

Improving spray fallow techniques for better moisture conservation, better winter and summer weed control at Mingenew.



Grant Thompson, Crop Circle Consulting and Research & Landmark.

Key messages

The financial and agronomic success of spray fallow in a rotation is determined by seasonal variability and timing of rainfall. A poor season in 2015 followed by a good season in 2016 at Mingenew favoured the crop on fallow rotation.

Higher value grain legumes and oilseeds can be highly profitable when grown on spray fallow.

Herbicide options for wide spectrum summer and winter weed control are available but need registration for WA fallow use before being adopted.

Tolerant crop species are pivotal to using residual herbicides safely and effectively.

Aims

Investigate soil applied herbicide actives for efficacy on summer and winter weeds.

Identify crop types that are tolerant of herbicide residues and are profitable in the WA cropping region.

Compare the economics of spray fallow:crop v wheat on wheat

Method

23 herbicide treatments x 10 crop treatments x 3 reps

Location, pH and 2016 Rainfall

Mingenew – pH 5.4 & 460mm

Herbicide Treatments / ha

Herbicides were applied in April of 2015. Treatments consisted of 1x,2x,4x rate of Imazapic, 1x,2x,4x rate Imazapyr, 1x,2x,4x rate Imazathapyr, 1x,2x,4x rate Atrazine, 1x,2x,4x rate gai Terbuthylazine, 2250 gai Glyphosate.

Crop Varieties

Varieties were planted in April 2016. Varieties planted were Impress CL++, Scepter, Latrobe, Spartacus CL, 44Y89CL, Hyola 404RR, Hyola 525RT, Jurien, Amira.

Results

The highest yielding Impress wheat on wheat from 2015 where residual herbicide was used were the plots treated with high rates of triazines in 2015. These plots yielded poorly in 2015 due to the toxicity of the herbicide treatment to wheat that year. These plots would have had carryover fertilizer and moisture, allowing the 2016 crop to yield well. Plots where no residual herbicide was used, ie. Glyphosate sprays only in 2015, yielded the highest at 6.19t/ha.

Impress CL on fallow treatments showed no yield advantage over the best wheat on wheat plot. Given the wet season at Mingenew, the advantage of fallow in the Impress variety was negligible. The best Impress on fallow treatments were 4x Imazapic, 2x Imazathapyr, 2x Sentry and 5L Glyphosate.

Scepter wheat performed exceptionally well on fallow. On the glyphosate only plots, Scepter wheat yielded 6.97t/ha. Scepter also performed well on 1x Sentry and the Terbuthylazine treatments.

Latrobe barley also performed well where only Glyphosate as applied in the 2015 winter fallow. These plots yielded 6.2t/ha. Latrobe also yielded well on the Terbuthylazine treatments. High rates of the imidazalinone treatments caused significant yield losses to Latrobe.

Spartacus CL barley showed reasonable tolerance to all rates of the imidazolinone herbicides, but did suffer a significant yield penalty compared to the Glyphosate only treatments.

44Y89CL canola yielded well on the highest rate of Terbuthylazine (4.4t/ha) and on treatments 14-16, where a combination of an imidazolinone and triazine product was used.

Hyola 404RR canola performed well where the triazine products were used, or where only Glyphosate was used on the 2015 winter fallow.

525RT canola performed best (4.01t/ha) where only Glyphosate was sprayed in the preceding fallow year. This variety was affected by the carryover of most imidazolinone treatments but tolerated the triazine fallow treatments well.

Jurien lupins yielded the best (4.1t/ha) where the high rate of Terbutylazine was applied in April 2015. This variety also performed well in the Glyphosate only treatments from 2015.

Table 1 : Grain Yields (t/ha) of all varieties across all treatments in November

TRT	2015 treatment	impon imp	IMP + IMP	impress MI	scoper MI	latrobe	spartacus	44Y89CL	404RR	525RT	jurien
1	UNTREATED	5.47-b-g	6.73	4.98 ghi	5.94 bcd	5.35 abc	5.83 b-f	4.01 a-d	2.71 a-d	4.05 ab	3.14 def
2	imazapic 1x	5.06 f-i	6.19	5.41 a-g	6.23 a-d	5.16 bc	5.99 bcd	3.91 b-e	2.7 a-d	2.45 de	3.1 def
3	imazapic 2x	4.57 i	6.2	5.16 d-h	6.19 a-d	4.83 bc	5.29 d-h	3.76 b-e	2.03 de	4.39 a	2.66 ghi
4	imazapic 4x	5.1 e-i	6.45	5.61 a-d	5.51 d	1.38 hi	5.68 c-g	3.65 c-g	0.42 hi	0h	2.15 jk
5	imazapyr 1x	4.88 ghi	6.49	4.84 hi	5.63 cd	3.06 ef	5.35 d-h	3.55 d-g	2.19 cde	2.79 de	2.84 fgh
6	imazapyr 2x	3.67 j	5.12	4.26 j	3.73 e	1.78 gh	4.73 h	4.08 abc	1.98 de	2.27 de	3.1 def
7	imazapyr 4x	5.18 d-h	6.72	5.55 a-f	3.28 ef	1.02 hi	5.13 fgh	3.74 b-e	1.03 fgh	0.83 gh	2.36 ijk
8	imazathepyr 1x	5.53 b-f	6.83	5.31 c-h	6.15 bcd	5.33 abc	5.73 c-g	3.71 b-f	2.89 abc	2.54 de	3.24 cde
9	imazathepyr 2x	5.7 a-d	7.13	5.8 ab	5.51 d	5.39 abc	5.89 b-e	4 a-d	1.47 efg	1.97 ef	3.11 def
10	imazathepyr 4x	5.27 c-g	6.66	5.08 f-i	2.54 f	2.32 fg	5.4 c-h	3.95 a-d	0.73 ghi	0h	2.29 ijk
11	sentry 1x	5.14 d-i	6.49	5.55 a-f	6.99 a	5.29 bc	6.09 bc	3.98 a-d	1.59 ef	1.11 fg	2.54 hij
12	sentry 2x	5.53 b-f	6.99	5.66 abc	6.21 a-d	3.26 e	5.65 c-g	3.88 b-e	0i	0h	2.84 fgh
13	sentry 4x	4.96 f-i	6.41	5.23 c-h	2.54 f	0.78 i	5.3 d-h	3.79 b-e	0i	0h	2.03 k
14	imazapic 1x + atrazine 2x	5.27 c-g	6.09	5.41 a-g	6.74 ab	5.43 abc	5.6 c-g	4 a-d	1.98 de	2.15 ef	2.94 efg
15	imazapyr 1x + atrazine 2x	5.18 d-h	5.91	5.27 c-h	6.07 bcd	4.56 cd	5.52 c-g	4.08 abc	2.47 bcd	3.01 b-e	3.09 def
16	SENTRY 2x + terbutylazine 2x	5.55 b-f	6.55	5.57 a-e	6.43 abc	3.66 de	5.87 b-e	4.15 ab	0i	0h	3.4 bcd
17	Atrazine 1x	5.25 c-g	6.45	5.1 e-i	5.47 d	5.26 bc	5.55 c-g	3.68 b-g	2.81 abc	2.93 de	3.07 def
18	Atrazine 2x	5.82 abc	6.95	5.2 c-h	6.33 abc	5.2 bc	5.26 e-h	3.45 efg	2.55 a-d	2.96 cde	3.13 def
19	Atrazine 4x	4.59 hi	5.63	4.67 ijj	5.86 cd	4.95 bc	5.04 gh	3.23 g	2.62 a-d	3.28 bcd	3.06 def
20	Terbutylazine 1x	5-f-i	6.35	5.29 c-h	6.7 ab	5.61 ab	5.74 b-g	3.26 ffg	2.84 abc	3.03 b-e	3.11 def
21	Terbutylazine 2x	5.66 a-e	6.58	5.21 c-h	6.19 a-d	5.63 ab	5.52 c-g	3.78 b-e	3.14 ab	2.83 de	2.8 fgh
22	Terbutylazine 4x	5.98 ab	6.59	5.47 a-f	6.37 abc	5.05 bc	5.86 b-e	4.41 a	2.68 a-d	2.92 de	4.11 a
23	FST - 2 summer and 2 winter	6.19 a	6.19	5.37 b-g	6.41 abc	5.51 ab	6.45 ab	3.93 bcd	3.26 a	3.24 bcd	3.61 bc
24	glyphosate 5L/MMV Palmero TX	5.66 a-e	6.7	5.88 a	6.97 a	6.21 a	6.82 a	3.97 a-d	3.22 ab	4.02 abc	3.72 ab
	LSD 0.05	0.595		0.486	0.809	0.922	0.706	0.48	0.754	1.084	0.394
	CV	6.85		5.57	8.65	13.14	7.59	7.6	23.18	29.9	8.02
	Replicate F	31.323		9.699	6.94	5.648	11.359	6.414	1.446	3.892	17.193
	Replicate Prob(F)	0.0001		0.0003	0.0023	0.0064	0.0001	0.0035	0.246	0.0274	0.0001
	Treatment F	6.354		4.495	20.887	26.295	3.289	2.662	16.506	13.591	12.44
	Treatment Prob(F)	0.0001		0.0001	0.0001	0.0001	0.0003	0.0023	0.0001	0.0001	0.0001

Table 2: Gross Margin Analyses of highest yielding treatments at MINGENEW from 2015 and 2016

	Grade	yield	trt cost	var costs	gross 2015	gross 2016	rank
treatment		t/ha	\$/ha	\$/ha	\$/ha	\$/ha	1 to 11
IMPRESS 2015 IMAZAPIC 2x	APW1	1.63	7.392	236	226	0	11
IMPRESS ON WHEAT 2016 2 X 5L GLYPHOSATE	APW1	6.19	50	236	0	1497	7
IMPRESS 2015 IMAZATHEPYR 1x + IMPRESS 2016 IMAZATHEPYR 1x	APW1 APW1	7.13	30	472		1551	5
IMPRESS ON fallow 2 X 5L GLYPHOSATE	APW1	5.88	50	236	0	1407	8
SCEPTER ON fallow 2 X 5L GLYPHOSATE	AH2	6.97	50	236	0	1770	3
LATROBE ON fallow 2 X 5L GLYPHOSATE	MALT1	6.21	50	236	0	1397	9
SPARTACUS ON fallow 2 X 5L GLYPHOSATE	MALT1	6.82	50	236	0	1562	4
44Y89CL ON fallow TERBUTHYLAZINE 4x	CAN1	4.41	68	271	0	2225	1
404RR ON fallow 2 X 5L GLYPHOSATE	CAG1	3.26	50	271	0	1518	6
525RT ON fallow IMAZAPIC 2x	CAG1	4.39	7.392	271	0	2091	2
JURIEN ON fallow TERBUTHYLAZINE 4x		4.11	68	241	0	994	10

*Grain Prices are 5 year average, Assume Spartacus is deliverable as Malt. Canola Grain Value derived from CBH Canola Calculator.

Note – Farming fixed costs have not been deducted from these results, only seasonal variable cropping costs associated with inputs and operations have been deducted.

The highest 2 year gross margin was achieved by growing 44Y89CL canola on 4x Terbutylazine treated fallow, which returned \$2225/ha over the 2 years. With a cost of \$271/ha, the return on variable costs is 8.2:1.

This was followed by Hyola 525RT canola on 2x Imazapic treated fallow, earning \$2091/ha. The return on variable costs is 7.7:1.

The third highest earner was Scepter wheat planted into a glyphosate treated fallow which yielded 6.97t/ha and netted \$1770/ha over the 2 year period. The return on variable costs is 7.5:1.

The highest yielding wheat on wheat treatment was the IMPRESS CL wheat planted into Imazathapyr 2x rate, which returned a total of 7.13t/ha over the 2 years and a net return of \$1601/ha. With costs of \$452/ha for 2 years, the return on variable costs is 3.5:1.

Conclusion

Given a dry 2015 followed by a wet 2016, a crop on spray fallow option provided the highest gross margin at Mingenew.

High yielding high value oilseed hybrids HYOLA 525RT and 44Y89CL provided a broadleaf break crop on fallow to spread the cereal rotation out and achieve an additional season of weed control, whilst still making a high gross margin significantly greater than wheat on wheat.

Robust weed control from residual herbicides coupled with good crop herbicide tolerance can contribute significantly to high broadleaf crop yield and gross margin and reduce risk of moisture stress in this crop type. Over use and reliance on Glyphosate for fallow maintenance is also reduced by using soil applied herbicides. Glyphosate resistance is developing in summer and winter grass species and some broadleaf weeds. Use of alternative herbicide actives is a powerful tool to offset or delay this problem.

Key words

Spray Fallow, Residual Herbicides.

Acknowledgments

GRDC RCSN, ADVANTA, PIONEER, INTERGRAIN, AGT, LANDMARK, CSBP, ADAMA, SYNGENTA, SIPCAM, Horwood Family.

GRDC Project Number: CRC00004

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Crop Varieties

Varieties were planted in April 2016. Varieties planted were Impress CL++, Scepter, Latrobe, Spartacus CL, 44Y89CL, Hyola 404RR, Hyola 525RT, Jurien, Amira.

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Table 1: Grain Yields (t/ha) of all varieties across all treatments in November

TRT	2015 treatment	imp on imp	IMP + IMP	impress MI	scepter MI	latrobe	spartacus	44V89CL	40ARR	525RT	jurien
1	UNTREATED	5.47-b-g	6.73	4.98 ghi	5.94 bcd	5.35 abc	5.83 b-f	4.01 a-d	2.71 a-d	4.05 ab	3.14 def
2	Imazapic 1x	5.06 f-i	6.19	5.41 a-g	6.23 a-d	5.16 bc	5.99 bcd	3.91 b-e	2.7 a-d	2.45 de	3.1 def
3	Imazapic 2x	4.57 i	6.2	5.16 d-h	6.19 a-d	4.83 bc	5.29 d-h	3.76 b-e	2.03 de	4.39 a	2.66 ghi
4	Imazapic 4x	5.1 e-i	6.45	5.61 a-d	5.51 d	1.38 hi	5.68 c-g	3.65 c-g	0.42 hi	0h	2.15 jk
5	Imazapyr 1x	4.88 ghi	6.49	4.84 hi	5.63 cd	3.06 ef	5.35 d-h	3.55 d-g	2.19 cde	2.79 de	2.84 fgh
6	Imazapyr 2x	3.67 j	5.12	4.26 j	3.73 e	1.78 gh	4.73 h	4.08 abc	1.98 de	2.27 de	3.1 def
7	Imazapyr 4x	5.18 d-h	6.72	5.55 a-f	3.28 ef	1.02 hi	5.13 fgh	3.74 b-e	1.03 fgh	0.83 gh	2.36 ijkl
8	Imazatheyr 1x	5.53 b-f	6.83	5.31 c-h	6.15 bcd	5.33 abc	5.73 c-g	3.71 b-f	2.89 abc	2.54 de	3.24 cde
9	Imazatheyr 2x	5.7 a-d	7.13	5.8 ab	5.51 d	5.39 abc	5.89 b-e	4 a-d	1.47 efg	1.97 ef	3.11 def
10	Imazatheyr 4x	5.27 c-g	6.66	5.08 f-i	2.54 f	2.32 fg	5.4 c-h	3.95 a-d	0.73 ghi	0h	2.29 ijkl
11	senry 1x	5.14 d-i	6.49	5.55 a-f	6.99 a	5.29 bc	6.09 bc	3.98 a-d	1.59 ef	1.11 fg	2.54 hij
12	senry 2x	5.53 b-f	6.99	5.66 abc	6.21 a-d	3.26 e	5.65 c-g	3.88 b-e	0i	0h	2.84 fgh
13	senry 4x	4.96 f-i	6.41	5.23 c-h	2.54 f	0.78 i	5.3 d-h	3.79 b-e	0i	0h	2.03 k
14	Imazapic 1x + atrazine 2x	5.27 c-g	6.09	5.41 a-g	6.74 ab	5.43 abc	5.6 c-g	4 a-d	1.98 de	2.15 ef	2.94 efg
15	Imazapyr 1x + atrazine 2x	5.18 d-h	5.91	5.27 c-h	6.07 bcd	4.56 cd	5.52 c-g	4.08 abc	2.47 bcd	3.01 b-e	3.09 def
16	SENTRY 2x + terbutylazine 2x	5.55 b-f	6.55	5.57 a-e	6.43 abc	3.66 de	5.87 b-e	4.15 ab	0i	0h	3.4 bcd
17	Atrazine 1x	5.25 c-g	6.45	5.1 e-i	5.47 d	5.26 bc	5.55 c-g	3.68 b-g	2.81 abc	2.93 de	3.07 def
18	Atrazine 2x	5.82 abc	6.95	5.2 c-h	6.33 abc	5.2 bc	5.26 e-h	3.45 efg	2.55 a-d	2.96 cde	3.13 def
19	Atrazine 4x	4.59 hi	5.63	4.67 ij	5.86 cd	4.95 bc	5.04 gh	3.23 g	2.62 a-d	3.28 bcd	3.06 def
20	Terbutylazine 1x	5 f-i	6.35	5.29 c-h	6.7 ab	5.61 ab	5.74 b-g	3.26 fg	2.84 abc	3.03 b-e	3.11 def
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24	glyphosate 5L/MW Palmero TX	5.66 a-e	6.7	5.88 a	6.97 a	6.21 a	6.82 a	3.97 a-d	3.22 ab	4.02 abc	3.72 ab
	LSD 0.05	0.595		0.486	0.809	0.922	0.706	0.48	0.754	1.084	0.394
	CV	6.85		5.57	8.65	13.14	7.59	7.6	23.18	29.9	8.02
Replicate F		31.323		9.699	6.94	5.648	11.359	6.414	1.446	3.892	17.193
Replicate Prob(F)		0.0001		0.0003	0.0023	0.0064	0.0001	0.0035	0.246	0.0274	0.0001
Treatment F		6.354		4.495	20.887	26.295	3.289	2.662	16.506	13.591	12.44
Treatment Prob(F)		0.0001		0.0001	0.0001	0.0001	0.0003	0.0023	0.0001	0.0001	0.0001

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24 herbicide treatments x 10 crop treatments x 3 reps

Locations, pH and 2016 Rainfall

Mullewa – pH 6 & 270mm;

Herbicide Treatments / ha

Herbicides were applied in April of 2015. Treatments consisted of 1x,2x,4x rate Imazapic, 1x,2x,4x rate Imazapyr, 1x,2x,4x rate Imazathapyr, 1x,2x,4x rate Atrazine, 1x,2x,4x rate Terbutylazine, Isoxaflutole, 2250 gai Glyphosate.

Crop Varieties

Varieties were planted in April 2016. Varieties planted were Impress CL++, Scepter, Latrobe, Spartacus CL, 44Y89CL, Hyola 404RR, TR3000, Jurien, Amira.

Results

The highest yielding Impress treatment on fallow was the 2x Terbutylazine treatment at 5.34t/ha. Sentry 2x + 2x rate of Terbutylazine also yielded well at 5.01t/ha. Rates of Atrazine exceeding 1x rate proved damaging to Impress yields.

Scepter yielded the highest on the 2x rate of Terbutylazine treatment, and surprisingly yielded well on the 2x rate of Sentry and 4x rate of Imazapic. Imazathapyr at the two highest rates proved damaging to Scepter, as did the highest rate of Imazapyr, which reduced Scepter yields by 67%.

The 2x of Terbutylazine also gave the highest yield in the Latrobe barley. Surprisingly, Latrobe yielded well on the low and high rate of Imazapic at Mullewa. This result seems odd. The 2x and 4x rate of Imazapyr was quite damaging to Latrobe, reducing yield by 2.1t and 3.04t respectively.

Spartacus CL performed well at the 2x rate of Sentry, and also on 2x Sentry + 2x rate of Terbutylazine. Spartacus was damaged by the high rate of Atrazine and highest rate of Imazathapyr.

44Y89CL canola yielded 3.26t on the Sentry + Terbutylazine treatment. It tolerated the high rate of Imazapic well, yielding 3.02t/ha. The high rate of Imazapyr and the high rate of Imazathapyr proved harmful to 44Y89CL yield. The highest rates of Atrazine and Terbutylazine proved harmful to this variety.

Hyola 404RR canola was significantly affected by all rates of imidazalinone treatments, with Imazapyr having the lowest residual effects on 404RR yield. The highest yield achieved by 404RR was where no residual spray was used and weeds were controlled by 2 applications of Glyphosate.

As expected, **TR3000** yielded well on the Atrazine and Terbutylazine treatments from 2015. The 2x and 4x rates of Imazapic were highly damaging to TR3000 establishment. Imazapyr proved safer to this variety but still caused 0.5-0.7t/ha yield loss compared to the triazine treatments.

Amira albus lupins yielded well when planted on the glyphosate only treatments from 2015, and also performed well on the mid rate of terbutylazine.

Jurien lupins yielded well on the lowest rates of Imazapic, Imazapyr and Imazathepyr. As the rates increased, yields declined. Jurien also yielded well on the 2x rate of Terbutylazine plots.

Table 1: Grain Yields (t/ha) of all varieties across all treatments in November

TRT	2015 treatment	Impress fallow	Scepter	Latrobe	Spartacus	44Y89CL	40ARR	TR3000	Amira	Jurien
1	UNTREATED	4.31 fgh	4.38 c-f	5.33 a-d	4.91 d-g	2.74 b-e	1.81 f-i	2.07 a-d	3.25 a-f	4.52 c-h
2	Imazapic 1x	4.93 a-f	4.43 b-e	5.57 ab	5.46 a-f	2.81 a-d	2.34 c-f	1.89 bcd	3.22 b-f	5.41 ab
3	Imazapic 2x	4.14 gh	3.53 j	4.45 e-i	4.66 fg	2.36 d-i	0.72 j	0 h	2.01 k	3.58 jk
4	Imazapic 4x	4.49 c-h	4.93 ab	5.21 a-d	5.95 ab	3.02 abc	0.19 jk	0.17 gh	3.32 a-e	3.83 ij
5	Imazapyr 1x	4.38 e-h	4.21 c-h	4.41 f-i	4.83 efg	2.52 c-g	2.27 c-g	1.83 cde	2.93 e-i	5.05 a-d
6	Imazapyr 2x	5.13 ab	4.01 e-j	3.4 kl	5.3 a-g	2.46 d-h	2.13 d-g	1.9 bcd	3.03 d-h	3.96 hij
7	Imazapyr 4x	3.96 h	1.67 l	1.39 m	4.64 fg	1.95 i	1.36 hi	2.08 a-d	2.77 g-j	4.09 g-j
8	Imazathiepyr 1x	4.35 fgh	4.19 d-i	5.07 b-f	5.14 b-g	2.36 d-i	2.17 c-g	1.22 ef	3.55 ab	5.55 a
9	Imazathiepyr 2x	4.61 b-g	3.95 e-j	5.12 b-e	5.61 a-e	2.78 a-e	1.78 ghi	0.78 fg	3.11 c-g	3.93 hij
10	Imazathiepyr 4x	4.64 b-g	3.67 ij	4.04 ijk	4.49 g	2.17 f-i	0.28 jk	0.2 gh	2.48 j	4.25 e-i
11	sentry 1x	4.43 d-h	4.19 d-i	4.13 hij	5.14 b-g	2.75 a-e	0.27 jk	0 h	2.89 f-i	4.48 d-h
12	sentry 2x	5.08 abc	4.93 ab	3.68 jk	6.12 a	2.52 c-g	1.3 i	0.23 gh	2.7 hij	4.75 c-f
13	sentry 4x	4.4 d-h	2.92 k	2.79 l	4.97 d-g	2.4 d-i	0 k	0 h	1.97 k	2.96 k
14	Imazapic 1x + atrazine 2x	4.06 gh	4.17 d-i	4.79 d-h	5.7 a-d	2.21 f-i	1.91 efg	1.71 de	3.07 c-h	5.13 abc
15	Imazapyr 1x + atrazine 2x	4.15 gh	4.08 e-i	4.87 c-g	5.38 a-f	2.56 c-g	2.44 cde	2.4 abc	2.89 f-i	4.12 f-j
16	SENTRY 2x + terbuthylazine 2x	5.01 a-d	4.62 a-d	4.87 c-g	5.92 abc	3.26 a	0.23 jk	0.18 gh	3.22 b-f	4.04 hij
17	Atrazine 1x	4.56 b-h	4.32 c-g	5.48 abc	5.26 b-g	3.02 abc	2.99 ab	2.69 a	3.44 abc	4.69 c-g
18	Atrazine 2x	4.36 fgh	4.39 c-f	5.1 b-e	5.09 c-g	2.15 ghi	2.5 bcd	2.54 ab	3.03 d-h	4.34 e-i
19	Atrazine 4x	4.22 gh	3.75 hij	4.8 d-g	4.67 fg	2.01 hi	2.11 d-g	2.48 abc	2.47 j	4.06 g-j
20	Terbuthylazine 1x	4.32 fgh	4.06 e-i	5.04 b-f	5.01 d-g	2.42 d-i	1.99 d-g	1.97 bcd	2.91 f-i	4.39 e-i
21	Terbuthylazine 2x	5.34 a	5 a	5.83 a	5.44 a-f	2.67 b-f	2.7 bc	2.49 ab	3.59 ab	5.51 ab
22	Terbuthylazine 4x	4.99 a-e	3.89 f-j	5.35 a-d	5.7 a-d	2.3 e-i	2.69 bc	2.25 a-d	2.56 ij	4.06 g-j
23	FST - 2 summer and 2 winter	3.98 h	3.81 g-j	4.23 g-j	4.62 fg	2.48 d-h	3.26 a	2.27 a-d	3.65 a	4.88 b-e
24	glyphosate 5L/MW Palmero TX	4.31 fgh	4.73 abc	5.3 a-d	5.74 a-d	3.09 ab	1.89 fgh	2.04 a-d	3.42 a-d	4.14 f-j
	LSD 0.05	0.619	0.522	0.67	0.85	0.51	0.542	0.655	0.406	0.641
	CV	8.32	7.76	8.84	9.83	12.16	19.05	26.91	8.27	8.82
	Replicate F	2.184	1.759	0.764	0.39	2.914	4.908	0.749	2.393	13.53
	Replicate Prob(F)	0.1241	0.1837	0.4716	0.6793	0.0643	0.0117	0.4783	0.1026	0.0001
	Treatment F	3.158	14.779	18.146	2.495	3.712	25.827	18.365	10.07	7.842
	Treatment Prob(F)	0.0004	0.0001	0.0001	0.0041	0.0001	0.0001	0.0001	0.0001	0.0001

Table 2: Gross Margin Analyses of highest yielding treatments at MULLEWA from 2015 and 2016

	Grade	yield	trt cost	variable costs	gross 2015	gross 2016	rank
treatment		t/ha	\$/ha	\$/ha	\$/ha	\$/ha	1 to 12
IMPRESS 2015 IMAZAPYR 2x	APW1	3.55	13.5	236	772	0	12
IMPRESS ON WHEAT 2016 TERBUTHYLAZINE 2x**	APW2	4.86	34	236	0	1115	10
IMPRESS 2015 IMAZATHEPYR 4x + IMPRESS 2016 IMAZATHEPYR 4x	APW1 APW1	7.24	11.10	472		1602	2
IMPRESS ON fallow TERBUTHYLAZINE 2x	ASW1	5.34	34	236	0	1193	8
SCEPTER ON fallow TERBUTHYLAZINE 2x	ASW1	5	34	236	0	1100	11
LATROBE ON fallow TERBUTHYLAZINE 2x	FED1	5.83	34	236	0	1123	9
SPARTACUS ON fallow IMAZAPIC:IMAZAPYR 3:1 2x	FED1	6.12	16.8	236	0	1210	7
44Y89CL ON fallow IMAZAPIC:IMAZAPYR 3:1 2x + TERBUTHYLAZINE 2x	CAN1	3.26	50.8	271	0	1616	1
404RR ON fallow 2 x WINTER GLYPHOSATE 5L/HA	CAG1	3.26	50	271	0	1546	3
TR3000 ON fallow ATRAZINE 1x	CAG1	2.69	7.2	271	0	1214	6
AMIRA ON fallow 2 x WINTER GLYPHOSATE 5L/HA	ALBUS	3.65	50	261	0	1513	4
JURIEN ON fallow IMAZATHEPYR 1x	LUPIN	5.55	14.98	241	0	1503	5

Note – Farming fixed costs, interest and opportunity costs have not been deducted from these results, only seasonal variable cropping costs associated with inputs and operations have been deducted.

At Mullewa, the Pioneer hybrid 44Y89CL on Imazapic:Imazapyr 3:1 2x rate + 2x Terbutylazine treated fallow was most profitable in the 2015-16 seasons. These plots produced 3.26t of CAN1 canola for the 2 years earning a gross margin of \$1616/ha. The return on variable costs is 6:1

This was closely followed by Impress wheat on Impress wheat planted into Imazathepyr treated fallow earning \$1602/ha for 2 years. The return on variable costs is 3.4:1.

The third highest gross earner was Hyola 404RR planted into Glyphosate treated fallow, earning \$1546/ha for the 2 year period. . The return on variable costs is 5.7:1.

Conclusion

Given two reasonable seasons in a row, consecutive wheat crops provided the highest gross margin at Mullewa.

High yielding high value oilseeds and grain legumes present an opportunity for a broadleaf break crop on fallow to spread the cereal rotation out and achieve an additional season of weed control, whilst still making a high gross margin comparable to wheat on wheat. Using alternative chemistry other than Glyphosate for this purpose will offset the looming threat of Glyphosate resistance in some summer and winter weed species. Planting canola onto fallow was marginally ahead of the wheat on wheat for returns. Robust weed control from residual herbicides with good crop tolerance can contribute significantly to additional crop yield and gross margin.

Key words

Spray Fallow, Residual Herbicides.

Acknowledgments

GRDC RCSN, ADVANTA, PIONEER, INTERGRAIN, AGT, LANDMARK, ADAMA, SYNGENTA, SIPCAM, CSBP, BAYER, Critch Family, Weir Family. **GRDC Project Number: CRC00004**

Improving spray fallow techniques for better moisture conservation, better winter and summer weed control at Wyalkatchem.



Grant Thompson, Crop Circle Consulting and Research & Bernie Quade, Quade Agri-services Landmark.

Key messages

The financial and agronomic success of spray fallow in a rotation is determined by seasonal variability and timing of rainfall. A dry year in 2015 and a wet year in 2016 favoured the crop on spray fallow rotation at Wyalkatchem.

Barley and wheat can be highly profitable when grown on spray fallow.

Herbicide options for wide spectrum summer and winter weed control are available but need registration for WA fallow use. Imidazalinone herbicides combined with triazines gave very good control of summer grasses and melons.

Tolerant crop species are pivotal to using residual herbicides safely and effectively.

Aims

Investigate soil applied herbicide actives for efficacy on summer and winter weeds.

Identify crop types that are tolerant of herbicide residues and are profitable in the WA cropping region.

Compare the economics of a crop on spray fallow v wheat on wheat.

Compare residual herbicide actives against multiple applications of Glyphosate.

Method

23 herbicide treatments x 10 crop treatments x 3 reps

Location, pH and 2016 Rainfall

Wyalkatchem – pH 7 & 360mm

Herbicide Treatments / ha

Herbicides were applied in April of 2015. Treatments consisted of 1x,2x,4x rate Imazapic, 1x,2x,4x rate Imazapyr, 1x,2x,4x rate Imazathapyr, 1x,2x,4x rate Atrazine, 1x,2x,4x rate Terbutylazine, 2250 gai Glyphosate and mixtures of these actives.

Crop Varieties

Varieties were planted in May 2016. Varieties planted were Impress CL++, Scepter, Latrobe, Spartacus CL, 44Y89CL, Hyola 404RR, TR3000, Jurien, Amira.

Results

Impress CL on fallow yielded highest on the 4x rate of Imazapic treatment. Given that the site had a lot of summer grasses emerge and grow over the summer period, and this treatment provided the most robust summer grass control, it is not surprising that this treatment then provided the best wheat yields. Significant amounts of retained moisture and mineralized N would have been preserved by this treatment.

The highest yielding Impress on Impress treatments in 2016 were those that suffered from herbicide damage in 2015. As with the other 2 locations, the high rate of Terbutylazine yielded the highest in 2016 due to the potential carryover of fertilizer and moisture from 2015.

In contrast to the Mullewa and Mingenew sites, the Wyalkatchem site is a high pH (pH7) and had frequent summer rains. This would have been conducive to the breakdown of the imidazalinone herbicides but lengthened Triazine activity. The highest yielding Scepter wheat treatments was on 4x rate of Imazapic, 4x rate of Sentry, 1x rate of Atrazine and 4x rate of terbutylazine.

Spartacus CL barley performed quite consistently across the rate range of all the imidazolinone treatments. The highest yield for Spartacus was achieved on the 900gai rate of Atrazine.

The highest yielding Latrobe barley treatment was where no residual herbicide was used. As there were very little significant differences between most treatments within the Latrobe plots, it is difficult to make many assumptions.

There were no significant differences between the yields of Hyola 404RR across any of the treatments at this trial site. Significant summer rains would have enhanced the breakdown of herbicide residues at this site.

The Clearfield canola variety 44Y89CL was the top yielding canola variety at this site, and yielded well on the low rate of Imazathapyr and the Imazapic + Atrazine treatments.

Jurien lupins performed well where Atrazine and Terbutylazine were used as fallow treatments. The highest yield was achieved on the 900gai Atrazine treatment.

Jurien also performed well on the highest rate of Imazapic. Again, good control of summer grasses and a wet summer on higher pH soils, and lower specificity of Imazapic on broadleaf species may have contributed to this.

Table 1: Grain Yields (t/ha) of all varieties across all treatments in November

TRT	2015 treatment	Scepter	Impress	Impress	Spartacus	LaTrobe	3000TR	404	44Y89	Jurien	Amira
1	UNTREATED	3.19 abc	3.24 a-e	3.25 ab	4.71 ab	5.02 a	0.81 a-d	1.04 ab	1.25 cd	1.85 abc	1.25 abc
2	Imazapic 1x	3.32 abc	3.3 a-d	3.31 ab	4.61 ab	4.71 a-d	0.91 a-d	1.13 ab	1.25 bcd	1.76 abc	1.03 bc
3	Imazapic 2x	3.2 abc	3.27 a-d	3.15 ab	4.6 ab	4.65 a-d	1.03 a-d	1.15 ab	1.2 cd	1.81 abc	1.14 abc
4	Imazapic 4x	3.46 a	3.55 a	3.32 ab	4.68 ab	4.7 a-d	1.06 abc	1.17 ab	1.24 cd	2.01 ab	1.33 ab
5	Imazapic 1x	3.32 abc	3.47 ab	3.36 ab	4.63 ab	4.49 a-d	0.63 cd	0.88 ab	1.23 cd	1.61 abc	1.27 abc
6	Imazapic 2x	3.28 abc	3.29 a-d	3.11 ab	4.19 bc	4.53 a-d	0.9 a-d	1.04 ab	1.15 cd	1.67 abc	1.15 abc
7	Imazapic 4x	3.39 ab	3.18 a-f	3.18 ab	3.89 c	4.47 a-d	0.94 a-d	1.13 ab	1 d	1.7 abc	1.07 bc
8	Imazathapyr 1x	3.11 abc	3.2 a-f	3.27 ab	4.66 ab	4.28 bcd	0.56 d	0.95 ab	1.57 ab	1.65 abc	1.2 abc
9	Imazathapyr 2x	3.48 a	3.37 abc	3.33 ab	4.79 ab	4.89 ab	1.21 a	1.3 a	1.25 cd	1.65 abc	1.05 bc
10	Imazathapyr 4x	3.23 abc	3.38 abc	3.27 ab	4.64 ab	4.65 a-d	1.05 abc	1.11 ab	1.25 bcd	1.9 abc	1.21 abc
11	sentry 1x	2.87 c	3.02 c-f	3.19 ab	4.44 abc	4.27 bcd	0.74 a-d	0.8 b	1.26 a-d	1.45 c	1.24 abc
12	sentry 2x	3.16 abc	3.08 b-f	3.34 ab	4.42 bc	4.73 a-d	1.13 ab	1.18 ab	1.28 a-d	1.71 abc	1.23 abc
13	sentry 4x	3.5 a	3.35 a-d	3.24 ab	4.33 bc	4.74 a-d	1.08 abc	1.17 ab	1.31 a-d	1.68 abc	1.11 abc
14	Imazapic 1x + atrazine 2x	3.35 abc	3.28 a-d	3.19 ab	4.82 ab	4.67 a-d	0.92 a-d	1.14 ab	1.38 a	1.69 abc	1.22 abc
15	Imazapic 1x + atrazine 2x	3.15 abc	2.85 ef	2.96 b	4.36 bc	4.15 d	0.95 a-d	0.86 ab	1.39 abc	1.73 abc	1.41 a
16	SENTRY 2x + terbutylazine 2x	3.21 abc	3.41 abc	3.09 ab	4.68 ab	4.63 a-d	1.03 a-d	1.03 ab	1.45 abc	1.56 bc	1.15 abc
17	Atrazine 1x	3.57 a	3.03 c-f	3.42 a	5.11 a	4.87 abc	1.1 abc	1.35 a	1.41 abc	2.09 a	1.25 abc
18	Atrazine 2x	3.25 abc	3.11 b-f	3.08 ab	4.37 bc	4.57 a-d	0.72 bcd	0.88 ab	1.17 cd	1.8 abc	1.14 abc
19	Atrazine 4x	3.31 abc	2.97 def	3.25 ab	4.59 ab	4.52 a-d	0.96 a-d	1.18 ab	1.44 abc	1.83 abc	1.23 abc
20	Terbutylazine 1x	3.2 abc	2.83 f	3.15 ab	4.54 abc	4.65 a-d	1.03 a-d	1.12 ab	1.28 a-d	1.76 abc	1.08 abc
21	Terbutylazine 2x	3.4 ab	3.25 a-d	3.3 ab	4.58 ab	4.5 a-d	0.87 a-d	1 ab	1.45 abc	1.9 abc	1.16 abc
22	Terbutylazine 4x	3.59 a	3.41 abc	3.37 a	4.8 ab	4.78 a-d	0.9 a-d	1.24 ab	1.22 cd	1.58 bc	1.25 abc
23	FST - 2 summer and 2 winter	2.94 bc	3.09 b-f	3.12 ab	4.52 abc	4.23 cd	1.02 a-d	1.1 ab	1.35 abc	1.45 c	0.99 c
24	glyphosate 5L/MW Palmero 1X										
	LSD 0.05	0.476	0.397	0.411	0.67	0.646	0.481	0.493	0.323	0.485	0.335
	CV	8.8	7.49	7.72	8.9	8.52	31.1	27.57	15.04	16.97	17.2
	Replicate F	181.657	261.466	312.006	7.911	4.082	6.443	1.638	6.778	8.885	1.868
	Replicate Prob(F)	0.0001	0.0001	0.0001	0.0012	0.0236	0.0035	0.2059	0.0027	0.0006	0.1664
	Treatment F	1.152	1.908	0.617	1.085	0.921	0.915	0.661	1.441	0.85	0.712
	Treatment Prob(F)	0.3356	0.0339	0.8879	0.3973	0.5707	0.5782	0.8519	0.1492	0.6519	0.8027

Table 2: Winter and summer weed control (%) from fallow treatments at Wyalkatchem

		WYALK	WYALK	WYALK	WYALK
		Annual Ryegrass	VOL MEDIC	Afghan melon	summer grass
		% control	% control	% control	% control
TRT	2015 treatment				
1	UNTREATED	0 h	0 g	30 c-f	10 h
2	imazapic 1x	40 g	73.3 bc	40 b-f	70 a-e
3	imazapic 2x	40 g	80 b	66.7 abc	80 a-d
4	imazapic 4x	60 de	66.7 cd	70 ab	83.3 abc
5	imazapyr 1x	53.3 ef	60 de	26.7 def	56.7 c-g
6	imazapyr 2x	53.3 ef	60 de	6.7 ef	30 gh
7	imazapyr 4x	40 g	73.3 bc	30 c-f	56.7 c-g
8	imazathepyr 1x	40 g	53.3 ef	56.7 a-d	70 a-e
9	imazathepyr 2x	46.7 fg	80 b	60 a-d	73.3 a-e
10	imazathepyr 4x	53.3 ef	73.3 bc	71.7 ab	86.7 ab
11	sentry 1x	40 g	60 de	63.3 a-d	68.3 a-e
12	sentry 2x	60 de	66.7 cd	50 a-d	73.3 a-e
13	sentry 4x	40 g	60 de	70 ab	88.3 a
14	imazapic 1x + atrazine 2x	80 b	80 b	76.7 ab	86.7 ab
15	imazapyr 1x + atrazine 2x	80 b	93.3 a	73.3 ab	60 b-f
16	SENTRY 2x + terbuthylazine 2x	80 b	100 a	85 a	90 a
17	Atrazine 1x	73.3 bc	73.3 bc	65 abc	50 efg
18	Atrazine 2x	80 b	100 a	63.3 a-d	53.3 d-g
19	Atrazine 4x	100 a	100 a	43.3 b-e	73.3 a-e
20	Terbuthylazine 1x	73.3 bc	60 de	53.3 a-d	66.7 a-e
21	Terbuthylazine 2x	66.7 cd	60 de	56.7 a-d	66.7 a-e
22	Terbuthylazine 4x	80 b	53.3 ef	65 abc	78.3 a-d
23	FST - 2 summer and 2 winter	40 g	46.7 f	4.7 f	33.3 fgh
24	glyphosate 5L /MW Palmero TX	0 h	0 g		
	LSD 0.05	9.32	11.21	36.99	27.12
	CV	10.27	10.36	41.98	25.12
	Replicate F	6.273	5.901	0.94	5.386
	Replicate Prob(F)	0.0039	0.0052	0.3982	0.0081
	Treatment F	56.091	41.382	2.766	4.489
	Treatment Prob(F)	0.0001	0.0001	0.002	0.0001

Table 2 shows that Imazapic at 2x-4x rates, Imazathepyr at 4x rate and Terbuthylazine at 4x rate were very effective at reducing the incidence and biomass of the summer grass species Button Grass, Windmill Grass and soft burr grass at Wyalkatchem.

Imazapyr proved much less effective on summer grasses than Imazapic. The combination of Imazapic or Imazapyr with Atrazine proved to be the most effective on afghan Melon control. The co-mix of Imazapic and Imazapyr with Terbuthylazine proved to be the most effective treatment on melon control at Wyalkatchem with an 85% reduction in melon numbers. High rates of Atrazine provided the best volunteer medic and ryegrass (ARG) control at Wyalkatchem.

Table 3: Gross Margin Analyses of highest yielding treatments at WYALKATCHEM from 2015 and 2016

Treatment	Grade	Grain yield t/ha	2015 trt cost \$/ha	2015-16 VAR COSTS \$/ha	gross returns 2015 \$/ha	gross returns 2016 \$/ha	rank 1 to 12
IMPRESS 2015 IMAZAPIC 1x	APW1	1.13	3.70	236	86	0	12
IMPRESS ON WHEAT 2016 ATRAZINE 1x	ASW1	3.42	7.2	236	0	694	5
IMPRESS 2015 IMAZAPIC 4x + IMPRESS 2016 IMAZAPIC 4x	APW1 APW1	4.44	14.70	472		792	3
IMPRESS ON fallow IMAZAPIC 4x	APW1	3.55	14.70	236	0	772	4
SCEPTER ON fallow TERBUTHYLAZINE 4x	ASW1	3.59	68	236	0	680	6
LATROBE ON fallow UNTREATED	FED1	5.02	0	236	0	964	2
SPARTACUS CL ON fallow ATRAZINE 1x	MALT	5.11	7.2	236	0	1142	1
44Y89CL ON fallow IMAZAPIC 1x + ATRAZINE 2x	CAN1	1.58	18.09	271	0	612	7
404RR ON fallow ATRAZINE 1x	CAG1	1.35	7.2	271	0	464	8
TR3000 ON fallow IMAZATHEPYR 2x	CAG1	1.12	29.96	271	0	290	11
AMIRA ON fallow IMAZAPIC 4x	ALBUS	1.41	21.192	241	0	422	9
JURIEN ON fallow ATRAZINE 1x	LUPIN	2.09	7.2	261	0	414	10

*Grain Prices are 5 year average, Assume Spartacus is deliverable as Malt. Canola Grain Value derived from CBH Canola Calculator. Note – Farming fixed costs have not been deducted from these results, only seasonal variable cropping costs associated with inputs and operations have been deducted.

The highest earning treatment at Wyalkatchem was Spartacus CL barley planted into an Atrazine treated fallow from 2015. This treatment netted \$1142/ha over the 2 year period. It is assumed that Spartacus will achieve malt accreditation. The return on variable costs is around 5:1.

The second highest earner was planting Latrobe barley into an untreated fallow. Weeds would have grown uncontrolled in this plot and finally sprayed at the end of the season to eliminate seed set. This approach netted \$964/ha over the 2 year period. The return on variable costs for the 2 year period is 4:1. Significant summer rains may have eliminated any penalty from a light infestation of winter weeds here.

The third placed earner was wheat on wheat, where Impress CL wheat was planted into 4x rate of Imazapic in 2015 and 2016. Variable costs for the 2 years was \$472/ha and this returned a \$792/ha gross margin for the 2 year period. The return on variable costs for the 2 year period is 1.7:1.

Conclusion

Given a dry 2015 followed by a wet 2016, a crop on spray fallow option provided the highest gross margin on this clay loam soil at Wyalkatchem.

Spartacus CL barley, assumed as a malt variety, achieved the highest gross margin over the 2 year period. The numerous frost events experienced at this site, along with the neutral pH, may have favoured the barley varieties and hindered some of the other varieties grown here.

Key words

Spray Fallow, Residual Herbicides.

Acknowledgments

GRDC RCSN, ADVANTA, PIONEER, INTERGRAIN, AGT, QUADE AGRISERVICES LANDMARK, CSBP, ADAMA, SYNGENTA, SIPCAM, BAYER, Jones Family. GRDC Project Number: CRC00004