbicide options were used. However, incorporating a "double break" (two broadleaf crops, or one hay crop or fallow and a broadleaf crop) were the most effective in reducing the ARG seedbank number to low levels (Table 2).

Table 2: Effect of a Double break, Single break with higher cost herbicides in Wheat (H), a Single break with lower cost herbicides (Wheat L) on ARG panicle numbers and seedbank after 3 years. (All plots were sown to wheat in year 3 and sprayed with Sakura® 850WG @ Avadex® Xtra @ 2L/ha). For more information see guideline "Break crops in stubble". * Lupin grain crop spray-topped prior to ryegrass maturity

Break Crop	Crop x Input (Year 1)	Crop x Input (year 2)	ARG Panicles November year 1	ARG Panicles November Year 2	ARG panicles November Year 3	Seedbank March Year 4
Double	Fallow	Canola	0	0	2	56
Double	Lupin	Canola	43*	0	6	63
Single (H)	Lupin	Wheat (H)	43*	8	19	148
Nil (H)	Wheat (H)	Wheat (H)	78	29	60	366
Single (L)	Lupin	Wheat (L)	43*	200	122	1167
Nil (L)	Wheat (L)	Wheat (L)	504	898	943	3140

The profitability and impact of implementing one of three management strategies (diverse, aggressive or conservative) when establishing crop sequences using either a disc or a tine opener in a full stubble-retain system from a fully phased experiment where the average ARG seedbank at the start was 1864 plants/m^2 was examined between 2014 and 2017 at Temora (Table 3).

Table 3: Crop rotation, plant density, nitrogen quantity at sowing and herbicide cost for the three management strategies between 2014-17 for disc and tine openers.

Management Strategy	Crop type and sowing density (plants/m^2)	Upfront Nitrogen (kgN/ha)	Herbicides*
Diverse	Wheat (80) – Barley (120) - Vetch/Hay (40) - CanolaTT (40)	20 & (Nil in Vetch)	Higher cost
Aggressive	Wheat yr1 (150) – Wheat yr2 (150) – CanolaRR (40)	40 (Wheat), 20 (Canola)	Higher cost
Conservative	Wheat yr1 (80) – Wheat yr2 (80) – CanolaTT (40)	20	Lower cost

** For more information on herbicide types see Swan et al 2017 A flexible approach to managing stubble in the Riverina and South West Slopes. GRDC Update Grenfell July 2017.*

Figure 1: Crops sown at TAIC in the "Sequence for Seeders" trial 2014-2017. ABOVE LEFT— 1a: Crop competition from Fathom barley in Sept 2016. ABOVE RIGHT— 1b: Vetch hay sown into barley stubble used for nitrogen and weed control (August 2015). 1c: Barley (Diverse), wheat (Aggressive) and TT canola (Diverse) in August 2016

After 3 years, the diverse strategy which incorporated a double break into a crop sequence of was not only the most profitable sequence (Table 4) but also the most effective at reducing ARG seedbank (Table 4 & 5) compared to both the aggressive and conservative strategies that incorporated a single break. The aggressive and diverse management strategies significantly reduced the ARG seedbank to 351 plants/m^2 by February 2016, significantly lower than in the conservative strategy. However, following the wet 2016 season with a soft late finish, the diverse strategy had reduced the ARG seed bank by 70% to 145 seeds/m^2 in February 2017 compared to the aggressive strategy, with the conservative strategy increasing ARG seedbank by 600% to above 4000 seeds/m^2 (Table 4). The diverse strategy also allowed each crop species in each year to be sown into a less antagonistic crop residue such as barley into wheat (rather than wheat into wheat or canola into wheat), vetch into barley (big seeded legume), canola into a hay cut vetch crop (rather than canola into wheat or barley) and wheat into a canola stubble.

Table 4: Main effects of management strategy on ARG plant numbers in June, panicle numbers in November, ARG Seedbank numbers the following February, average nitrogen costs and average nett margins averaged across disc and tine openers at Temora, 2014 to 2017. Different letters in *italics* means significant difference at each measurement time

Management Strategy	ARG plants June 2015	ARG plants June 2016	ARG panicles Nov 2015	ARG panicles Nov 2016	Seedbank Feb 2017	Average Nitrogen costs	Average Net Margin (3 years)
	(plants/m^2)		(panicles/m^2)		(seeds/m^2)	($/ha/yr)	($/ha/yr)
Diverse	5*b*	13*b*	9*b*	7*c*	145*c*	$70	$512
Aggressive	3b	4*c*	16*b*	23*b*	573*b*	$109	$498
Conservative	20*a*	136*a*	161*a*	234*a*	4188*a*	$103	$415

Competition from crops such as barley or wheat sown using high seed rates successfully suppressed ARG weeds. Crop competition from barley was extremely evident in the late wet 2016 season where the pre-emergent herbicides (Boxer Gold ®) stopped working and crop competition was the main plant attribute to combat late emerging ARG weeds (see Guideline *"Spacing sowing rows"*).

NOTE: The Temora trial used 4 of the "Big 6" strategies. Crop topping in the canola and capturing weed seed at harvest in all crops (except baling hay), were not implemented. The incorporation of all six strategies would have further reduced ARG seedbank in the 3 years.

FACT: A diverse strategy that incorporates a legume crop in a double break increases the sustainability of the farming system by reducing nitrogen input requirement, allows for improved crop emergence from crops sown into less antagonistic stubbles and is more effective at weed control in stubble retained farming systems. NOTE: It is important to apply a full rate of all herbicides to control ARG weeds.

Herbicide efficacy affected by different stubble management strategies for disc and tine openers

Table 5: Effects of management strategy and opener type on ARG plant numbers in June, panicle numbers in November and seedbank numbers the following February at Temora, 2014 to 2017 * T = Tine, D=Disc

Management Strategy *	ARG plants June 2015 (plants/m^2)	ARG plants June 2016 (plants/m^2)	ARG panicles Nov 2015 (panicles/m^2)	ARG panicles Nov 2016 (panicles/m^2)	Seedbank Feb 2017 (seeds/m^2)
Diverse (T)	3*c*	13*c*	5*c*	4	82
Aggressive (T)	3*c*	3*d*	10*c*	17	498
Conservative (T)	8*b*	51*b*	81*b*	142	2322
Diverse (D)	7*b*	12*c*	15*c*	15	260
Aggressive (D)	3*c*	5*d*	22*c*	31	659
Conservative (D)	48*a*	359*a*	267*a*	388	7631

The combination of the higher-cost pre-emergent herbicide options of Sakura®/Avadex Xtra®, Boxer Gold®, and Rustler® in the Diverse and Aggressive strategies (plus TriflurX ® in tine canola) provided good early ARG control in **stubble loads of 6-9t/ha** sown with both disc and tine openers as indicated by low ARG plant numbers in June (Table 5). These higher-cost herbicide were more effective and would be recommended compared to cheaper options such as Diuron in wheat and Atrazine in canola (plus TrifurX in both wheat and canola with tine openers). It must be noted, that using tine openers resulted in the lowest ARG seedlings after 3 years for each management strategy and if using a disc opener, a diverse strategy with higher cost herbicides would be recommended (data not shown).

NOTE: Crop topping the canola in 2016 and harvest weed seed management would have reduced the seed bank further in all strategies.

What are some key recommendations if using a disc seeder?

What are some key recommendations if using a disc seeder?

When using disc openers, there needs to be more emphasis on cultural weed control methods such as crop competition, early sowing, narrower row spacing and incorporation of harvest weed seed control. Understand the herbicide behaviour (water solubility, binding affinity, volatility, sunlight degradation and persistence) for your soil type, stubble load and crop for your disc setup (single, double or triple disc with or without residue managers).

Pre-emergent herbicides need to be located at or below the weed seed, but not in contact with the crop seed. Low disturbance disc openers can result in poor separation of chemical and crop seed. Triple disc openers can increase soil disturbance which allows for improved incorporation of soil applied herbicides and lower risk to crop, with the leading coulter reducing hair pinning. Maintain a higher percentage of standing stubble, apply herbicides on 25cm row spacing between rows, use residue managers to move treated stubble away from crop, ensure even closing of the seed furrow particularly if using water soluble herbicides. Incorporate a more diverse crop strategy and use more expensive herbicide mix of Rustler®/Atrazine in canola, Sakura/Avadex Xtra® in wheat and late season crop-topping in canola and pulses.

For more information read "Disc seeding systems and pre-emergent herbicides, Soil behaviour of pre-emergent herbicides, Beat down annual ryegrass, Guideline 8 – "Herbicides in stubble".

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