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INCORPORATING THE WEED SCIENCE SOCIETY

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Next Meeting	**'Exciting Trial Results'**
Venue	**Richardson Theatre, Roseworthy Campus**
Date	**WEDNESDAY 17th APRIL**
Time	**7.30 pm**

Speakers

Craig Davis: AW Vater & Co

Craig will discuss results from his trials, as well as moisture modeling and some foliar P results.

Sarah Noack: Hart Trial Site Manager

Sarah will talk on her PhD work which includes soil P uptake and stubble management

Paul Bogacki: SARDI – "New fungicides for Rhizoctonia control"

Paul has some interesting results from trials which used new seed dressings Vibrance and EverGol Prime to suppress Rhizoctonia.

Editorial – Discs or Tynes?

Our most important changes in cropping technology usually have their origins in astute observations by those actually on the spot - farmers. So the original observations of herbicide resistance were at Bordertown by Robert Mock. Intense efforts towards the control of Cereal Cyst Nematode (CCN) followed an amazing demonstration near Paskerville of the effect on growth of wheat following a crop of CCN-resistant Festiguay in the previous year. And continuing interest in subsoil constraints followed the widespread observations by many farmers of the superior adaptation of the old variety Halberd compared with the potentially higher yielding semi-dwarf varieties.

So many of our new and most interesting observations of moisture conditions and crop yields in heavy, tall stubbles are coming from the group at Mallala - Paul Lush, Ashley Robinson and, I suspect others. These heavy, tall stubbles can only be handled by disc seeders. Plant-water relations promises to be the major topic for the foreseeable future.

I was fortunate to see an excellent comparison between tynes and discs in the Wakerie district on the students' tour last year and in the subsequent TV documentary. Under those managed conditions and environment it seemed to me the tyned machines were clearly superior. Paul and his colleagues are, however, concerned with an entirely different management system involving the retention of stubble.

Our understanding of crop water relations did not attract much attention until recently when a few, with commendable initiative, installed soil moisture meters. Along the way, however, there have been some very astute observations. Ray Fisher commented many years ago on the disappointing outcome from a dry spring that "there weren't any fogs or dews to sap up the stems". And at a fascinating meeting somewhere near Robinvale in NSW a farmer remarked that if one were to go out at midnight on a dewy night with a torch a ring of wet soil would be seen around the base of the plants. In a heavy fog east of Mt Pleasant, and having to go back after forgetting something, I realised that I switched the windscreen wipers each time under large pine trees - the road under the trees was wet but dry elsewhere. Most recently Clyde Hazel made some most interesting comments on maturing barley crops in circumstances like those of last spring.

We need a better understanding on the mostly good cropping outcomes last year which occurred despite the lack of rainfall and soils being dry to about half a metre (see Alison Millar's article in the last newsletter).

No doubt the tall, stripped stubble of our Mallala group both shades the soil surface and, perhaps at least as importantly, reduces wind speed and thereby evaporation. But we do not know whether more water is collected by the stubbles and there are some really significant observations on the wetting of soil at depth. So we have important questions regarding the hydraulic conductivity of old root lines. Hmm!

We have been running historical articles not only for their intrinsic interest but because there is, coincidentally, illumination from these articles on the discs vs tynes debate. Much of the landscape at the time of settlement by Europeans was often, at least in higher rainfall districts, compared with an 'English Park' with scattered trees and an understorey of Kangaroo Grass nearly a metre tall. A spectacular landscape like this is described in Bill Gammage's book. The landscape was much wetter then - remember Millie Nicholls' and Marcus Cooling's articles? What lessons can we draw from this?

As we move into autumn and with an increasing frequency of dewy nights, but soils dry at depth, what can we expect for this year?

Disc seeders & pre-emergence herbicides

Sam Kleemann[1], Jack Desbiolles[2], Gurjeet Gill[1] & Chris Preston[1]
[1] University of Adelaide, [2]Agricultural Machinery Group, University of South Australia

An increasing proportion of no-till farmers are making the transition to disc-based zero-till cropping. Disc seeding systems can create significantly less soil disturbance than narrow-point seeding systems, enable greater residue retention, allow faster sowing and can result in more uniform crop establishment (Desbiolles, 2011). However, due to crop safety concerns most pre-emergent herbicides are not registered for use with disc seeders. Even where herbicide labels do not specifically prohibit use with disc seeders, chemical companies will often not support their use with disc seeding equipment, due to lack of reliable results and some limited understanding of the processes involved in securing crop safety. A situation complicated further by the huge range of disc seeding system technology available which can differ enormously in both the level and type of soil disturbance they create.

Herbicide safety at sowing is often obtained by creating "positional selectivity", that is the physical separation of seed and herbicide. Under high soil disturbance, knife-point and press wheel systems, a satisfactory separation and good crop safety are typically achieved with herbicide treated surface soil thrown clear of the furrow onto the inter-row, especially under a controlled speed of sowing. However, disc seeding systems present a different challenge, with often a lack of adequate separation between the herbicide and germinating seedlings resulting in a significant risk of crop damage.

The movement of herbicide treated surface soil and the physical herbicide incorporation can vary greatly with different disc seeders and configurations, and this can also affect the efficacy of volatile pre-emergence herbicides such as trifluralin and pendimethalin. These herbicides require mechanical incorporation with soil throw at seeding to reduce losses from sunlight degradation and volatilisation. In contrast, new pre-emergence herbicides Boxer Gold® and Sakura® have low volatility and are much more stable in the soil. However, little is known of the behaviour of these new pre-emergence herbicides under disc systems.

Consequently field trials have been undertaken over the past 5 years at the University of Adelaide's Roseworthy Campus, to investigate the behaviour of pre-emergence herbicides with disc seeders. More specifically the range of trials have been designed to evaluate the effect of different seeding systems on pre-emergence herbicide control of annual ryegrass and their phytotoxicity to wheat. The systems evaluated over the period have included: KHart and Bertini triple discs, Austil (MT3500 series), John Deere (90 series), NDF (650 series) and DayBreak (Duodec) single discs, and a double shoot (DS) knife-point and press wheel system.

In these field trials, wheat seedling establishment was consistently affected by the interaction between herbicides and seeding system (Figure 1). Trifluralin significantly reduced wheat emergence under single discs (37 to 64%), whereas little or no reduction in wheat density was recorded for the DS knife-point system (≤23%). Boxer Gold also reduced wheat establishment with single discs, however the level of damage was far more variable and ranged between 8 to 56%. This variation in damage with Boxer Gold was probably related to post-sowing rainfall which may have influenced the movement and concentration of this soluble herbicide in and around the crop root zone. In contrast, no crop damage was observed for Sakura, which appears to be the safest pre-emergent option for use in wheat sown with discs.

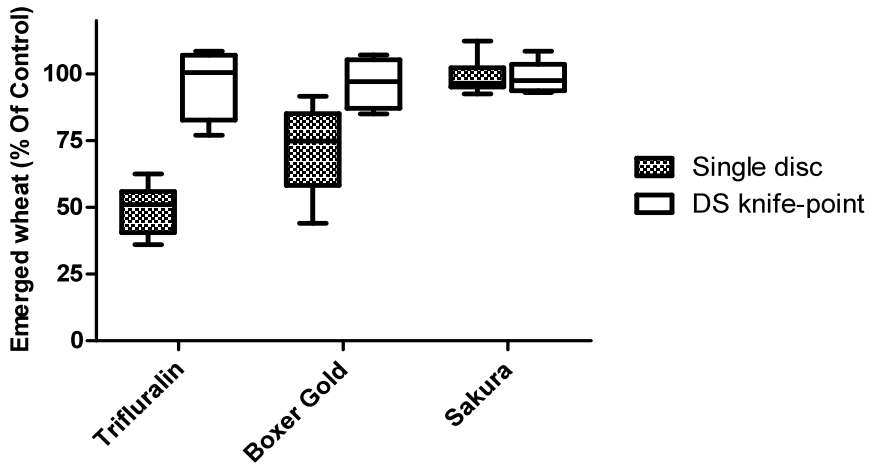

Figure 1. Box plots showing the effect of pre-emergence herbicides on wheat emergence (% Of Control) under single disc & DS knife-point & press wheel seeding systems. Data were sourced from 6 trials undertaken at Roseworthy in the years from & including 2008 to 2012.

The higher soil disturbance knife-point system has been shown to create enough soil throw to remove herbicide treated surface soil out of the furrow (Solhjou et al, 2012) and this is the likely reason for the observed low or no phytotoxicity to the wheat crop. Conversely, the single disc systems appear to leave herbicide treated surface soil in the furrow where it is in close proximity to crop seeds. The greater herbicide phytotoxicity observed under single discs was not the result of shallower seed placement as measurements determined the wheat seeds had been placed at a similar depth to the comparative knife-point system (data not presented). Movement of herbicide treated surface soil into the furrow slot from entrainment by the disc blade and/or gathering by the closing furrow wheel appears to exacerbate crop damage under single disc systems.

Preliminary results from trials undertaken last year showed that disc seeding system setup also has a critical role in the level of wheat crop damage from pre-emergence herbicides. Disc seeding system design and setting up, including operating and sowing depth, travel speed and whether or not residue managers are used all appear to influence the behaviour of pre-emergence herbicides in disc systems. For example, a comparatively aggressive soil throw arising from the seed banding boot deflector of the DayBreak Duodec disc seeding system resulted in significantly better crop safety than that achieved with other single disc configurations, likely due to a more effective herbicide separation process.

Disc seeders are often operated at fast travel speeds (i.e. in a 2007 disc seeder survey, 50% of 31 SA farmers surveyed operated between 11-13 kph, with reported speeds of up to 16 kph), with research and industry evidence showing that higher speeds reduce seed placement uniformity. Variable or shallow seed placement can often increase the risk of herbicide damage where furrow surface soil has not been cleared and limited vertical separation may not secure the required positional selectivity. In the 2012 trials, increasing sowing depth minimised herbicide damage when a double shoot version of NDF 650 disc seeding system was used which created greater soil disturbance and achieved deeper seeding depth, and thus increased the likely separation between the herbicide and germinating seed (Figure 2). A shallow sown seed is more likely to be closer to herbicide on the soil surface and less rain is required to move soluble chemicals (i.e. Boxer Gold) from the surface down to the seed.

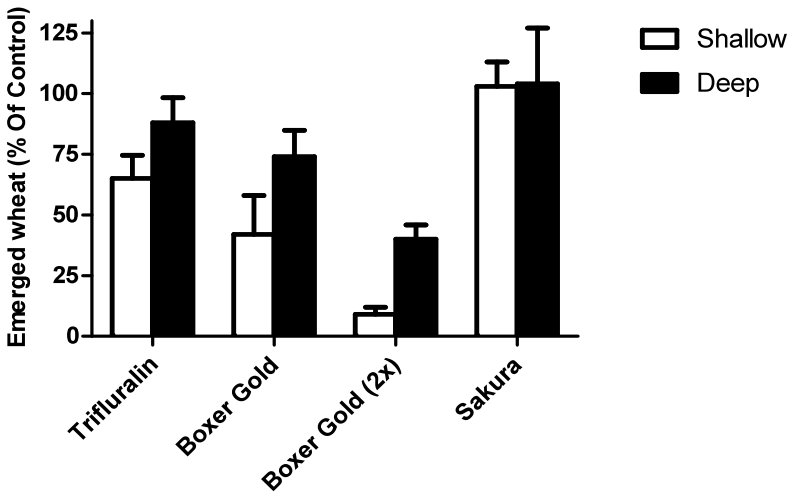

Figure 2. Influence of disc operating depth (shallow vs. deep) on wheat emergence (% Of Control) with different pre-emergence herbicides. The single disc seeding systems used were NDF 650 (single vs double shoot). Mean shallow & deep sowing depths were 25.2 & 40.5 mm respectively. Control wheat emergence = 168 plants m^{-2} (shallow) and 159 plants m^{-2}, (deep). Bars represent SE of mean.

Herbicide damage was especially reduced by the use of residue managers on single disc seeding systems in the 2012 trial (i.e. John Deere 90 series + Aricks wheel - data in Figure 3 - and NDF 650 + Ndf wheel - data not shown). The residue managers were set to clear a 3 to 4 cm band of surface residue and herbicide ahead of the disc opener, limiting the interaction between treated soil and the germinating crop.

In field trials over the period, triple disc configurations consistently provided greater crop safety relative to single disc systems and showed comparative wheat establishment to the DS knife-point system. Controlled soil throw with leading rippled coulters fitted ahead of Bertini and KHart double disc openers ensures that herbicide treated soil is thrown out of the furrow and concentrated on the inter-row, which provided excellent crop safety in the 2012 trials. Risk of herbicide damage is normally minimised by operating the furrow opening coulters side by side on the same rank to control furrow ridging and minimise residue pinning by rear rank coulters which could operate in looser soil when set at narrow row spacing. Illustrating this soil throw benefit in a different way, some significant herbicide damage resulted from both trifluralin and Boxer Gold when coulter skids were fitted to Bertini leading coulters. These skids are 'soil throw controllers' designed to limit the amount of soil movement out of the furrow by preventing soil from riding up the coulter and thus keeping herbicide treated soil close to the furrow, increasing the risk of herbicide damage.

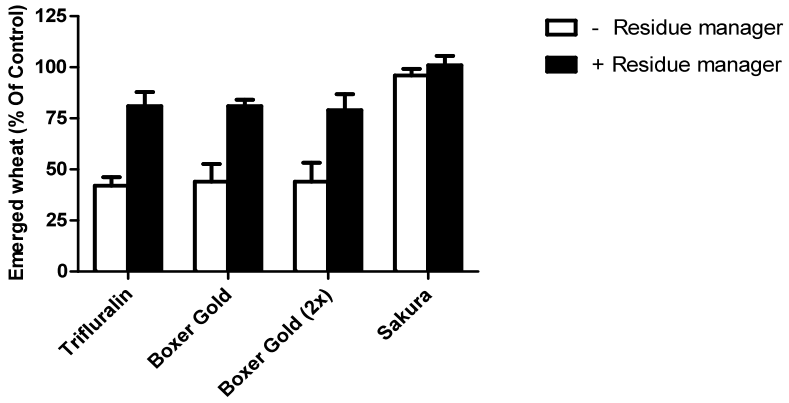

Figure 3. Effect of pre-emergence herbicides on wheat emergence (% Of Control) under John Deere (90 series) single disc opener with & without Aricks wheel residue manager. Control wheat emergence = 203 plants m^{-2} (+ residue manager) and 211 plants m^{-2} (- residue manager). Bars represent SE of mean.

At several field trials, annual ryegrass control was shown to differ between pre-emergence herbicides following disc incorporation (Figure 4). Even though most of the ryegrass seedbank was near or on the soil surface at these sites, control with trifluralin was on average consistently lower (39%) than both Boxer Gold (82%) and Sakura (84%). The low level of ryegrass control provided by trifluralin was likely a result of poor incorporation as well as herbicide resistance. Boxer Gold and Sakura are much more stable and show longer persistence in the soil than trifluralin and can be applied well before incorporation without significant loss in efficacy. Use of trifluralin under single disc seeding systems, where weed control failed due to poor incorporation and crop density declined due to phytotoxicity, often resulted in massive seed set by ryegrass (data not presented). Such high levels of ryegrass seed production would be expected to have serious effects on productivity of subsequent crops in the rotation.

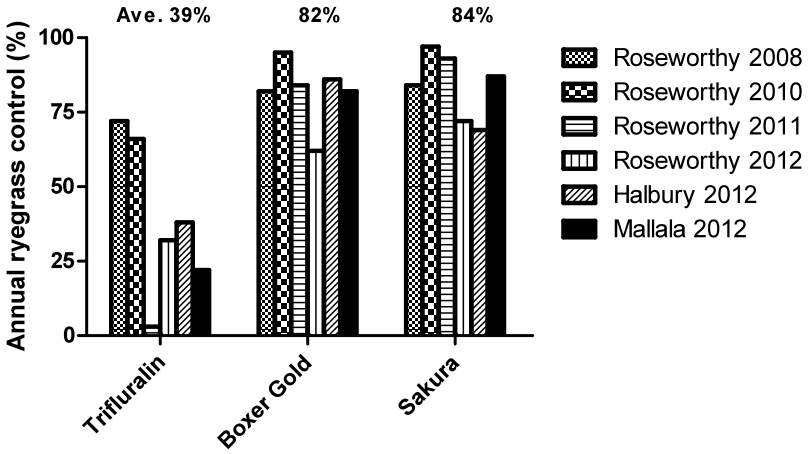

Figure 4. Performance of pre-emergent herbicides on annual ryegrass control (%) at 5 field trials sown with single disc seeding systems. It should be noted that inability of trifluralin to control ryegrass at Roseworthy in 2011 was most likely due to herbicide resistance rather than poor incorporation. Weed control is expressed as reduction in annual ryegrass plant density.

Desbiolles J (2011) Disc seeders in conservation agriculture: An Australian survey. Proceedings of the 5th World Congress on Conservation Agriculture, Brisbane, 26-29 September 2011.

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AW Vater & Co Trials Conducted at MNHRZ in 2012 yield no clear answers.

Craig Davis – Senior Agronomist at AW Vater & Co.

In 2012, AW Vater & Co conducted two plot scale replicated trials investigating the use of alternative fertiliser products in a range of novel timings in wheat and canola at the Navan trial site.

The statistical analysis has yielded no clear answers in either 46Y83 Canola or Scout Wheat.

What we can learn, interestingly, is that there are notable differences between the grouped treatment timing in Canola favouring the T2 (early-flowering) application, supporting calls for further investigation in this approach to trace element timing in high yielding canola crops.

For Wheat, we can glean some advantages (through paired analysis comparisons) may be likely from the application of trace element nutrition beyond Zinc. Further work will aim to support this with the use of tissue testing, large scale (farmer) test strips and follow up tissue tests.

Further trial information can be sourced from AW Vater & Co Staff.

Treatment	Yield kg/ha	Standard Error
Nil	3014	234
Z @ 1L T1	2781	145
Z @ 3L T1	3033	342
K @ 500ml T1	2745	271
SZ @ 3L T1	2619	147
SM @ 300ml T1	2581	119
Z @1L T2	2499	295
Z@ 3L T2	3059	237
K @ 500ml T2	3025	48
TT @ 2L T2	2966	224
CZMC 2L T2	3136	186
Z 3L T3	2898	332
K 500ml T3	2768	62
TT @ 2L T3	2949	148
CZMC @ 2L T3	3034	225
T1 = full cabbage T2 = early flower, T3 = Early-Mid Podding		
Trial not significant (LSD 631kg/ha) P < 95% (68%)		

Table 1. Yield of 46Y83 Canola treated with a range of Trace Element products at three foliar application timings.

Treatment (Starter, T1, T2)	Yield kg/ha	Standard Error
Nil, Nil, Nil	4202	244
P, Nil, Nil	4905	63
P, NS, Nil	4205	559
P, NS, AZ	3938	340
P, NS , CZMC	4185	201
P, NS, AZ fb BZ	4032	300
P, NS, CZMC fb BZ	3809	285
PSZ, Nil, Nil	3861	214
PSZ, NS, Nil	3587	274
PSZ, NS, AM	3867	479
PSZ, NS , CZMC	4040	314
PSZ, NS, AZ fb BZ	4160	367
PSZ, NS, CZMC fb BZ	4294	763
PS, Nil, Nil	4059	548
PS, NS, Nil	4093	184
PS, NS, AZ	3502	95
PS, NS , CZMC	3935	435
Trial not significant (LSD 531kg/ha) P < 95% (68%)		

Table 2. Yield of Scout Wheat treated with a range of starter applied nutrients (Starter), Seed Dressings (T1), and foliar Regimes (T2).

Standing stubble improves yield stability of lentils

Mick Lines & Larn McMurray, SARDI, Southern Region Pulse Agronomy

The benefits of early sowing and stubble retention have been widely discussed in seasons and environments characterised by low growing season rainfall, and/or short, sharp finishes. However the importance of sowing time and stubble retention in relation to increased grain yield has been less evident in recent favourable growing seasons. However this research shows that retained stubble can be important in lentil under both favourable and less favourable growing season conditions.

Lentil sowing date by stubble management trials were set up between 2010 and 2012 in the Mallala region of the lower Mid North of SA in response to poor crop yields in previous low rainfall seasons. The trials aimed to determine whether yield of lentils could be improved by sowing inter-row into standing stubble, compared with retained but slashed stubble or situations where stubble was removed altogether (burnt). Each trial contained eight lentil varieties, three stubble management practices (Removed/burnt stubble, Slashed stubble and Standing stubble) and three sowing dates (break of season and 2-3 weekly intervals thereafter). Stubbles amounts ranged between 1.8-2.2t/ha of barley or wheat stubble, with a 30-35cm standing height.

A significant response was generated from stubble management in each season. Significant two-way (Sowing date x Stubble management and Variety x Stubble management) interactions were generated in 2010, while significant three-way (Sowing date x Variety x Stubble management) responses were generated in 2011 and 2012. A summary of these results is shown in Table 1.

Table 1: Summary of grain yield response (% of Removed/burnt stubble yield) of Slashed and Standing stubble treatments for six varieties and three sowing dates across three seasons in the Mallala region.

Variety	Variety Characteristics	2010		2011		2012	
		Slashed	Standing	Slashed	Standing	Slashed	Standing
Boomer	Late, high EV, high BM, prostrate	0	0	0-16% (M)	0-27% (L)	0-16% (E, L)	0-29% (E, L)
Nipper	Mid-Late, erect, low BM	11	12	0%	0%	0%	13-34% (E, M, **L**)
Nugget	Late, industry standard	17	11	0%	0-21% (M)	0-33% (M)	0-38% (M, **L**)
PBA Blitz	Early, erect, low BM	12	**22**	0%	0-36% (**E**, L)	0-33% (M)	0-28% (E, M)
PBA Bounty	Mid-Late, prostrate	0	11	0%	0-20% (**E, M**)	n/a	n/a
PBA Flash	Early-Mid, erect	9	9	0-34% (M)	0-26% (E, M)	0%	0-30% (E, L)
Average stubble treatment response (all sowing dates and varieties) P<0.05		7	**10**	8	**11**	11	**18**
Season summary		Average start Wet finish		Wet start Average finish		Average start Dry finish	
Site mean yield (t/ha)		3.8		2.0		1.4	

Bracketed treatments denote which sowing date (Early (E), Mid (M) or Late (L)) yielded higher than the Removed stubble treatment.
Bolded treatments denote the sowing date (E, M or L) where the Standing stubble treatment yielded higher than the Slashed stubble treatment.
Variety characteristics: EV = early vigour, BM = biomass, Early, Mid, Late refers to plant maturity, Erect or prostrate refers to plant growth habit.

Results with complex three-way treatment interactions complicate interpretation of the yield data, however some trends are apparent across the three years of experiments. Firstly, retained stubble treatments (Slashed and Standing) across all varieties were equal or greater than Removed stubble treatments. Secondly, there was generally a greater yield response from the Standing treatment than the Slashed treatment. Thirdly, there was generally a greater yield response from stubble retention at the Late sowing date than Early or Mid sowing dates. Variety interactions with sowing date and stubble management treatment were apparent but appeared to be seasonally dependent, and most significant in the driest season of 2012.

Soil moisture was measured in September in the 2010 trial, and Slashed and Standing stubble treatments showed increases in soil moisture by 3 and 12% respectively compared to the Removed treatment. This result was also evident through a delay in plant maturity timing in retained stubble treatments compared to Removed treatments, particularly in PBA Blitz, the earliest maturing variety.

PBA Blitz showed the highest yield response from retained stubble. This may be due to its erect growth habit, which often fails to cover the inter-row soil space with its canopy as it remains very upright once it has begun to

flower unlike other varieties such as Nugget or PBA Ace which regularly completely cover the inter-row space. This feature in PBA Blitz may increase the soil moisture lost in unprotected (ie Removed stubble) treatments and hence a greater benefit is achieved from retained stubble in this variety. In some seasons, PBA Blitz may also benefit from having delayed maturity in retained stubble systems by being able to respond to late rains which would normally only benefit later maturing varieties.

By contrast Boomer showed the least response from stubble management. It is thought that its high biomass and increased ability to close the inter-row earlier and more regularly than other varieties aids in conserving moisture, regardless of the presence of stubble. Further to this Boomer is more indeterminate in its flowering pattern than other varieties and often has the latest maturity date of the varieties tested.

Other reasons may also explain why Standing stubbles generated the greatest yield increase. Firstly, previous research has attributed changes in the "microclimate" at the plant level in standing stubble systems to increased soil moisture and subsequent yield. Soil temperature, solar radiation and wind speed were all reduced in standing stubble systems, which was thought to reduce evapotranspiration during the lifecycle of the crop (Cutforth et al, 2002). Secondly, the protection from buffeting winds afforded by standing stubbles means that plants are able to divert more carbohydrates into the photosynthetic development and flower production, rather than into stem development for wind resistance. The costs of stem development in response to stimuli like wind (a process called thigmomorphogenesis) has been documented in a number of plants (eg Jaffe, 1993; Cipollini, 1999). Finally, several cereal breeders have noted that constant friction between the soil and moving plants can cause erosion and displacement of soil from around the plant stem. Standing stubble may minimise this process by providing wind protection and stilling the plant, and may also prevent breakage of upper lateral roots.

These results show that stubble management improve yield stability in lentil across seasons varying in rainfall and length. However a larger yield response was observed from retained stubbles in the driest season. Stubble management may also be more important in lentils than in other break crops due to their smaller canopy size. Precise reasons for the grain yield response from standing stubbles remain unclear, but work will continue to establish causes and characterise factors which maximise the responses observed. The importance of conserving soil moisture, even in favourable seasons, is significant and the advent of modern farming systems such as minimum tillage and GPS guidance will facilitate this practice. However, growers looking to implement this practice should also be aware of the both the positives and negative issues associated with stubble retention in their particular farming system.

Figure 1: photos show effect of Removed (left), Slashed (centre) and Standing (right) stubbles on visual growth of PBA Blitz lentil, Pinery 2012.

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