Herbicide tolerance of new Canola varieties

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Key messages

•Trifluralin 1440g, clethodim 120g and dicamba 100g/ha applied at the label recommended timing were tolerated well with good crop safety margin by all the canola varieties. Clopyralid 120g/ha in mixture with fluroxypyr 100g or haloxyfop 52g/ha was also tolerated well by the varieties.

•S-metolachlor at 240g/ha (label rate) caused significant yield loss in ATR Snapper, propyzamide at 500g/ha rate recorded low crop safety margin in Sturt TT and diuron 270g/ha applied pre-seeding followed by diflufenican 100g/ha at 3-4 leaf stage caused significant yield loss across all the varieties.

•Majority of the herbicides had no significant negative effect on oil content of the canola varieties.

Note: The herbicide rates reported in this paper are based on active ingredients (a.i.).

Aims

To identify herbicide sensitivities of new canola varieties with the view to reduce their yield losses due to herbicide damage.

Method

A field trial was conducted at Mingenew in criss-cross design on Gary Cosgrove's property in which six Canola varieties (ATR Snapper, ATR Stingray, Hyola® 450TT, Sturt TT, Hyola® 404RR, Pioneer® 43Y23 (RR)) were sown on 14 May 2014 on a sandy soil ($CaCl_2$ measured pH 4.9 and OC 0.91%) with three replications. The varieties were sown 2cm deep in 15m long and 1.1m wide (5 rows at 22cm row spacing) plots at 3kg/ha seed rate using knife points and press wheels. Agstar Extra 80kg and Urea 50kg/ha were applied with the seed. A blanket spray of registered insecticides was applied immediately after seeding and on 31 July 2014.

A range of herbicide treatments (Table 1) were applied randomly in 1.1 metre wide strips across all the variety plots. For herbicide plots, plot centre to centre was 1.8 metres with 70cm buffers between any two plots. The treatments were applied before crop seeding (14 May), at 2-3 leaf stage (5 June), at 3-4 leaf stage (12 June) and at 6-8 leaf stage (7 July) using a spray rig. The spray rig was fitted with air induction nozzles and shields on boom and was calibrated to deliver 80L/ha water volume. Every 5th plot was kept as an untreated control to assess the spatial variability. At the time of pre-emergent herbicide treatments application (14 May), the gravimetric soil moisture content at 0-10cm depth was 5% which was marginally enough for activation of pre-emergent herbicides like trifluralin and propyzamide. However, within 2 weeks of these treatments application, 13mm rain fell which might have helped further in activation of pre-emergent herbicides. The canola varieties were assessed for visual injury in terms of leaf yellowing and spotting, and biomass reduction at 2-4 weeks after each treatment application and again at flowering stage using a 0 to 100% scale, where 0 = no visible injury and 100 = complete plant death (20 June, 1 July, 6 August and 25 September 2014).

Ideally, herbicide tolerance trials are conducted under weed free conditions. However, in this trial annual ryegrass emerged in low to medium density with the crop in almost all the plots. To control ryegrass tepraloxydim 60g/ha + oil adjuvant 1% (eg Hasten™) was applied in June to all the plots except clethodim plots. The ryegrass appeared to be group A resistant and thus it continued to grow. Ryegrass population density rating was conducted on 6 August 2014 using 1 to 4 scale, where 1 = very low ryegrass density and 4 = very high ryegrass density.

The trial was harvested on 8 October 2014 and net plot size was 11.9m X 1.1m. To convert grain yield from plot to hectare basis, 1.8m plot width was used (distance from a plot centre to the next plot centre). At the time of harvesting, grain samples were collected from each plot to determine the oil content. The grain oil content was determined using Cropscan 2000B NIR analyser and it was adjusted to 6% moisture level.

The grain yield and oil content data was subjected to REML analysis (spatial) with ryegrass density as a covariate using the Genstat programme.

Total rainfall from May to October at Mingenew was 245mm. Of this total rainfall (May-October), May, June, July, August, September and October received 21, 15, 24, 8, 26 and 6% rainfall, respectively.

Crop safety margins: Higher than label rates of the herbicides were included in the trial to determine the crop safety margin of the herbicides at the maximum label rates. Good crop safety margin means that a herbicide at its maximum label rate and at the higher rate was tolerated well by a crop variety. Whereas, low crop safety margin for a particular herbicide indicates that the variety tolerated the maximum label rate well, but at higher than the label rate there was significant yield loss. A low crop safety margin implies that when spraying under less than optimal conditions, herbicide damage and yield loss may occur. For example, when overlapping herbicide; spraying under wet conditions (for soil active and residual herbicides); and /or there are stressed plants due to abiotic/biotic factors.

Results and Discussion

•The grain yield ranged from 411kg (ATR Stingray) to 822Kg/ha (Pioneer® 43Y23 (RR)) in the untreated control plots across the varieties. Roundup Ready (RR) varieties yielded higher than Triazine Tolerant (TT) varieties. Pioneer® 43Y23 (RR) was the highest yielding variety in this trial and it recorded 8, 69, 86, 94 and 100% higher grain yield than Hyola® 404RR, ATR Snapper, Hyola® 450TT, Sturt TT and ATR Stingray, respectively (Table 1).

•None of the herbicides produced any visual symptoms on canola plants except diuron 270g/ha applied pre-seeding followed by diflufenican 100g/ha at 3-4 leaf stage.

•Trifluralin 1440g, propyzamide 500g and dicamba 100g/ha were tolerated well by all the varieties. All these herbicides also recorded good crop safety margin across the varieties except propyzamide which caused significant yield loss in Strut TT at higher than the label rate (Table 1).

•S-metolachlor at the label (240g/ha) and higher than label rate was safe to all the varieties except ATR Snapper that registered significant yield loss at both the rates (Table 1).

•Clopyralid + fluroxypyr and Clopyralid + haloxyfop at the label rates were tolerated well by all the varieties.

•Clethodim is registered up to the rate of 120g/ha with a safe application window until flower bud becomes visible on canola plants. In this trial, all the varieties tolerated clethodim 120g/ha rate with good crop safety margin applied at 2-3 leaf and at 6-8 leaf stage (before the bud formation). However, the late application results (6-8 leaf stage) are in contrary with the work done by Michael Zerner from SARDI at Yeelanna and Hart, South Australia during 2013. It has been reported that application of clethodim at 240g/ha rate at 8 leaf stage resulted in a 10 to 25% yield reduction with variation between varieties. Furthermore, applications of clethodim at bud initiation stage at 120g and 240g/ha rates, caused significant yield loss up to 52%. The variety AV Garnet appeared to suffer less yield loss at the differing rates and timings compared to the other two varieties tested (RMS Agricultural Consultants, 2014).

•Clethodim affected plants are paler green in colour. Flower buds become distorted and club like and fail to open, leading to poor pod development and reduction in grain yield (RMS Agricultural Consultants, 2014).

•Diuron 270g/ha applied before seeding followed by diflufenican 100g/ha at 3-4 leaf stage of canola caused around 35% bleaching or spotting on the leaves exposed to the spray and stunted all the varieties. This treatment also reduced the canola plant population from 9% (Hoyla 404RR) to 58% (ATR Snapper) and ultimately resulted in significant yield loss across all the varieties (12-78%). RR canola varieties (Hyola® 404RR and Pioneer® 43Y23 (RR)) appeared to tolerate this treatment better than the TT varieties, especially ATR Snapper and Sturt TT (Table 1). These results are in contrary to the earlier work done by John Moore (2002), where he reported that canola tolerated diuron up to 1000g/ha applied pre plant and diflufenican 133–220g/ha applied at the 4–5 leaf stage, quite well. Neither diuron nor diflufenican are registered for use on canola.

•FMZ 1204 is a potential new herbicide for grass weed control in canola and it was tolerated well by all the varieties (Table1).

•The oil content ranged from 41.6 (Pioneer® 43Y23 (RR)) to 46.3% (Hyola® 404RR). Oil content recorded positive correlation with grain yield (r = 0.25, average across the varieties). Majority of the herbicide treatments had no significant negative effect on oil content except FMZ 1204 recorded significantly lower oil content in ATR Stingray, diuron followed by diflufenican in Sturt TT and propyzamide at higher than label rate in ATR Snapper and Sturt TT (Table 2).

Conclusion

•All the herbicides registered on canola, at the label rates and timing, were safe to the canola varieties except s-metolachlor that caused significant yield loss in ATR Snapper. Similarly all the herbicides also recorded good crop safety margin across the varieties except propyzamide which registered significant yield loss in Sturt TT at higher than its label rate.

•Diuron 270g/ha applied before seeding followed by diflufenican 100 g/ha at 3-4 leaf stage was damaging (significant yield loss) to all the varieties. Varietal differences seem to exist for tolerance to this treatment.

•Majority of the herbicides at the label rate did not have significant negative effect on oil content of canola varieties.

References

- •Moore, John (2002) Tolerance of canola to herbicides. In “Proceedings of the 13th Australian Weed Conference”. Perth, Western Australia. (Eds S Spafford Jacob, J Dodd and JH Moore) Pp. 348-51.
- •RMS Agricultural Consultants (2014) Canola damage from clethodim. **RMS Agricultural Consultants Website - Canola Damage from Clethodim Article**

Note: For use of fluroxypyr (eg Comet®, Starane®) and dicamba on canola, please check permit to allow minor use (Permit number–PER 13477).

Always follow label recommendations. The Department of Agriculture and Food WA, does not endorse the use of herbicides above the registered rate or off-label use of herbicides or off-label tank mixes. Crop tolerance and yield responses to herbicides are strongly influenced by seasonal conditions.

Key words

Canola, herbicide, tolerance, grain yield.

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Table 1: Effect of herbicides on grain yield (% of untreated control) of canola varieties at Mingenew during 2014 (14CH51).

No	**Herbicides**	**Rate a.i./ha**	**Timing**	ATR Snapper	ATR Stingray	Hyola® 404RR	Hyola® 450TT	Pioneer® 43Y23 (RR)	Sturt TT
0	Untreated Control			100	100	100	100	100	100
0	Yield (kg/ha)			487	411	764	442	822	423
1	S-metolachlor	240g	Before seeding (BS)	**76**	94	98	81	103	83
2	S-metolachlor	Higher rate	Before seeding	**74**	101	104	97	99	101
3	Trifluralin	1440g	Before seeding	111	104	113	124	101	101
4	Trifluralin	Higher rate	Before seeding	115	95	101	106	99	95
5	Propyzamide	500g	Before seeding	96	76	100	129	105	115
6	Propyzamide	Higher rate	Before seeding	91	90	94	122	100	**72**
7	FMZ 1204	1 L (product rate)	Before seeding	83	92	106	125	105	105
8	Clethodim + oil adjuvant	120g + 1%	2 leaves	91	106	86	120	97	104
9	Clethodim + oil adjuvant	Higher rate + 1%	2 leaves	101	126	113	132	99	123
10	Clopyralid + fluroxypyr	90g + 100 g	2 leaves	85	100	96	83	94	96
11	Clopyralid + haloxyfop + oil adjuvant	90g + 52g + 0.5%	2 leaves	108	103	115	123	95	91
12	Diuron fb diflufenican	270g fb 100g	BS fb at 3-4 leaves	**22**	**50**	**78**	**52**	**68**	**41**
13	Dicamba	100g	3-4 leaves	97	85	96	129	94	108
14	Dicamba	Higher rate	3-4 leaves	88	90	88	83	105	100
15	Clethodim + oil adjuvant	120g + 1%	6-8 leaves	88	105	95	115	90	95
16	Clethodim + oil adjuvant	Higher rate + 1%	6-8 leaves	101	92	98	111	102	99
	Lsd (0.05) Control vs Herbicides (1-tail)			18	24	16	31	15	20
	Lsd (0.05) Herbicides vs Herbicides (1-tail)			23	31	20	40	19	26
	CV (%)			17	23	15	29	14	19

The herbicide products used in the trial were Dual® Gold (s-metolachlor), Triflur® X 480 (trifluralin), Edge® 900 (propyzamide), Select® 240 (clethodim), Lontrel® 750 (clopyralid), Comet® 400 (fluroxypyr), Verdict® 520 (haloxyfop) and Brodal® (diflufenican). Clethodim was applied with Hasten™ and clopyralid + haloxyfop with Uptake™ oil. Treatments 15 and 16 were applied before flower bud became visible (green).

fb = followed by and a.i = active ingredient.

Figures in **BOLD** are significantly lower than untreated control.

ATR Stingray, ATR Snapper, Pioneer Sturt and Hyola 450TT are Triazine Tolerant (TT) varieties.

Table 2: Effect of herbicides on oil content (%) of different canola varieties at 6 % moisture at Mingenew during 2014 (14CH51).

No	Herbicides	Rate a.i./ha	Timing	ATR Snapper	ATR Stingray	Hyola® 404RR	Hyola® 450TT	Pioneer® 43Y23 (RR)	Sturt TT
0	Untreated Control			45.0	42.9	46.3	45.1	41.6	43.7
1	S-metolachlor	240g	Before seeding (BS)	44.9	42.7	46.4	44.8	41.4	43.8
2	S-metolachlor	Higher rate	Before seeding	44.5	43.0	45.9	45.0	42.6	43.1
3	Trifluralin	1440g	Before seeding	44.5	42.5	46.5	45.6	41.4	41.8
4	Trifluralin	Higher rate	Before seeding	44.4	42.7	46.5	45.5	41.3	43.0
5	Propyzamide	500g	Before seeding	44.6	**42.0**	46.8	45.2	42.0	43.5
6	Propyzamide	Higher rate	Before seeding	**43.9**	42.5	46.7	45.1	41.7	**42.9**
7	FMZ 1204	1 L (product rate)	Before seeding	44.5	**42.0**	46.6	45.5	40.9	43.1
8	Clethodim + oil adjuvant	120g + 1%	2 leaves	45.4	43.1	46.5	44.6	41.8	44.2
9	Clethodim + oil adjuvant	Higher rate + 1%	2 leaves	45.3	43.3	46.5	45.6	41.2	43.6
10	Clopyralid + fluroxypyr	90g + 100g	2 leaves	45.5	43.4	47.1	45.6	42.2	43.9
11	Clopyralid + haloxyfop + oil adjuvant	90g + 52g + 0.5%	2 leaves	45.6	43.6	47.0	45.8	41.4	44.5
12	Diuron fb diflufenican	270g fb 100 g	BS fb at 3-4 leaves	44.9	42.5	46.7	45.0	40.6	**42.4**
13	Dicamba	100g	3-4 leaves	46.2	42.6	46.8	**41.5**	43.5	43.6
14	Dicamba	Higher rate	3-4 leaves	45.8	42.7	47.6	46.3	41.4	44.1
15	Clethodim + oil adjuvant	120g + 1%	6-8 leaves	44.7	43.1	46.5	45.1	41.7	44.2
16	Clethodim + oil adjuvant	Higher rate + 1%	6-8 leaves	45.3	43.1	46.8	45.8	42.2	44.1
	Lsd (0.05) Control vs Herbicides (1-tail)			0.8	0.8	0.6	0.6	1.2	0.8
	Lsd (0.05) Herbicides vs Herbicides (1-tail)			1.0	1.1	0.7	0.7	1.5	1.0
	CV (%)			1.7	1.9	1.2	1.2	2.6	1.6

The herbicide products used in the trial were Dual® Gold (s-metolachlor), Triflur® X 480 (trifluralin), Edge® 900 (propyzamide), Select® 240 (clethodim), Lontrel® 750 (clopyralid), Comet® 400 (fluroxypyr), Verdict® 520 (haloxyfop) and Brodal® (diflufenican). Clethodim was applied with Hasten™ and clopyralid + haloxyfop with Uptake™ oil. Treatments 15 and 16 were applied before flower bud became visible (green).

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