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Next Meeting	**'Eye on the Weather'**
Venue	**Richardson Theatre, Roseworthy Campus**
Date	**WEDNESDAY 18th MARCH**
Time	**7.30 pm**

Darren Ray: Senior Meteorologist/Climatologist - South Australian Regional Climate Services, Bureau of Meteorology

Darren is an experienced meteorologist who at a meeting last June, when we all thought the rain was never going to stop, very accurately predicted the then upcoming dry spring that we experienced. Darren will talk about forecasts for the 2015 season and new weather related information.

Marg Evans: Plant Pathologist – SARDI

Marg will be covering some very topical information on the cereal diseases Crown Rot & Eye spot, including yield results from last season's crown rot trials and cover varietal difference in susceptibility to both eyespot and crown rot.

Sowing Strategies to Improve Productivity on Sandy Mallee Soils

Therese McBeath[1], Bill Davoren[1], Vadakattu Gupta[1], Rick Llewellyn[1]
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Variable productivity on Mallee soil types has been linked to poor crop establishment. In turn this poor crop establishment has been related to the availability of water to the emerging crop, the management and positional availability of nutrients, disease pressure in the early phase of crop establishment and competition with grass weeds. As growers move towards earlier sowing dates, crops are often being sown on marginal early soil moisture. This trial looks at whether the potential benefits of sowing on last year's crop row to harvest any extra water and nutrition can outweigh risks of increased disease pressure and lead to better crop performance on Mallee soil types.

Key Messages

- There were no measurable differences in 2014 wheat yield in response to two different sowing dates and sowing on-row vs. inter-row.
- On the sandy soil type, there was more plant available water (PAW) in the top 10cm when sowing on-row.
- Rhizoctonia inoculum was higher with on-row compared to inter-row sowing but this did not carry through to an effect on rhizoctonia infection in the crop.
- In a season where the profile PAW was similar for the two sowing dates (April 30 and May 14) crop establishment was better with the earlier time of sowing but ryegrass pressure on the swale was also higher with the earlier time of sowing.

About the trial

The trial was established in 2014 on a paddock that had been under continuous cereal for several years. Treatments were repeated on the sandy dunes soil and the heavier swale type soil. Corack wheat was sown at 70 kg/ha with 50 kg/ha DAP and 24 kg/ha Urea applied below the seed. In addition 33 kg/ha of potassium sulfate was applied pre-seeding to avoid deficiencies of potassium or sulfur and a trace element spray including zinc, copper and manganese was applied at early tillering. All crop row spacings were 28 cm.

Table 1. Treatments for the Sowing Strategies trial

Treat	Time of Sowing	Row Position
1	30th April	On –row
2	30th April	Inter-row
3	14th May	On –row
4	14th May	Inter-row

Results

Nutrition and Water

Soil mineral N measured in late April was not significantly different when sampled on-row compared to inter-row. However, as shown in Table 2 there was a high level of variation about the values measured both in the top 0.1m and for mineral N summed over the top metre of the soil profile.

Table 2. Pre-seeding 2014 mineral nitrogen (kg/ha) ± standard error from soil cores taken on last year's crop rows (on-row) and between last year's crop rows (inter-row).

Soil	Row Position	Mineral N (kg/ha/0.1m)	Mineral N (kg/ha/m)
Dune	On-row	11±2	44±1
	Inter-row	8±2	34±6
Swale	On-row	32±5	125±15
	Inter-row	27±7	118±8

Profile PAW was measured prior to the sowing dates in late April and mid-May. Conditions were quite similar for the two sowing dates and the only significant difference was in the dune at the time of the April sowing where there was significantly more PAW in the top 0.1m on-row compared to inter-row (P<0.05, LSD 1.5, Table 3).

Table 3. Pre-seeding 2014 plant available water (PAW) ± standard error from soil cores taken on last year's crop rows (on-row) and between last year's crop rows (inter-row).

		April Sowing		May Sowing	
Soil	Row Position	PAW (mm/0.1 m)	PAW (mm/m)	PAW (mm/0.1 m)	PAW (mm/m)
Dune	On-row	4.1±0.6	87.0±12.7	4.5±1.2	85.1±10.2
	Inter-row	1.7±0.5	70.5±10.8	1.1±0.4	81.1±7.1
Swale	On-row	17.5±2.3	91.8±27.9	12.1±1.6	127.8±33.9
	Inter-row	18.2±2.2	110.7±41.3	11.9±1.3	87.8±20.5

Disease

Inoculum levels for soil borne pathogens (Takeall (Ggt) and Fusarium) at seeding were generally higher on-row compared to inter-row (Figure 1 and Table 4). Rhizoctonia inoculum (*Rhizoctonia solani* AG8) levels were not different between on-row and inter-row as it forms hyphal networks whereas the other diseases are more closely associated with decomposing stubble material.

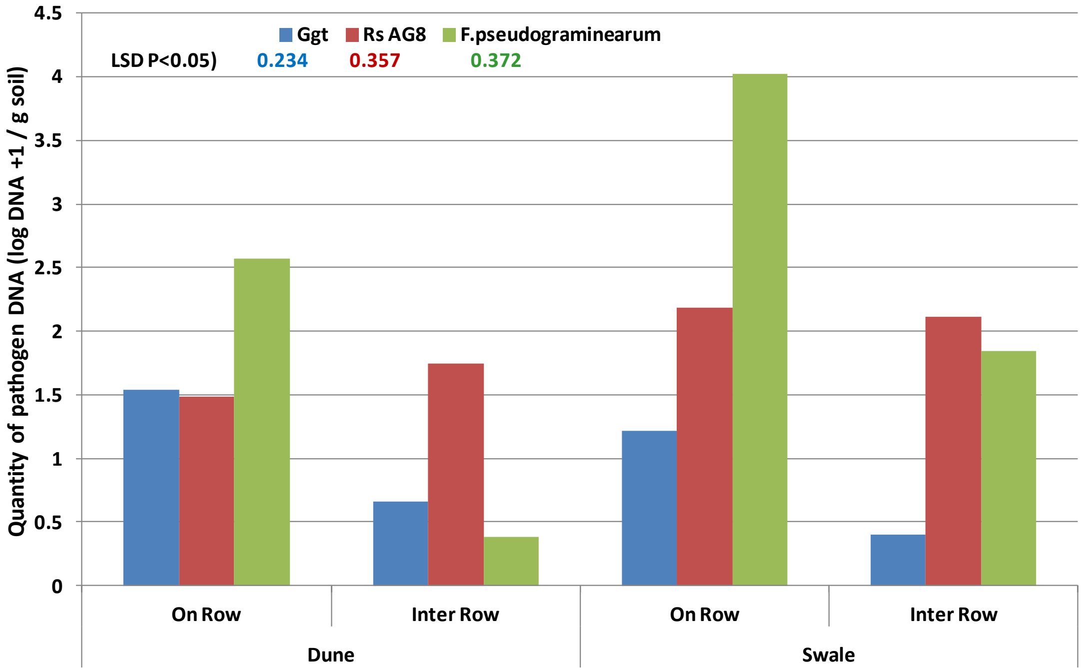

Figure 1. Disease inoculum levels for Takeall (Ggt), Fusarium (F. pseudograminearum) and Rhizoctonia (RsAG8) in soil on last year's crop rows and in the inter-row.

Table 4. Disease risk ratings Takeall (Ggt), Fusarium (F. pseudograminearum) and Rhizoctonia (RsAG8) in soil on last year's crop rows and in the inter-row.

Location		*Ggt*	*Rs AG8*	*F.pseudograminearum*
Dune	**On Row**	Medium	Medium	Med-High
	Inter Row	BDL	Medium	BDL
Swale	**On Row**	Medium	High	High
	Inter Row	BDL	High	Low

*BDL = Below Detection Level

Root disease scores for rhizoctonia at 8 weeks after seeding were significantly higher on the dune compared with the swale but no significant difference between on row and inter-row were found (Figure 2).

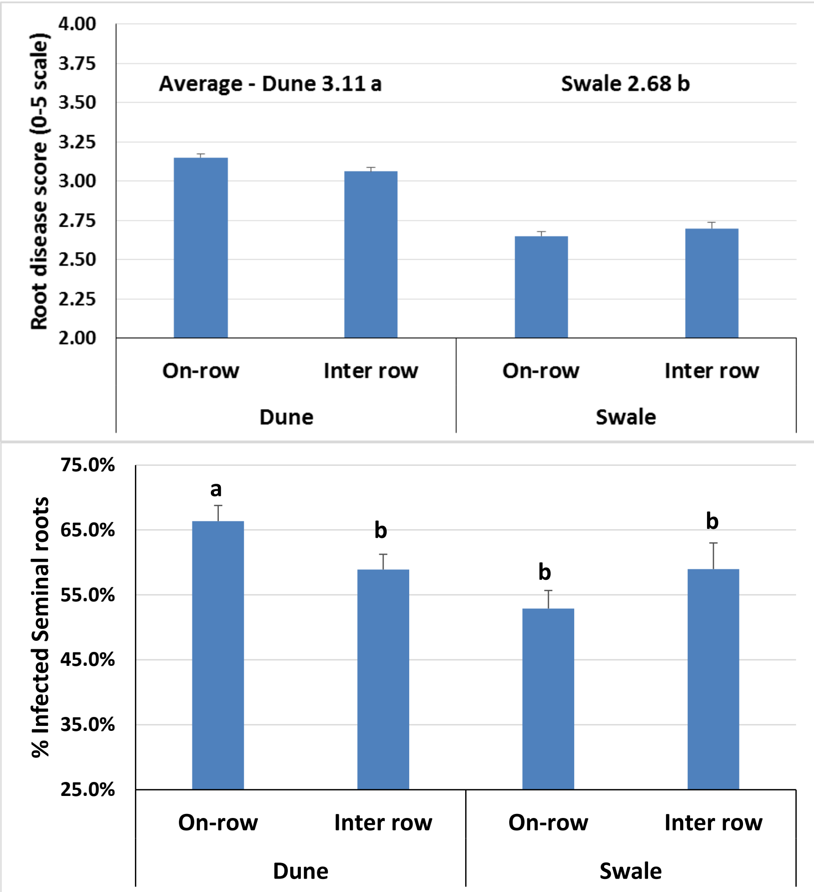

Figure 2. Rhizoctonia root rot incidence for wheat plants sown on last year's crop rows and between last year's crop rows. The higher the score the greater the level of disease impact on crop roots; Treatments followed by different letters are significantly different at LSD P<0.05.

Crop Establishment

Crop emergence was significantly better following the April sowing date compared with May on both soil types, while there was no difference between the sowing row positions (Table5).

Table 5. Crop emergence (plants/m^2) in response to sowing date and row position. Within a soil, emergence appended by a different letter is significantly different.

Soil	Row Position	April Sowing	May Sowing
Dune	On-row	82	59
	Inter-row	68	51
	Mean (P<0.05, LSD 15)	75[a]	55[b]
Swale	On-row	110	83
	Inter-row	113	79
	Mean (P<0.05, LSD 10)	112[a]	81[b]

Weeds

Grass weeds were monitored at three points in the growing season using fixed monitoring points in four replicate plots for each treatment. The position of the sowing row did not have a significant effect on the population density of rye or brome grass. Early sowing in April did result in a higher rye grass population compared with May sowing on the swale at the two sampling times that occurred before application of hoegrass®(Table 6).

Table 6. Rye and brome grass populations (plants/m^2) counted at fixed sampling points at three times during the growing season. Where a mean rye count is appended by a different letter, the sowing date had a significant effect on the rye grass population ($P<0.05$).

Soil	Treatment	Count 1-30DAS*		Count 2-45DAS		Count 3-90DAS[#]	
		Brome	Rye	Brome	Rye	Brome	Rye
Dune	April Sowing						
	On-row	2.7	0.2	2.7	0.2	5.8	0.0
	Inter-row	8.6	0.0	12.8	0.6	8.6	0.0
	May Sowing						
	On-row	0.2	0.0	2.5	0.0	1.6	0.0
	Inter-row	4.0	0.7	0.7	0.0	6.0	0.0
Swale	April Sowing						
	On-row	0.0	14.3	0.0	15.2	0.0	0.5
	Inter-row	0.0	11.0	0.0	15.2	0.0	0.0
	Mean		12.7[a]		15.2[a]		
	May Sowing						
	On-row	0.0	5.5	0.0	3.3	0.0	0.7
	Inter-row	0.0	4.7	0.0	6.9	0.0	1.1
	Mean		5.1[b]		5.1[b]		

[*]DAS, days after sowing [#]Post-application of hoegrass® herbicide to control ryegrass.

As there were no surviving ryegrass plants within the fixed sampling points, only brome grass was destructively harvested at crop maturity in order to measure the brome grass plant density and seed production. Both the plant density and seed production showed a response to sowing row position ($P<0.05$) with significantly more plants following inter-row sowing compared with on-row sowing (64 vs 14 plants/m^2) and as a result significantly more seeds following inter-row sowing (1859 vs 389 seeds/m^2) (Table 7).

Table 7. Plant density (plants/m^2), total seed production (seeds/m^2), and plant seed production (seeds/plant) ± standard error of brome grass at maturity.

		Plant density (plants/m^2)	Seed density (seeds/m^2)	Plant seed production (seeds/plant)
April sowing	On row	21±10	579±317	24±5
	Inter row	70±41	1925±1183	27±3
May sowing	On row	7±4	199±147	26±5
	Inter row	58±33	1793±1062	30±1

Crop Productivity

No differences between treatments were measured at tillering or anthesis and the data is not shown. In addition there were no treatment effects on grain yield or protein in the 2014 growing season (Table 8).

Table 8. Mean grain yield (t/ha) and protein (%) ± standard error in response to sowing date and sowing row position.

		April Sowing		May Sowing	
Soil	Row Position	Yield (t/ha)	Protein (%)	Yield (t/ha)	Protein (%)
Dune	On-row	1.34±0.03	9.8±0.3	1.34±0.1	9.8±0.2
	Inter-row	1.43±0.2	9.8±0.2	1.39±0.1	9.5±0.2
Swale	On-row	2.23±0.1	11.0±0.2	2.01±0.1	11.3±0.2
	Inter-row	2.07±0.1	11.0±0.3	2.05±0.1	10.9±0.2

Implications for commercial practice

- There were measurable effects of time of sowing on ryegrass populations, with earlier sowing resulting in poorer control on the swale but better crop establishment on both the dune and swale.
- There were measurable effects of sowing row position on soil moisture (more on-row in the dune), disease (more on-row) and weeds (more brome grass inter-row in the dune).
- These effects did not translate into a yield effect in 2014.

Acknowledgements

Thanks to the Loller family for their generous support in hosting the trial, to Jeff Braun for monitoring and advising on trial agronomy. Funding for this work was from the Stubble Retention initiative (Project MSF00003) and the CSIRO Agriculture Flagship.

Optimising the Impact of Glyphosate

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Take home messages

- Glyphosate resistance is occurring in new weed species. Over 500 cases of glyphosate resistant ryegrass have been confirmed in Australia; 78 in Victoria.
- Glyphosate resistance results in reduced efficacy of glyphosate and is dependent on the mechanism of resistance.
- Stressed weeds, poor coverage, poor water quality or dust covered plants can reduce the efficacy of glyphosate.
- Glyphosate efficacy is greater on younger plants and under cooler conditions.
- Using maximum label rates of glyphosate can help overcome factors that may otherwise result in sub-optimum control.
- If glyphosate is used annually or if resistance testing confirms survivors are glyphosate resistant, seed-set control should be implemented to prevent build-up of glyphosate resistant seedbank .
- Resistant testing is recommended to establish if higher rates could be effective.

Glyphosate resistant weed species on the rise

Nationally, the number of species and individual cases of confirmed glyphosate resistance continues to increase. Resistance in new species such as sowthistle and wild radish is of particular concern for Victoria. In Victoria, 78 ryegrass, 6 windmill grass and 2 brome populations have been confirmed resistant to glyphosate. A prickly lettuce population from the Wimmera is also suspected to be resistant.

Table 1: Current status of glyphosate resistance in Australia.

Weed species	Year first documented	Nr of confirmed cases
Annual ryegrass (*Lolium rigidum*)	1996	574
Barnyard grass (*Echinochloa colona*)	2007	98
Liverseed grass (*Urochloa panicoides*)	2008	4
Fleabane (*Conyza bonariensis*)	2010	58
Windmill grass (*Chloris truncata*)	2010	11
Great brome (*Bromus diandrus*)	2011	5
Wild radish (*Raphanus raphanistrum*)	2013	2
Sowthistle (*Sonchus oleraceus*)	2014	4
Red brome (*Bromus rubens*)	2014	1

Table courtesy of the Dr C Preston, Glyphosate Sustainability Working Group

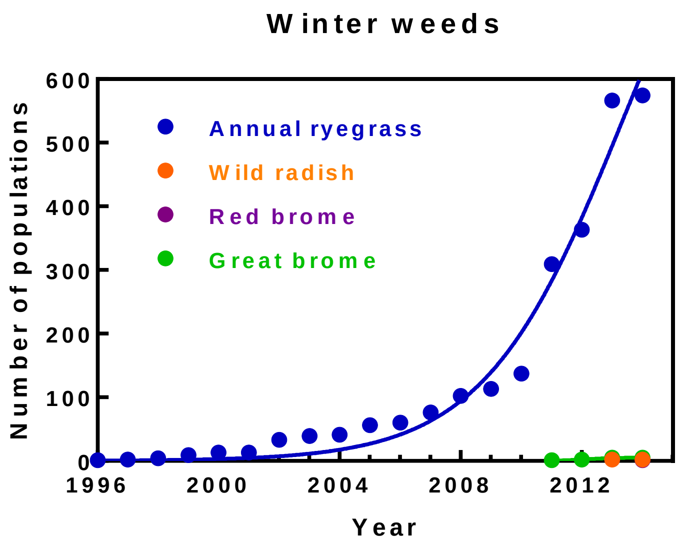

Figure 1: The increase in confirmed cases of glyphosate resistance in winter weeds between 1996 and 2014

Most cases of glyphosate resistant ryegrass come from samples where weed control had been ineffective. Additionally, in a random weed survey conducted by the University of Adelaide in south-eastern Australia in 2013, 16% of the samples were glyphosate resistant. Identification of such high levels of resistance is a serious concern.

Table 2. Glyphosate resistant annual ryegrass has occurred in the following situations:

Situation		Number of sites	States
Broadacre cropping	Chemical fallow	32	NSW
	Winter grains	295	Vic, SA, WA, NSW
	Summer grains	1	NSW
	Irrigated crops	1	SA
Horticulture	Tree crops	10	NSW, SA
	Vine crops	25	SA, WA
	Vegetables	2	Vic
Other	Driveway	5	NSW, Vic, SA, WA
	Fence line /Crop margin	89	NSW, SA, Vic, WA
	Around buildings	2	NSW
	Irrigation channel /Drain	14	NSW, SA, Vic
	Airstrip	1	SA
	Railway	2	WA, NSW
	Roadside	95	SA, NSW, WA

Table courtesy of the Dr C Preston, Glyphosate Sustainability Working Group

Reduced efficacy of glyphosate

There are numerous reasons for the poor performance of glyphosate, a common one being herbicide resistance. Resistance to glyphosate can range from weak resistance to strong resistance. Plants with weak resistance may be controlled with higher label rates, but this strategy should not be overused because weeds can develop resistance to very high rates. One Victorian roadside population has survived 20L/ha glyphosate in pot trials.

Table 3. Percent survival (%) of a selection of grower resistance tests from 2013 and 2014 treated with Glyphosate (540g ai/L). Data ranked according to percent survival at 1000ml/ha.

2013		Glyphosate 540 (ml/ha)			2014		Glyphosate 540 (ml/ha)		
Town	**State**	**1000**	**1500**	**2000**	**Town**	**State**	**1000**	**1500**	**2000**
Wagin	WA	5	0	0	Cowangie	Vic	5	5	0
Yendon	NSW	5	5	0	Hopetoun	Vic	5	5	0
Griffith	NSW	5	5	5	Birchip	Vic	10	0	0
Dowerin	WA	5	0	0	Bannockburn	Vic	10	5	0
Lake Grace	WA	10	0	0	Dubbo	NSW	10	10	5
Yendon	NSW	20	20	0	Deniliquin	Vic	15	5	0
Yendon	NSW	20	0	0	Berriwillock	Vic	15	0	0
Deniliquin	NSW	20	5	0	Donald	Vic	20	0	0
Temora	NSW	20	5	0	Burra	SA	25	25	10
Goomalling	WA	20	0	0	Cobram	Vic	30	20	0
Goomalling	WA	20	20	0	Birchip	Vic	30	10	5
Calingirri	WA	20	0	0	Hopetoun	Vic	30	0	0
Griffith	NSW	20	5	5	Hopetoun	Vic	50	20	20
Griffith	NSW	25	0	0	Bannockburn	Vic	50	5	5
Yendon	NSW	40	20	0	Dubbo	NSW	50	0	0
Badgingarra	WA	50	5	0	Donald	Vic	50	50	50
Griffith	NSW	55	5	5	Jerrumungup	WA	60	0	0
Ballidu	WA	80	70	70	Monarto	SA	90	70	40
Griffith	NSW	80	60	0	Quambatook	Vic	90	5	0
Nhill	Vic	80	80	5	Echuca	Vic	100	0	0
Naracoorte	SA	90	55	0	Bannockburn	Vic	100	0	0
Calingirri	WA	100	90	90	Elmore	Vic	100	10	0

Data courtesy of P. Boutsalis, Plant Science Consulting

Glyphosate is usually absorbed within 24 h of application and moves readily in the phloem of actively growing plants. Application of glyphosate in the morning can result in greater uptake than application at night. Greater glyphosate activity is usually observed in actively growing young plants. On larger plants, higher rates are required to maintain good efficacy. Herbicide uptake can be restricted when plants are stressed. Factors that can cause stress include frost, moisture (drought or waterlogging), temperature, nutrition and pest damage. Pot trials have shown that glyphosate activity is often reduced as ambient temperature increases. In ryegrass it has been observed that the optimum daily temperatures for glyphosate activity range between the low teens and mid-twenties. These findings have been observed in unstressed 2-3 leaved ryegrass growing in pots.

Factors that limit the contact of glyphosate with a target weed include poor coverage (water rates, nozzle selection, applying on very dense populations or wet leaves), poor water quality or application onto dust covered plants. Glyphosate is readily bound to soil particles present as dust or in dirty water.

Applying glyphosate on herbicide resistant weeds that are stressed or exposed to sub-optimum herbicide concentrations (reduced coverage, dust etc) can result in poor control. Combinations of factors that reduce glyphosate efficacy on plants with weak resistance mechanism can exacerbate the resistance response. Testing for glyphosate resistance using either seed or plants (Quick-Test) can aid in making future weed control decisions. A test can highlight the presence of weak glyphosate resistance mechanisms and if higher rates could be effective under ideal conditions. The identification of strong resistance can aid in convincing growers to adopt alternative strategies to combat the problem.

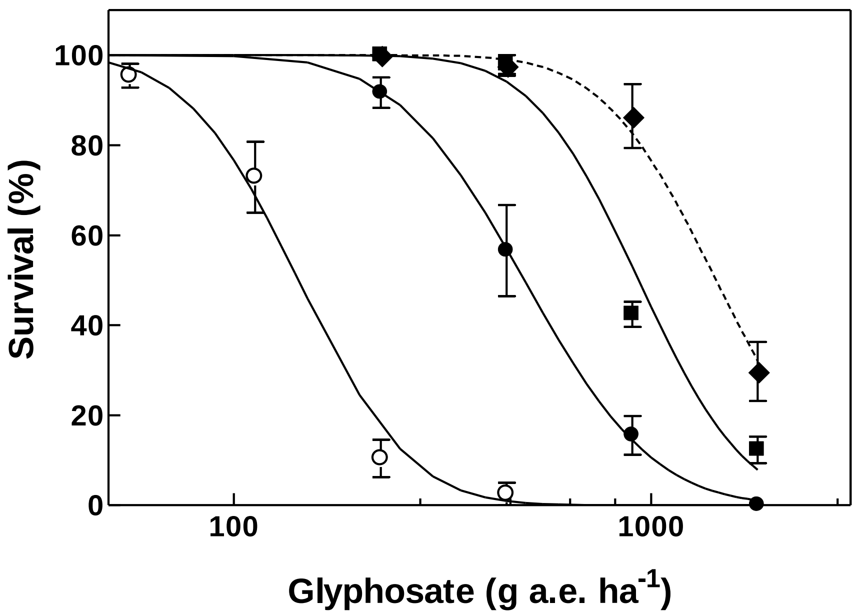

Figure 2: Glyphosate resistance mechanisms are additive. Dose response of ryegrass populations with a target site mutation, SLR 77, (●), the translocation resistance mechanism, NLR 70, (■), and the F_1 cross between SLR 77 and NLR 70 (♦) compared with the susceptible population VLR1 (○).

Improving glyphosate efficacy

Using higher label rates can often improve weed control. Weeds with weak glyphosate resistance mechanisms can often be killed with higher label rates. Additionally, higher rates can help counteract poor application, improve control of older plants, stressed plants or overcome reduced efficacy caused by using poor quality water or treating plants covered by dust. Higher label rates can also improve glyphosate activity of plants exposed to higher temperatures that can arise in early autumn or late spring.

Research has shown that although glyphosate resistant weeds are resistant at all growth stages, seedlings are more sensitive than multi-tillered plants. Numerous trials have shown that herbicide resistant weeds are often killed or heavily damaged if treated at the seedling stage. A common strategy by some growers is to delay application of glyphosate to maximise germination from the seedbank in order to 'treat all the weeds'. This strategy can be effective if the weeds are not herbicide resistant or stressed. However, reduced control of older plants that are herbicide resistant can occur if rates are not sufficiently high or weeds are stressed. In weed species that exhibit staggered germination such as brome, wild oats and wild radish, multiple herbicide timings are recommended. The type of resistance mechanism(s) present and more importantly the level of resistance it confers can also influence glyphosate efficacy.

For more information on herbicide resistance testing visit

Plant Science Consulting: www.plantscienceconsulting.com.au

- herbicide resistance seed & Quick testing
- crop quality testing

Charles Sturt University: www.csu.edu.au/research/grahamcentre

- herbicide resistance seed testing

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A cover crop is simply a crop that is planted between periods of regular crop production. The proposed benefit of cover crops is to reduce soil erosion, increase organic matter, provide supplemental grazing opportunities, recycle nutrients, fix atmospheric nitrogen, reduce compaction, and improve water infiltration, by growing a mixture of different plant species after harvest. There is little known about the potential for this practice in dryland agriculture regions of SA in particular. The main issue is the trade-off between soil protection and the water use of the cover crop, which will use stored and accumulated water over the summer period, thereby leaving less moisture in the soil profile before seeding - Editors

2015 Cover Crop Trial Eudunda as part of a SANTFA project.

Aim to see if Covers in a mix will grow, and what happens when they do and through the use of soil moisture probes the impact on soil moisture through the growing period on sown and unsown area.

- Sown dry into hay oats stubble on Wednesday 7th January 2015
- 65mm over the following 5 days.
- Very little since.
- SMP showed no available moisture at sowing
- A mix of species sown to a rate of 18kg/ha including Sunflowers, Safflower, Mung Beans, Lab Lab and Cowpea.
- Nil Fert or inoculation to legumes.

Date 3/2/15

Date 15/1/15

Date 19/2/15 moisture from 75 cm

Date 4/3/15, SMP showing moisture being drawn below 85 cm