Herbicide tolerance of *Bannister* and *Williams* Oats

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Key Messages

- Bannister consistently showed sensitivity to Diuron 500 0.5 L + MCPA 500 (amine) 0.5 L/ha applied at Z13-Z14. Williams also seems sensitive to this mixture.
- Bannister grain yield was reduced significantly with Precept® and Flight® EC applied at label rates in two out of three trials.
- Williams grain yield was reduced significantly at label rates of diuron + Dual®, Broadside®, Conclude®, diuron + MCPA, Flight® EC and 2,4-D amine in one out of two trials.

Aims

Bannister and Williams are the new high yielding oat varieties with potential milling quality, released during 2012 and 2013, respectively. Both the varieties are suggested for all cropping regions of WA.

Three herbicide tolerance trials were conducted under weed free conditions from 2011 to 2013 at the Great Southern Agricultural Research Institute (GSARI) in Katanning. The aim of these trials was to identify herbicide sensitivities of these new varieties and thus reducing their potential yield losses due to herbicide damage. Carrolup was used as the comparison variety during 2011 and 2012 only.

Method

Trial Years	2011	2012	2013
Location	Great Southern Agricultural Research Institute (GSARI), Katanning.		
Soil Type pH ($CaCl_2$) and OC (%)	Loamy sand 4.7 and 2.33	Loamy sand 4.7 and 2.43	Sandy loam 5.1 and 2.5
Trial design	Criss-cross, every 5th plot as untreated control.		
Varieties	Bannister and Carrolup.	Bannister, Carrolup and Williams.	Bannister and Williams.
Plot size (net) and replications	9.4 - 10.5 m X 1.1 m (5 rows at 22 cm row spacing) and 3 reps. To convert plot yield to kg/ha, 1.8 m plot width was used (plot to plot centre).		
Seeding date and rate	22 June and 75 kg/ha	3 July and 75 kg/ha	24 June and 75 kg/ha
Seeding machinery and sowing depth	Coneseeder with knife points and press-wheels and 2-4 cm deep.		
Fertilizer	K-Till Extra 100 kg/ha at seeding. Top dressed with Urea 60 kg/ha on 3 Sept.		
Soil moisture at seeding Method used Rainfall within in 4 WAS*	0-10 cm: 11.6 % 10-20 cm: 10.0 % Gravimetric method 88 mm	0-10 cm: 24 % 10-20 cm: 17 % Volumetric method 28 mm	0-10 cm: 15.8 % 10-20 cm: 9.2 % Volumetric method 44 mm

Treatment application date: Pre-em., Z12-Z13, Z13-Z14, Z15-Z16 and Z31.	22 June, 18 July, 5 Aug, 5 and 13 Sept.	3 July, 8 Aug, 17 Aug, 6 Sept and 13 Sept.	21 June, 8 Aug, 19-23 Aug and 29 Aug.
Herbicide application machinery	Spray rig with shields on boom at a width of 1.5 m. Air induction nozzles and 75 L/ha water volume used.		
Visual observations scale:	0 to 100 %, where 0 = no visible injury & 100 = complete plant death.		
Visual observations dates:	1 Sept and 28 Sept.	7 & 23 Aug and 14 & 27 Sept.	28 Aug, 18 Sept and 7 Nov.
Harvesting date	12 December 2011	26 November 2012	27 November 2013

Rainfall (mm) :	May	June	July	Aug	Sept	Oct	Nov	Total
2011	43.3	68.8	47.8	66.8	56.6	68.6	66.6	418.6
2012	42.2	86	24	44	65	11	26.6	298.8
2013	62.6	19.0	58.0	76.4	107.8	27.8	2.2	354.8

* WAS = Weeks after sowing, Pre-em. = Pre-emergent/before crop seeding.

Higher than label rates of some herbicides were included in the trials 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. Where as, **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.

Results

The effect of herbicides during early crop growth stages, at anthesis time and on grain yield (Table 1) of oat varieties was as follows:

- Diuron 500 + Dual® 720 1 L + 0.5 L/ha applied before crop seeding caused significant yield reduction in Carrolup and Williams during 2012.and Glean® 20 g/ha applied at 2 - 3 leaf stage reduced grain yield only of Carrolup during 2012. These herbicides didn't produce any visual symptoms on the varieties.
- Diuron 500 + MCPA 500 (amine) 0.5 L + 0.5 L/ha applied at 3 - 4 leaf stage of the crop caused yellowing across all varieties during 2012 and 2013, and reduced around 15% biomass of all the varieties during 2012 only. Also in 2012, a height and biomass reduction in Bannister was visible at the flowering stage of the crop. These phytotoxic symptoms were not visible or noticed during 2011. However, diuron + MCPA registered significant yield loss in Bannister during all the years, in Williams during 2012 and no significant negative effect on Carrolup's grain yield at all. Williams recorded low crop safety margin for this mixture during 2013.
- Tigrex® 1 L/ha applied at 3 - 4 leaf stage of the crop resulted in visible spotting/bleaching (15%) on leaves which were exposed to the spray, across all the varieties during all the three years, but registered significant yield loss only in Bannister during 2011.
- Similar to Tigrex®, during 2012 and 2013, Precept® 2 L and Flight® EC 720 mL/ha also caused bleaching/yellow leaf spotting across all the varieties, as observed three weeks after spraying. However, these visual effects were outgrown with time. Precept® recorded significant yield reduction in Bannister during 2012 and 2013. Flight® EC reduced grain yield of Carrolup during 2012 and of Bannister and Williams during 2013. Interestingly, Flight® EC also caused significant yield reduction in Bannister during 2011 without producing any noticeable leaf symptoms.

- Affinity® + MCPA 500 (amine) 60 g + 0.5 L/ha applied at 3 - 4 leaf stage caused around 15-30% leaf burning/necrosis across all the varieties during 2012 and 2013 only. These visual symptoms were outgrown with time and there was no significant negative effect on grain yield of these varieties in any of the trials. Chances of necrotic and white leaf spotting appearance on crop with Affinity® +MCPA is greater, when spraying is done under high relative humidity, high temperature, high soil moisture, high leaf moisture, dewy and high sunlight conditions (*Herbiguide, 2011*).
- Broadside® 1 L/ha caused significant yield loss in Williams without producing any visual phytotoxic symptoms during 2012. However, leaf spotting (15%) caused by this herbicide during 2013 across the varieties did not result in significant yield loss.
- Conclude® 0.7 L/ha caused significant yield loss in Carrolup during 2011 and in Williams during 2013. This herbicide has been safe on Bannister during all three years of testing.
- 2, 4-D (amine) 625 1.3 L/ha applied at 5-6 leaf stage caused significant yield reduction in Carrolup and Williams during 2012 and in Bannister during 2013. However, Amicide® Advance 700 at the label rate (1.15 L/ha) applied at stem elongation stage (Z31) was tolerated well by all the varieties. Interestingly, Carrolup and Williams registered low crop safety margin for Amicide Adavnce 700 at 1.15 L/ha during 2012.
- Amicide® Advance 700 is a new 2, 4-D (amine) formulation designed for stability and better compatibility with other products in a range of conditions.

Conclusion

- Diuron 500 + MCPA 500 (amine) applied at 3 – 4 leaf stage of the crop reduced grain yield (5-15%) of Bannister consistently. Williams also seems sensitive to this mixture. The grain yield of widely grown variety Carrolup was unaffected with this herbicide mixture in the three trials conduced from 2010-2012. (2010 data is not presented here).
- Bannister seems sensitive to Carotenoid biosynthesis inhibitor (Flight® EC, group F, C and I) and HPPD inhibitor (Precept®, group H and I) herbicides. Bannister had two bad (significant yield loss) result with these herbicides out of three years of testing.
- Williams tolerated around half of the herbicides tested (at the label rates) quite well except, diuron + Dual®, Broadside®, Conclude®, diuron + MCPA, Flight® EC and 2,4-D amine applied at Z15-Z16. These herbicides need further testing to confirm the results.
- Significant yield loss in Carrolup with Conclude® during 2011 and with diuron + Dual®, Glean®, Flight® EC and 2,4-D amine during 2012 is not consistent with the previous results (2000 and 2010).

Key words

Oat, herbicides, tolerance and grain yield.

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Table 1: Effect of herbicides on grain yield (% of control) of oat varieties at Katanning (2011-2013).

No	Herbicides/ha	Timing	Bannister			Williams		Carrolup	
	Years		2011	2012	2013	2012	2013	2011	2012
0	Untreated Control >>>>>>Grain yield kg/ha		100 2583	100 1997	100 3197	100 2265	100 2303	100 1653	100 1785
1	Diuron 500 1 L + Dual® 0.5 L *(Diuron + Metolacholr 720)*	Pre- seeding	102	107	100	**91**	105	113	**84**
2	Glean® 20 g *(Chlorsulfuron)*	Z12-Z13	100	113	98	92	110	101	**90**
3	Affinity® 60g + MCPA 500 (amine) 0.5L (*Carfentrazone-ethyl + MCPA)*	Z13-Z14	109	95	97	97	104	102	96
4	Broadside® 1 L *(Bromoxynil + MCPA + Dicamba)*	Z13-Z14	92	102	100	**91**	99	95	101
5	Conclude® 0.7 L *(Florasulam + MCPA)*	Z13-Z14	108	100	97	93	**93**	**85**	95
6	Diuron 500 0.5 L + MCPA 500 (amine) 0.5 L	Z13-Z14	***89***	**85**	**95**	**83**	96	96	102
7	Diuron 500 + MCPA 500 (amine) Higer rate	Z13-Z14	**-**	**-**	**87**	**-**	**92**	-	-
8	Flight® EC 720 mL *(Picolinafen + Bromoxynil + MCPA ester)*	Z13-Z14	**88**	95	**84**	100	**89**	109	**89**
9	Precept® 2 L *(Pyrasulfotole + MCPA)*	Z13-Z14	108	**88**	**94**	103	99	106	93
10	Tigrex® 1 L *(Diflufenican + MCPA)*	Z13-Z14	**90**	98	98	111	97	89	100
11	2 4-D (amine) 625 1.3 L	Z15-Z16	109	91	**95**	**87**	102	122	**87**
12	Amicide® Advance 700 1.15 L *(2,4-D, amine)*	Z31	94	104	-	94	-	104	97
13	Amicide® Advance 700 (2,4-D, amine) Higer rate	Z31	98	99	-	**86**	-	95	**89**
Lsd (0.05) Control vs Herbicides (1-tail)			10	10	4	9	5	15	10
Lsd (0.05) Herbicides vs Herbicides (1-tail)			12	12	5	12	6	19	13
CV (%)			9	9	4	9	4	14	10

Treatments 2 + BS 1000 0.1%, 5 + Uptake® 0.5% and 9 + Hasten® 1%. – indicates herbicide was not tested.
Affinity® WG 60 g = Affinity® Force 100 mL and Diuron 500 0.5 L = Diuron 900 278 g.
Figures in **BOLD** are significantly lower than untreated control. Names in the parenthesis are the chemical names.