CROP SCIENCE SOCIETY OF S.A. INCORPORATED

C/- WAITE CAMPUS
P.M.B No 1, GLEN OSMOND, SOUTH AUSTRALIA 5064
INCORPORATING THE WEED SCIENCE SOCIETY
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NEWSLETTER No. 291 MARCH, 2014
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Next Meeting	**'Weeds, weeds everywhere but not a plant in sight!'**
Venue	**Richardson Theatre, Roseworthy Campus**
Date	**THURSDAY 27th MARCH**
Time	**7.30 pm**

******PLEASE NOTE CHANGE OF NIGHT******

Speakers

Has proven tricky to get the ducks lined up for this meeting…however we present, for you entertainment and learning:

Rob Wheeler – SARDI

Highlighting the good, bad and best of the NVT data – with an interesting twist!

Daniela Montalvo – University of Adelaide

Will present her work on Liquid V's Granular Phosphorus in acid soils

Should be a good show!

BOOK LAUNCH:

"The Waite: a social and scientific history of the Waite Agricultural Research Institute"

The book will be launched at a special ceremony as part of the University of Adelaide's 140th anniversary celebrations during the afternoon of Monday May 12th, at Urrbrae House, on the Waite campus. The work focuses on developments since 1975, linking these developments into the earlier history of the Waite and the lives of the people who have worked on the Campus. More information can be found at <http://www.adelaide.edu.au/press/titles/waite>.
Those members wishing to attend the event are requested, for catering purposes, to email <peter.burdon@adelaide.edu.au> and ask for their names and postal address to be added to the invitation list".

Potential of harvest seed collection of annual ryegrass in the southern cropping region

Ben Fleet, Malinee Thongmee, Chris Preston, & Gurjeet Gill
School of Agriculture, Food & Wine, University of Adelaide

Abstract

Widespread herbicide resistance in the southern cropping region has sharpened the focus on non-chemical weed management strategies. Recently there has been considerable discussion on the potential role of harvest weed seed collection for the management of herbicide resistant weed populations. Field studies were undertaken in South Australia over three years to determine the amount of ryegrass seeds that could be captured during crop harvest. Linear regression between total seed production and seeds below cutting height was used to determine seed collection efficacy at each experimental site. The effectiveness of seed capture of annual ryegrass varied from 26 to 73% across the sites, with an average of 47%. However, the capture of weed seeds at harvest was completely ineffective against barley grass (0.5% seed capture).

Introduction

A recent review of harvest weed seed collection (HWSC) by Walsh et al. (2013) reported that the Harrington weed seed destructor can kill more than 90% of annual ryegrass (ARG) seeds that enter the mill. In a recent report, Walsh et al. (2014) concluded that HWSC methods can reduce ARG population next year by 57%. This disparity between potential control and actual control achieved in the field is likely to be associated with the effectiveness of the harvester to capture weed seeds and feed them into the mill or the chaff cart. Possible escape mechanisms for weeds include presence of some ARG seed heads below the cutting height or shedding of seeds prior to the harvest operation. Most of the studies on HWSC have been undertaken in Western Australia. In order to complement the work done in WA, field trials were undertaken in South Australia over 3 years to determine to the expected level of ARG seed collection by HWSC.

Materials and methods

The study focussed on harvest seed collection of ARG as it is known to be the most suited to seed collection due to its later maturity, erect nature and is known to be less prone to seed shedding than other grass species like wild oats, brome or barley grass. One of the field sites was infested with barley grass. It was decided to focus this research on wheat which is the dominant crop in this region.

A field site at Mintaro in 2011 was used to develop and evaluate the methodology for HWSC. In 2012 three sites were sampled across diverse rainfall zones (high, medium & low rainfall) and at various timings through harvest. In 2013 sampling was repeated at the medium rainfall site prior to harvest. The high rainfall HR sites were Mintaro in 2011 & Merilden in 2012 (average 540mm per annum), Roseworthy Campus (average 440mm per annum) for medium rainfall MR, and Port Germein (average 270mm per annum) for low rainfall LR (MLA 2014).

At each field site, a suitable of patch of ARG infested wheat crop was identified. Within this experimental area, 1m^2 sample area was carefully cut at 10 cm height above the ground. The entire sample was placed in large sample bags for processing. All ARG seed heads below 10 cm height were collected and loose seeds vacuumed from the soil surface. This process was replicated ten times at each site and timing.

The ARG seed from above and below the cutting height (10 cm) was later cleaned and quantified with the aid of a seed counter to give ARG seeds per m^2 above and below 10 cm cutting height. A linear regression between total seed production and seeds below the cutting height was used to determine potential seed collection efficacy. This regression approach is able to cope with the variability in ryegrass density between sampling units, which is important because weed populations tend to be inherently patchy in the field.

Results and Discussion

There was s significant linear relationship between the total seed production of ARG and seeds below the cutting height which would be expected to escape seed capture. The effectiveness of seed capture varied from 26 to 73%. The high rainfall site at Merilden in 2012 showed 65 to 73% seed capture potential. However, the high rainfall site at Mintaro in 2011 only showed a modest level of seed capture (31%). There seems to be a strong seasonal influence on the level of potential seed capture of ARG. Averaged across the seasons and trial sites, there was 47% potential seed capture. Our potential seed capture estimate (47%) is fairly similar to the figure of 57% seed capture reported recently by Walsh et al. (2014).

Table 1. Potential ARG seed capture from harvest operation in wheat for all sites and timings.

Site and year	**Date and** ***harvest stage***	**Wheat yield t/ha** ***(variety)***	**ARG** ***seeds/m²*** ***(range)***	**Potential ARG seed capture (%)** *(R^2)*
Mintaro 2011	1 Dec. *(early)*	5.5 *(Orion)*	9,018 *(1,092 – 26,540)*	**31** *(R^2=0.97***)*
Merilden 2012	29 Nov. *(early)*	2.5 *(Mace)*	4,347 *(1,656 – 10,924)*	**73** *(R^2 = 0.70**)*
Merilden 2012	12 Dec. *(mid)*	2.5 *(Mace)*	4,775 *(2,845 – 7,354)*	**65** *(R^2 = 0.68**)*
Roseworthy 2012	23 Nov. *(early)*	2.25 *(Mace)*	9,923 *(4,665 – 20,567)*	**45** *(R^2 = 0.95***)*
Roseworthy 2012	7 Dec. *(mid)*	2.25 *(Mace)*	8,513 *(6,539 – 10,502)*	**38** *(R^2 = 0.56**)*
Roseworthy 2013	10 Dec. *(mid)*	4.1 *(Justica)*	9,381 *(1,878 – 25,969)*	**26** *(R^2 = 0.99***)*
Pt Germein 2012	7 Nov. *(early)*	2.75 *(Kord)*	12,243 *(7,877 – 14,806)*	**51** *(R^2 = 0.49*)*
Pt Germein 2012	22 Nov. *(mid)*	2.75 *(Kord)*	15,274 (8,436 – 29,386)	**46** *(R^2 = 0.88***)*

* $P<0.05$; ** $P<0.01$; *** $P<0.001$

Large differences between sites and seasons could be related to competitive effects of crops as well as the amount and pattern of growing season rainfall. Differences between ARG biotypes in erectness and maturity time could also have a major influence on the efficacy of weed seed capture at harvest.

Even though seed capture of barley grass was only investigated at a single site, the results indicated a complete failure to capture seeds (0.5% seed capture) of this species even when the crop was harvested early (Table 2). These results are consistent with barley grass biology, especially its ability to mature much earlier than wheat and ready dispersal of its seeds well before crop harvest.

Table 2. Potential barley grass seed capture from harvest operation at Port Germein (low rainfall site – LR).

Site	**Date and** ***harvest stage***	**Wheat yield t/ha** ***(variety)***	**Barley grass** ***seeds/m²*** ***(range)***	**Potential barley grass seed capture (%)** *(R^2)*
Pt Germein 2012	7 Nov. *(early)*	2.75 *(Kord)*	2,265 *(947 – 5,405)*	**0.6** *(R^2=0.999)*
Pt Germein 2012	22 Nov. *(mid)*	2.75 *(Kord)*	513 *(0 – 3,265)*	**0.5** *(R^2 = 0.999)*

Acknowledgements

The research on harvest seed collection reported here was undertaken in a current GRDC funded project (UA00134). The authors would also like to thank Peter Hooper (Hooper consulting) and Roy Rogers (HRZ / Hart field day site) for their involvement with sampling at Mintaro 2011, and Jeff Braun & Mick Faulkner (AgriLink) for their involvement with sampling at both Mintaro and Merilden sites. Also Andrew Mitchell, Barry Mudge, & John Matheson for providing sampling sites.

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Impact of nitrogen and water on grain yield of canola

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Introduction
Water and N availability are the most critical factors for sustaining canola productivity but often water use efficiency (WUE) and N use efficiency (NUE) are low in South Australia. Canola has a high N requirement and how best to manage N in an environment where rainfall is variable is a challenging problem. Limited research has been undertaken in Australia to look at ways to improve NUE and to understand how N strategies affect canola water use. Consequently the aim of this study was to investigate the impact of N management on growth, yield and WUE under different water regimes.

Methodology
Field trials were undertaken at Roseworthy and Tarlee in 2013 to investigate the effect of N management on growth, yield, N and water use efficiency of canola. A medium maturity Clearfield Canola cultivar (Hyola 575cl) was sown on 17th of May 2013 at Roseworthy and 4th May 2013 at Tarlee under five different N application strategies: three N rates (0, 100 and 200 kg N/ha (as granular urea) with the N applied just after emergence or equally split at the rosette stage, green bud appearance and at first flower.

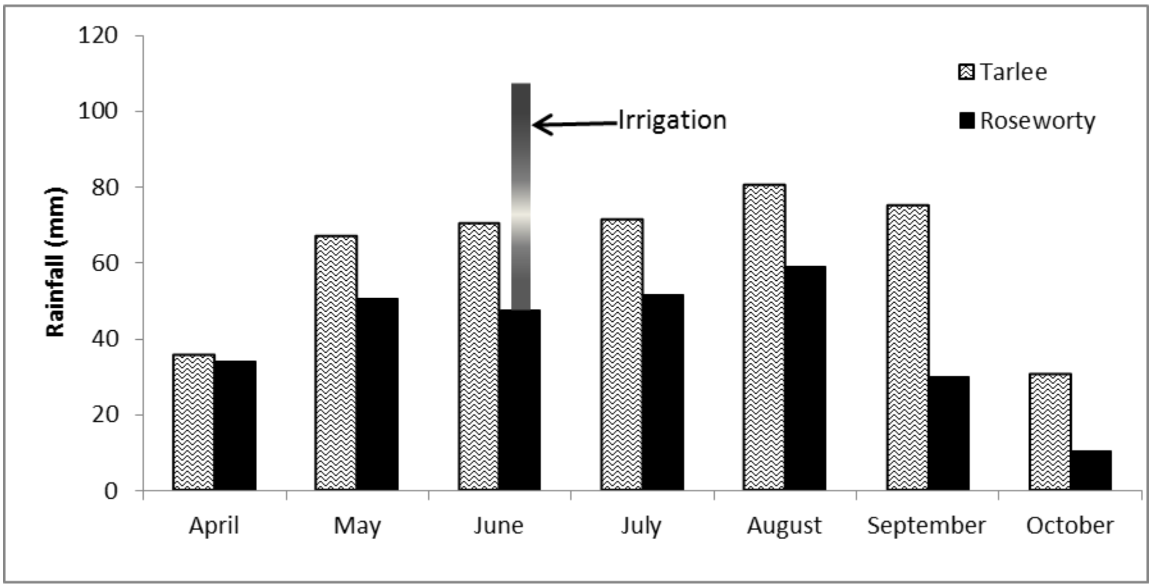

Figure 1: Growing season rainfall at Tarlee and Roseworthy, SA in 2013. The inserted bar represents irrigation (60mm).

Results

Grain yield and yield dynamics:
Applying N increased grain yield by 20% ($P<0.10$) at Tarlee and 77% at Roseworthy but there was no significant difference between rate and timing of N on the yield response. In the irrigated treatment, N produced significantly higher grain yield and total dry matter than the control at Roseworthy. Under dryland conditions split applications of the high N rate (200kg N/ha) produced significantly higher grain yield compared to the control, whereas a single application (200kg N/ha) produced the greatest total dry matter. At Tarlee, split applications produced greatest total dry matter. The responses in grain yield were affected mainly by changes in crop dry matter production demonstrated by similar harvest index (HI) for treatments at both Roseworthy

and Tarlee. Canola converted about 23-24% of its biomass into grain yield at Roseworthy and about 27% at Tarlee.
Oil content was higher at Tarlee than at Roseworthy. Irrespective of the site and irrigation treatment adding N decreased oil content, although the effect was influenced by the timing of application (Tables 1). On average there was no improvement in oil content when N was applied either split or as a single application.

Water use water use efficiency and agronomic efficiency:
The amount of N applied did not influence crop water use (Table 2). At Roseworthy the irrigated treatment used 62mm more water than the dryland treatment (Table: 2). The average WUE of the dryland crop was 7.5 kg/ha/mm whereas the irrigated crop was 8.7 kg/ha/mm (Table: 2) however, additional water from irrigation was used almost twice as efficiently compared to GSR (WUE = 13.8 kg/ha/mm). In dryland conditions higher WUE was observed when N was applied in split applications compared to the control but it did not differ from single N applications. At Tarlee, there was about 15 mm more water used by the crop when N was applied but no difference among the N treatments (Table: 2). Average WUE at Tarlee was 8.0 kg/ha/mm which was slightly higher than that measured in the dryland treatment at Roseworthy (7.5 kg/ha/mm). WUE was not significantly affected by N treatment.
At both sites there was greater depletion of soil water at maturity with the high rate of N (200 kg N/ha) in comparison to the control (Fig 2). At Tarlee water use was confined to 70cm without N (Fig: 2a) whereas the N treatments water use was extracted to a depth of 110cm. At Roseworthy, water use was limited to 70 cm in irrigated and 50cm in dryland treatments irrespective N treatment (Fig 2b & c). Agronomic efficiency (yield increase per unit N applied) decreased at the higher rate of N, however there was an improvement with additional irrigation. At Tarlee, single application of 100 kg N/ha gave higher AE than the equivalent split application. In contrast, split application showed increased AE with 200 kg/ha N.

Conclusions

Grain yield of canola was mainly driven by the biomass production. Timing of N had little impact on yield, however split application improved in oil content. Canola extracted water to 60-80 cm, however addition of N had no effect on total water use, other than rate of depletion. NUE and WUE were improved by the additional water availability.

Tables and Figures

Table 1: Grain yield, Total dry mater (TDM), HI and oil content of canola as affected N treatments at Roseworthy and Tarlee.

N treatments	Grain yield (kg ha^{-1})			TDM (kg ha^{-1})			HI			Oil Content (%)		
	Tarlee	Roseworthy		Tarlee	Roseworthy		Tarlee	Roseworthy		Tarlee	Roseworthy	
	Dry land	Irrigated	Dry land	Dry land	Irrigated	Dry land	Dry land	Irrigated	Dry land	Dry land	Irrigated	Dry land
0	2513	1676	1316	8555	6228	5587	0.28	0.27	0.24	44.8	42.8	43.2
100	2866	2701	1741	10306	11182	7737	0.27	0.24	0.23	44.1	42.2	42.3
200	2973	2971	1970	10181	12770	8542	0.27	0.23	0.23	43.9	42.7	43.3
Single	2964	2832	1805	9909	12086	8407	0.28	0.24	0.24	43.8	42.0	43.2
Split	2874	2839	1905	10579	11866	7872	0.26	0.22	0.24	44.2	43.0	42.4
$Lsd_{0.05}$	366	572		1850	2745		0.03	0.37		0.5	1.6	

Table 2: Agronomic efficiency (AE), Water use (WU), and water use efficiency (WUE) of canola as affected N treatments at Roseworthy and Tarlee

N treatments	Agronomic efficiency			Water Use (mm)			WUE (kg ha^{-1} mm^{-1})		
	Tarlee	Roseworthy		Tarlee	Roseworthy		Tarlee	Roseworthy	
	Dry land	Irrigated	Dry land	Dry land	Irrigated	Dry land	Dry land	Irrigated	Dry land
0				320	293	235	7.34	5.57	5.69
100	3.53	10.25	4.25	334	298	229	8.05	9.08	7.80
200	2.30	6.48	3.27	336	304	247	8.31	9.87	8.16
Single				336	307	236	8.29	9.30	7.70
Split				336	294	240	8.07	9.64	8.26
$Lsd_{0.05}$				13	43		1.21	2.50	

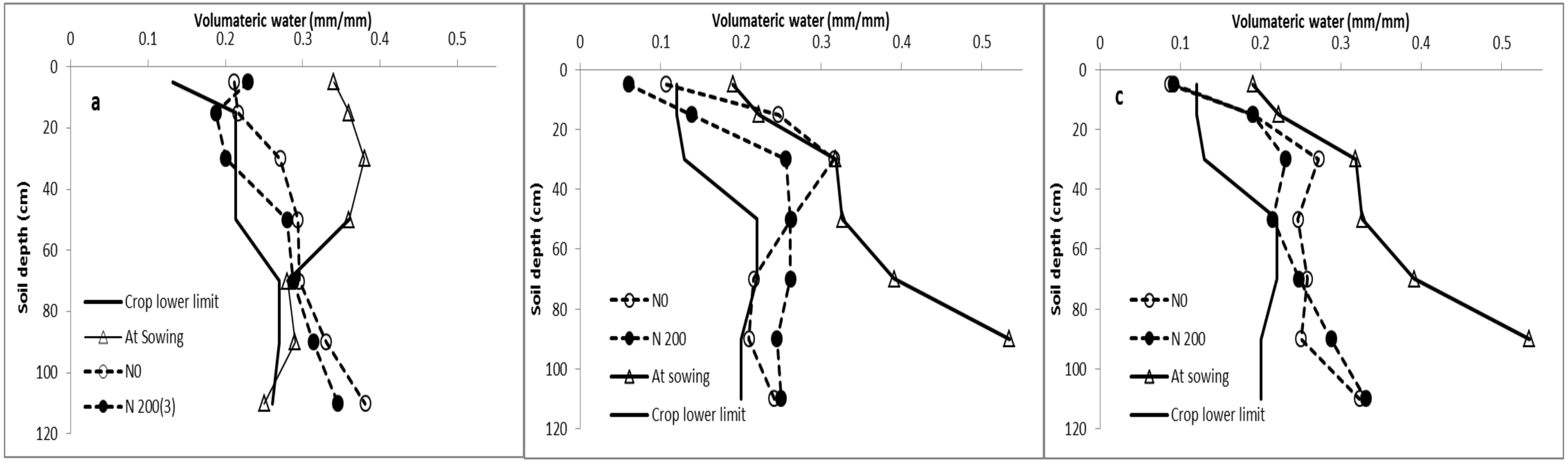

Figure 2: : Water use patterns in 0-120cm soil profile under no N and 200 kg N/ha at (a) Tarlee dry land (b) Roseworthy dry land and (c) Roseworthy Irrigated

The following two articles from our local weed experts highlights what is shaping up to be a huge problem for the coming season!

Identifying New Herbicide Options for Brome Grass

Sam Kleemann, Peter Boutsalis, Gurjeet Gill & Chris Preston

Brome grass is a well-adapted weed that has proliferated in the past decade across the South Australian and Victorian Mallee. This is due to the absence of effective herbicides for its control in cereals, intensification of cropping systems, especially wheat on wheat and the introduction of conservation tillage. Brome grass is extremely competitive and when competing early in wheat at a density of 100 plants/m^2 can reduce yields by as much as 30-50%. Fortunately recent introduction of Clearfield™ technology, which allows safe use of imidazolinone herbicides in several imi-tolerant crops, provides an excellent opportunity for brome grass control. However, overreliance on this herbicide group (ALS inhibitor, Group B) will lead to onset of resistance to these important herbicides. Therefore, research is needed to identify herbicides with alternative modes of action for brome grass management.

Consequently several herbicide efficacy trials funded by GRDC have been undertaken over the last 4 years in South Australia and the Victorian Mallee to identify effective alternative herbicides for managing brome. These trials have evaluated several new & experimental pre-emergent herbicides against common farmer practice of IBS (incorporated by sowing) trifluralin in wheat.

Of the herbicides examined, Sakura® provided excellent brome control (>90%) at some of the field trials. However at other field sites, the level of weed control was relatively low (25%) and underlying reasons for large variability in the performance of Sakura® remains unclear. Addition of Avadex® (triallate) to Sakura® has usually improved control over Sakura® alone, however under high weed pressure (>150 plants/m^2) the mixture has also struggled to provide adequate control (<60%). Several experimental herbicides have also been evaluated alone and as tank mixtures with Avadex® and some treatments appear to be worthy of further research.

Key messages:

- **Brome grass is becoming more problematic in the South Australian and Victorian Mallee due the absence of effective herbicides for control in cereals, intensification of cropping (i.e. wheat on wheat) and introduction of conservation tillage (no-till).**
- **At present brome grass management is heavily reliant on group A and B herbicides, especially Clearfield™ technology.**
- **Growers need to be aware that overreliance on these herbicide groups is expected to cause widespread resistance.**
- **Ongoing research is being undertaken to find effective alternative herbicide options for brome grass.**

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Herbicide Resistance in Brome Grass Across Southern Australia

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Brome grass is a significant weed of pastures and crops across southern Australia. Until recent selective control of brome in cereals was difficult due to limited choice of herbicides, however several Group B herbicides have since been released in Australia. These include sulfonylurea herbicides Atlantis® and Monza® and sulfonamide herbicide Crusader®. In addition the Group B imidazolinone herbicides OnDuty®, Intervix® and Midas® are now used by growers as part of Clearfield™ system to safely control brome in several imi-tolerant crops. In broadleaf crops such as peas, beans, lentils and canola, Group A herbicides such as Select®, Verdict® and Targa® are commonly used. Overreliance on Group A and B herbicides to control brome has resulted in resistance to these herbicides, however the extent and degree of resistance to different herbicides within the same herbicide group was unclear.

Consequently an extensive weed resistance survey funded by GRDC was undertaken across southern Australia from 2005 to 2013 to determine the incidence of herbicide resistance in brome grass. More specifically brome populations were sampled from random cropping fields by collecting seed. The following autumn each brome sample was tested in pot trials by applying Group A and B herbicides at recommended field rates when brome had reached appropriate growth stage.

Results showed that in the SA Mallee in particular, the incidence of resistance to the wheat selective Group B herbicides Altantis® (64% North Mallee, 26% South Mallee) and Crusader® (75% North Mallee, 24% South Mallee) was significant, whereas in the Victorian Mallee resistance was more prevalent to Group A herbicides Verdict® (10%) and Select® (6%). These populations are also likely to be resistant to Monza®. The study also identified differences between Group A herbicides in their activity on resistance brome and showed that increasing dose only marginally improved weed control in most cases. Fortunately at this stage few populations were shown to be resistant to any of the Group B imidazolinone herbicides such as Intervix®, OnDuty® or Midas®. However, considerable decline in the price of these herbicides, as well as release of better crop cultivars with imi-tolerance, is expected to lead to more widespread use, increasing the risk of resistance.

Key messages:

- **Herbicide resistance to Group A and B herbicides in brome grass is becoming more common across southeastern Australia.**
- **Of the resistant populations of brome identified, several differed in their level of resistance to Group A and B herbicides.**
- **Increasing herbicide dose only marginally improved control in most cases, but some Group A and B herbicides were more effective than others in controlling resistant populations.**

Acknowledgments:
GRDC for providing funding is gratefully acknowledged.