CROP SCIENCE SOCIETY OF S.A. INCORPORATED

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INCORPORATING THE WEED SCIENCE SOCIETY

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Next Meeting **'Agronomy Night'**

Venue **Richardson Theatre, Roseworthy Campus**

Date **WEDNESDAY 26th August**

Speakers:

Craig Davis – Craig Davis Agronomy

If you're worried about the coming fungal invasion, Craig will tell you everything you need to know about fungicide management for the warmer months ahead.

Dr Glenn McDonald – University of Adelaide

Glenn always gives interesting presentations and will not fail to deliver this time. Wondering what is happening with soil moisture at this time of the year? Glenn will give an update on soil water and also show some current research into the effect of wheat seed nutrition, seed source and size on grain yield.

Cereal varietal herbicide tolerance – 2014 results

David Brunton and Rob Wheeler, SARDI – New Variety Agronomy.

Key outcomes

Background

Australian cereal varieties are extensively tested to determine level of tolerance to commonly used herbicides in South Australia as part of a GRDC funded national program. All newly released varieties are tested to identify any potential herbicide sensitivity to provide additional information to cereal growers for the agronomic management of new varieties. Varieties are first tested in preliminary trials at higher than recommended rates of the herbicides to identify any sensitivity to specific herbicides. Once a significant variety and herbicide interaction has been identified, the variety is tested with the specific herbicide in more advanced trials using recommended and higher than recommended herbicide rates to determine the severity of the yield reductions caused by the herbicide.

Trial Results

Preliminary screening trials were conducted at Mallala, SA and advanced herbicide tolerance trials were conducted at Kybunga, SA during 2014. Trials were sown relatively late in order to achieve a high weed germination to provide best possible weed control, prior to trial commencement. All herbicide treatments were applied with good levels of soil moisture available to the crop early in the growing season. All cereal variety and herbicide entries selected in advanced trials were based on results in preliminary trials from previous years. Preliminary screening in cereal crops included the use of the following herbicides; Sakura®, Boxer Gold®, diuron + MCPA, Affinity Force® + MCPA, Hussar®, Achieve®, bromoxynil + MCPA, Axial®, Conclude®, Ally® + MCPA, Glean®, Eclipse® + MCPA LVE, Broadstrike®, dicamba + MCPA, Tigrex®, Precept® and 2,4-D amine.

Wheat

A number of recently released varieties were screened in preliminary evaluation trials at Mallala during 2014. These varieties included Axe, Dart, Grenade CL Plus, Mace and Shield, as well as a range of breeder lines yet-to-be released Cosmick (tested as IGW3423), Viking (tested as LPB08-0079) and a durum variety DBA Aurora (tested as UAD0951096). Of the herbicides used in the screening process, diuron + MCPA was found to be the most damaging, with Dart, Viking and Axe incurring significant grain yield reductions (Table 1). As preliminary screening involves the use of double the recommended rates of herbicide, Dart registered narrow safety margins for the application of Amicide 625 and now will be evaluated in the advanced stage of testing. Further studies will now be undertaken to identify the extent of this sensitivity to sulfonylurea herbicides. Numerous other narrow safety margins were identified during 2014; refer to Table 1 for all observed significant yield reductions.

Table 1. Grain yield of wheat varieties with herbicide treatments applied at double the recommended rate in the Preliminary Evaluation trial at Mallala. Yields are expressed as a % of control. Shaded figures indicate a significant yield reduction at the P<0.05 level.

Herbicide >>	Unsprayed Control	Achieve	Affinity Force + MCPA	Ally + MCPA	Amicide 625	Axial	Boxer Gold	Brominil M	Dicamba + MCPA	Diuron + MCPA	Hussar	Sakura	Tigrex
Rates (rate/ha) >>		760g	200mL + 660mL	14g + 660mL	2.8L	500mL	5L	2.8L	400g + 660mL	560g + 500mL	200mL	256g	2L
Timing >>	Yield (t/ha)	3 leaf	3 leaf	3 leaf	2 node	3 leaf	IBS	3 leaf	5 leaf	3 leaf	3 leaf	IBS	5 leaf
Dart	3.31	101	95	93	**91**	94	98	94	97	**76**	99	106	94
Grenade CL Plus	2.73	100	98	96	89	100	100	98	99	94	94	104	96
Cosmick	2.71	105	106	99	100	110	108	98	106	**80**	97	105	93
Viking	2.87	96	97	97	95	103	97	95	96	91	96	107	90
Mace	3.18	93	109	86	93	102	98	93	101	89	102	96	96
Axe	3.27	97	98	95	91	104	103	95	101	**77**	105	112	95
Shield	3.00	100	100	91	92	94	94	102	94	89	91	98	100
DBA Aurora	3.09	94	94	91	99	112	100	93	99	93	101	95	94

In the advanced evaluation trials conducted at Kybunga, Emu Rock was tested for its tolerance to Sakura® (pyroxasulfone) after incurring yield losses in 2013. Trial results from 2014 displayed very few significant effects and Sakura was not observed to affect Emu Rock as witnessed in previous years. Of all the herbicides tested the only interaction was Shield and Ally + MCPA which resulted in a 3% grain yield loss. All other herbicide did not show significant yield losses. This interaction will again be tested in the upcoming season and for all other responses of other current wheat varieties refer to the long-term summaries found on the NVT website.

Barley

Barley grain yields ranged in-between 3-4 t/ha at Mallala in preliminary herbicide screening trials during 2014. Few of the tested varieties were found to suffer reduced yields resulting from herbicide application (Table 2). Compass was found to have incurred an 11-14% yield reduction to Ally + MCPA, Amicide 625, Brominil M and Diuron + MCPA at twice the recommended rate. Hindmarsh also suffered yield losses of 10-16% to Affinity Force + MCPA, Ally + MCPA, Broadstrike and Brominil M applied at the double label rate. Newly released variety La Trobe was found to be more sensitive to Achieve® (tralkoxydim), Affinity Force + MCPA, Amicide 625 and Brominil M with a 10-16% yield decrease when applied at double rate. Further testing of these interactions will now occur during 2015 to identify the severity of these initial sensitivities.

Table 2. Grain yield of barley varieties with herbicide treatments applied at double the recommended rate in the Preliminary Evaluation trial at Mallala. Yields are expressed as a % of control. Shaded figures indicate a significant yield reduction at the P<0.05 level.

Herbicide >>	Unsprayed Control	Achieve	Affinity Force + MCPA	Ally + MCPA	Amicide 625	Axial	Boxer Gold	Broadstrike	Brominil M	Dicamba + MCPA	Diuron + MCPA	Precept	Tigrex
Rates (rate/ha) >>		760g	200mL + 660mL	14g + 660mL	2.8L	500mL	5L	50g	2.8L	400g + 660mL	560g + 500mL	2L	2L
Timing >>	Yield (t/ha)	3 leaf	3 leaf	3 leaf	2 node	3 leaf	IBS	5 leaf	3 leaf	5 leaf	3 leaf	5 leaf	5 leaf
Brewstar	3.39	97	85	96	99	106	96	98	94	108	98	102	97
Commander	3.91	103	94	91	100	97	104	99	93	100	94	96	91
Compass	4.47	103	92	**89**	**86**	106	107	94	**88**	104	**88**	100	99
Hindmarsh	4.02	97	**89**	**86**	99	99	106	**90**	**84**	108	93	92	96
La Trobe	4.15	**90**	**90**	99	**88**	104	115	92	**84**	109	96	100	93
Maltstar	3.81	93	85	87	92	99	98	87	90	100	90	99	93

In the advanced evaluation of barley varieties no significant yield reductions were found in any of the variety and herbicide combinations tested, having previously reported narrow safety margins in the preliminary testing stage. Despite no varietal sensitivity being identified during 2014, it is important to refer to long-term herbicide tolerance summary (located on NVT website) as the degree of herbicide sensitivity can be strongly influenced by seasonal conditions.

Oat

Three oat varieties were evaluated in preliminary trials at Mallala during 2014 and they were Bannister, Potoroo and newly released variety Williams. Of the 12 registered herbicides used in the screening process no significant yield reductions were observed in any of the variety and herbicide combinations tested (Table 3). In the advanced evaluation experiments, no significant yield reductions were found, having previously reported in 2013 trials narrow safety margins in the preliminary testing stage of Wombat to dicamba. Wombat has previously been identified to suffer severe yield reductions from the use of dicamba and further testing will occur with the addition of MCPA 2015 to identify the recurrence of these initial sensitivities. Despite no varietal sensitivity being identified during 2014, it is important to refer to long-term herbicide tolerance summary (located on NVT website) as the degree of herbicide sensitivity can be strongly influenced by seasonal conditions.

Table 3. Grain yield of oat varieties with herbicide treatments applied at double the recommended rate in the Preliminary Evaluation trial at Mallala. Yields are expressed as a % of control. Shaded figures indicate a significant yield reduction at the P<0.05 level.

Herbicide >>	Unsprayed Control	Affinity Force + MCPA	Ally + MCPA	Amicide 625	Boxer Gold	Broadstrike	Brominil M	Conclude	Dicamba + MCPA	Diuron + MCPA	Eclipse + MCPA LVE	Glean	Tigrex
Rates (rate/ha) >>		200mL + 660mL	14g + 660mL	1.6L	5L	50g	2.8L	1.4L	400g + 660mL	560g + 500mL	100mL + 1L	40g	2L
Timing >>	Yield (t/ha)	3 leaf	3 leaf	2 node	IBS	5 leaf	3 leaf	5 leaf	5 leaf	3 leaf	3 leaf	3 leaf	5 leaf
Bannister	3.31	101	103	91	98	96	102	98	103	102	98	102	94
Potoroo	2.88	100	100	89	101	102	108	100	101	93	106	90	85
Williams	2.84	112	95	98	103	85	103	104	102	86	99	105	97

Conclusion and into the paddock

This long running research has identified cereal varieties can differ substantially in their sensitivity to commonly used herbicides when applied at registered label rates and timings. Therefore it becomes important to check the safety of various herbicide and variety combinations prior to sowing and spraying. Long-term summaries should also be used to identify herbicide and crop varietal combinations for potential grain yield penalties, as herbicide tolerance is strongly influenced by seasonal conditions. Information pertaining to varieties, which have been tested in one year only, should be treated with caution pending further trials over multiple growing seasons as environmental conditions can strongly influence herbicide interactions. Long-term summaries of herbicide tolerance testing for all crops can be found online from the NVT website www.nvtonline.com.au

Acknowledgements

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Massive gene amplification of the target enzyme provides great brome with resistance to glyphosate

Jenna Malone, Peter Boutsalis, Sarah Morran and Christopher Preston

University of Adelaide, School of Agriculture Food and Wine

Great brome (*Bromus diandrus*) with resistance to glyphosate was first identified on the Yorke Peninsula in SA in 2011 and Victoria in 2012 (Figure 1). The first two populations came from old fence lines that had been taken out and cropped over. Since then 3 more populations with resistance to glyphosate have been identified in SA and Victoria. In order to better understand why glyphosate resistance occurs, we have been investigating the mechanism of glyphosate resistance in brome. Brome is a particularly important weed as it is expanding in importance in South Australia and resistance to Group A and B herbicides is increasing.

Figure 1. Two resistant (back two rows) and 1 susceptible population (front row) of brome treated with 0, 0.25 L/ha, 0.5 L/ha, 1 L/ha, 2 L/ha and 4 L/ha of Roundup UltraMax herbicide.

Glyphosate resistance is interesting in that weed species have found numerous ways to avoid being killed by glyphosate. There are lots of questions about why specific mechanisms are found in specific weed species.

Our studies have identified the mechanism of resistance in two glyphosate resistant brome populations, one from SA and one from Victoria, to be *EPSPS* gene amplification, the first reported case of an Australian weed species having this recently identified mechanism of resistance. The resistant brome has an average of 30 fold more copies of the *EPSPS* gene (Figure 2) and this amplification leads to increased production of the EPSPS enzyme, the target of glyphosate, which overcomes glyphosate action, conferring resistance.

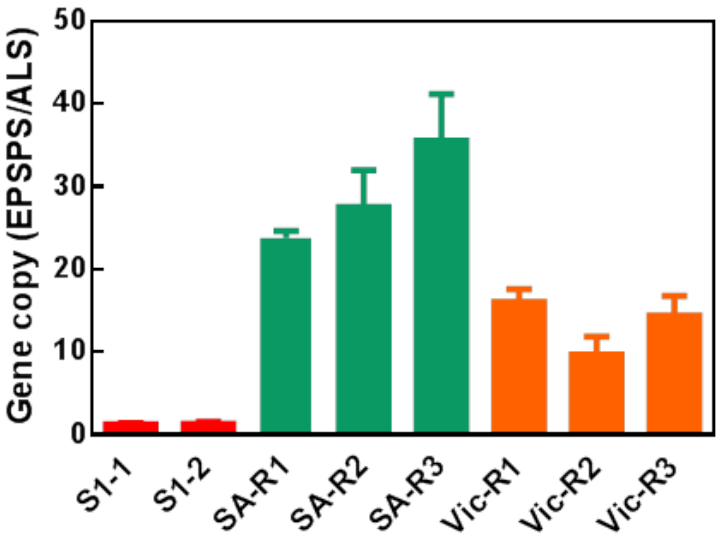

Figure 2. Number of copies of the *EPSPS* target enzyme gene compared with the number of copies of the *ALS* gene in 2 susceptible individuals (S1-1, S1-2) and 3 resistant individuals from each of the SA and Vic resistant populations.

Further work is underway to investigate how this gene amplification occurs and what is controlling it genetically. Initial results have found that only one of the four *EPSPS* alleles in brome is amplified in resistant plants. It is hoped that the whole genome sequencing that has been performed will be able to identify the genetic elements involved in the amplification process.

Investigation into the inheritance of glyphosate resistance in brome found no segregation in the F_2 generation. Every F_2 individual was resistant to the herbicide, and all contained an elevated copy number for *EPSPS* (Figure 3). This unusual inheritance pattern has some implications for management of this type of resistance. Firstly, it means that a high gene copy number will quickly move through populations, as all progeny from a cross with a susceptible plant will be resistant. This is less of an issue for a self-pollinated species, such as *B. diandrus*, but an outcrossing species with this type of resistance will prove problematic to manage.

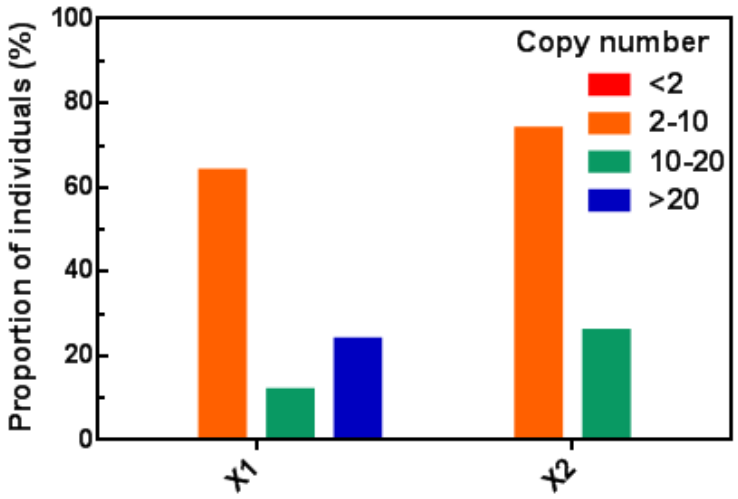

Figure 3. *EPSPS* gene copy number in segregating F_2 individuals from two hand-crosses between resistant and susceptible brome plants. All of the F_2 plants tested contained more than twice as many copies of the *EPSPS* gene compared to the susceptible parent.

This example has demonstrated that intense selection with herbicide will provide an advantage to any individual that is able to tolerate the herbicide, no matter how poorly. The use of glyphosate in areas like fence lines, because it results in bare ground and no competition, allows survivors to set a lot of seed. This may help explain why there are so many different ways that weeds become resistant to this herbicide.

This research was funded by the Grains Research and Development Corporation (Grant UA00124) and the Yitpi Foundation.

Tony Rathjen Student Contribution Award

The Tony Rathjen Student Contribution award has been created by the SA Crop Science Society in memory of the late Professor Tony Rathjen. Tony was a founding member of the Crop Science Society and believed strongly in a vibrant interaction between researchers and farmers. The Crop Science Society is centred around a monthly newsletter and meeting, which brings the broad agricultural community together for the dissemination of relevant new research, technical advice and emerging issues involved with crop production. During his long career, Tony was an influential mentor to many students and greatly encouraged innovative thinking and student participation in the debate of agricultural issues. The Tony Rathjen award is designed to encourage students to present their research in a media that is immediately accessible to farmers, as well as to continue his legacy of student participation in the Crop Science Society and the agricultural community.

- Students are encouraged to prepare an article for the Crop Science Society Newsletter highlighting their research. All articles published in monthly newsletters will receive $100.
- The recipient of the main Tony Rathjen Student Contribution will be decided in December. The student who prepared the best article that highlights excellent agricultural research combined with innovative thinking will be awarded $500. The recipient will present their research at a Crop Science Society meeting.

Application process:

- Eligibility - anyone studying, undertaking a Honours, Masters, PhD or any research project related to agriculture
- Applicants are required to prepare an article of 2-3 pages using plain English and suitable for a farming audience. Articles can then be emailed to kenton.porker@adelaide.edu.au
- Each article will be reviewed and assessed on merit by the President, editor and members of the Crop Science Society sub-committee and will normally be limited to 8-10 articles per year, depending on the quality of publications.

Guidelines for article:

Topic Title

Author, location and contact email

Why do this research?

Please make this a brief introduction to your topic in plain English and free from scientific jargon that addresses the following broad questions

- *What is this aim of this research (ie how may this benefit farmers, how does my topic fit into crop production at the farm level),*
- *What are the main research problems/questions that need addressing*

What and how am I doing the research

Avoid detailed methodology please briefly outline your approach to this research (ie this could be as simple as , in order to identify key traits involved with salt tolerance in wheat I am using a diverse set of wheat germplasm that will be grown across a series of glasshouse and field trials containing different salt gradients)

What have you found?

This section should include any key observations or results from your research. Figures, photos, and tables are all welcome in this section. **Commentary, discussion and conclusion**

Tony Rathjen Grower Award

During his long career, Tony was highly engaged with the farming community, and spent many hours listening and talking to farmers from many different areas to gain their perspective and explore current issues. Tony believed in the value of farming community as instrumental in the development of new varieties and technologies. The Tony Rathjen award is designed to encourage growers and members of the farming community to present interesting commentaries, research or new technologies relevant to current farming.

- **Growers are encouraged to contribute articles that highlight innovative perspectives on modern farming, with the best to be awarded $500. The winner will present at a Crop Science Society meeting.**

Application process:

- Eligibility - any grower.
- Applicants are required to prepare an article of 2-3 pages of text, photos and/or figures. Articles can then be emailed to juditrat@yahoo.com (Judy Rathjen).
- Each article will be reviewed and assessed on merit by the President, editor and members of the Crop Science Society sub-committee.

HART FIELD DAY

Sept 15th 2015

HART
SA's premier cropping field site

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PROGRAM HIGHLIGHTS

New fungicides & barley disease management
Nick Poole, Foundation Arable Research

Improving canola crop establishment with time of sowing, seed depth & size
Rohan Brill, NSW DPI

Public perceptions of agriculture – what influences consumer choice
Heather Bray, University of Adelaide

Bean agronomy: matching variety with sowing time
Jeff Paull, University of Adelaide & Christine Walela, SARDI

Seeding into stubble, pre-emergent herbicides and crop safety
Gurjeet Gill, University of Adelaide

Variety updates, agronomy, soil pH mapping and much more…

20 sessions in total

www.hartfieldsite.org.au