

Weed Tolerance and Suppression in Wheat

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Why investigate weeds?

It is well documented that herbicide resistance in weeds is an increasing problem for grain growers, and as a consequence, the adoption of integrated weed management (IWM) practices is also increasing. These methods include manipulating seeding rate and sowing date to maximise crop competitiveness, reducing weed growth through the use of cultivation, and herbicide application both pre-sowing and in-crop. Weed seed control at or post-harvest can also be achieved with the use of chaff carts, the 'Harrington Seed Destructor' and burning crop residues.

One area that warrants more investigation is the role of wheat variety selection in IWM. Do individual varieties differ in their yield response to the presence of weeds (weed tolerance) and do they vary in their ability to reduce weed seed set (seed suppression)? To answer these questions, Australian Grain Technologies (AGT) (with support from SAGIT and previously GRDC) established a multi-site and multi-year weed competition trial comparing varieties that are widely grown in South Australia, along with promising advanced breeders lines.

How did we do the trial?

The trial was conducted at five locations over four years. The locations were: Angas Valley (2012), Winulta (2012), Pinnaroo (2013), Rudall (2013) and Roseworthy (2010-2013). Rufus triticales was used as a 'weed' as it is easily distinguished from wheat and seed set can be readily calculated. A set rate of 'weeds' were dropped (using a plot seeder) on top of the soil immediately prior to sowing the wheat plots, thereby scattering the seeds to mimic grass weeds that are typically present. The 'weeds' were hand harvested prior to crop harvest, threshed, weighed and seed set per square metre calculated.

What did we learn?

When varieties grown over the four years of this trial were ranked for response to weed competition, their relative performance for both tolerance and suppression showed a high level of consistency across environments and years (data not shown). It is interesting to note, varieties that performed well were not of any particular maturity type, but the varieties that performed poorly all have a vernalisation requirement which is associated with poor early vigour.

The differing responses to weed competition are demonstrated in Figure 1. Axe[®], Gladius[®], Estoc[®] and Yitpi[®] all had a relatively small reduction in yield under weed

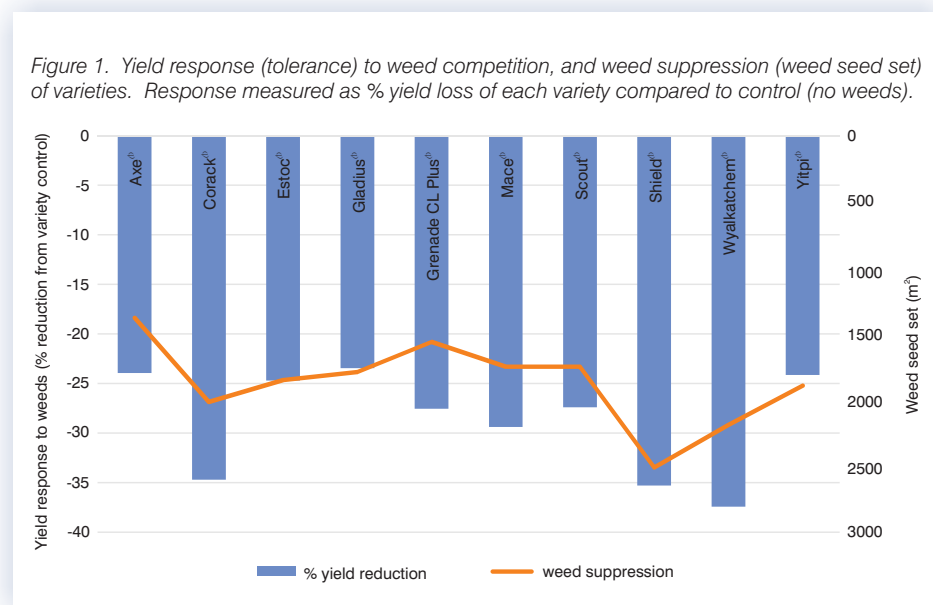


Figure 1. Yield response (tolerance) to weed competition, and weed suppression (weed seed set) of varieties. Response measured as % yield loss of each variety compared to control (no weeds).

competition (weed tolerance), while Wyalkatchem[®], Shield[®] and Corack[®] were the poorest performing varieties. The ability to suppress weed growth (lower weed seed set) was high for Axe[®], followed by Grenade CL Plus[®], Scout[®] and Mace[®]; average for Gladius[®]; and poor for Wyalkatchem[®] and Shield[®]. Although Yitpi[®]'s yield loss was low, similar to Axe[®] and Gladius[®], its ability to suppress weed growth was below average for the trial.

Figure 2 shows the yield of each variety without weed competition, plotted against yield with weed competition. The average yields across the experiments are indicated by the

horizontal (with weeds) and vertical (no weeds) blue lines. The suppression effect of each variety is indicated by the diameter of the circle; as the diameter increases the weed suppression effect decreases. Of these varieties, Axe[®] and Grenade CL Plus[®] had the best suppression effect with a weed seed set of 1380/m² and 1562/m² respectively. Estoc[®] (1849/m²) was near the site average; Corack[®] (2015/m²) and Wyalkatchem[®] (2190/m²) were at the higher end, while Shield[®] had the highest weed seed set at 2512/m². Although Axe[®] only achieved average grain yield in the absence of weeds, it was the highest yielding variety when weeds were present. This demonstrates that existing perceptions of the value of a variety may need to be reconsidered depending on the expected weed load in a paddock.

As expected, Mace[®] and Corack[®] performed similarly in this trial, although both were better than their major parent Wyalkatchem[®], for both weed tolerance and suppression; contributing to the agronomic advantage they offer growers. Interestingly, a breeders line (data not shown) that has now been discarded for other reasons, achieved a weed tolerance substantially better than Axe[®], providing confidence that breeding may offer even greater weed control benefits for farmers in the future.

The financial impact of weed competition is shown in Table 1. Although the percentage yield loss in response to weed competition for Mace[®] was average for the trial (29%), it was still the third most profitable variety in the presence of weeds due to its high yield potential. However, this was not the case with Wyalkatchem[®] which, despite its high yield (third) without weeds, had the second lowest yield in the presence of weeds and as an APW variety, the gross margin was the lowest in the trial. Without weed competition the gross margin for Mace[®] was \$110/ha higher than Wyalkatchem[®] but with weed competition it increased to \$161/ha.

Figure 2. Yield without weeds vs yield with weeds. The diameter of the circle relates to the number of weeds. The average yields are indicated by blue lines.

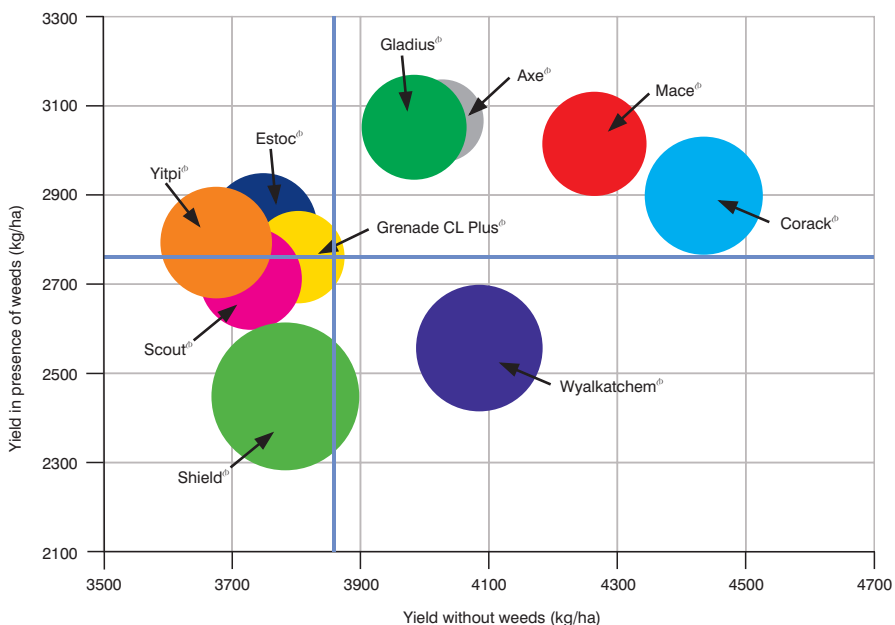


Table 1. Variety yield with and without weed competition, and financial impact.

Variety	No weeds		Weeds		Yield reduction (%)	Weed seed set (seeds/m ²)
	kg/ha	\$/ha	kg/ha	\$/ha		
Axe [®]	4028	1080	3063	821	24	1380
Corack [®]	4434	1122	2894	732	35	2015
Estoc [®]	3749	949	2823	714	25	1849
Gladius [®]	3984	1068	3049	817	23	1789
Grenade CL Plus [®]	3804	1020	2756	739	28	1562
Mace [®]	4265	1143	3011	807	29	1750
Scout [®]	3729	999	2707	726	27	1749
Shield [®]	3783	1014	2447	656	35	2512
Wyalkatchem [®]	4084	1033	2555	646	37	2190
Yitpi [®]	3676	985	2788	747	24	1893

\$ values calculated as per quality classification, and assume that varieties have qualified for maximum eligible grades: AH - Axe[®], Gladius[®], Grenade CL Plus[®], Mace[®], Scout[®], Shield[®], Yitpi[®]. APW - Corack[®], Estoc[®], Wyalkatchem[®]. AH \$268/tonne, APW \$253/tonne based on 10 year average.

Physical grain quality can also be affected by weed competition. On average, hectolitre weight (test weight) was lower in response to weed competition at all sites (Figure 3) but not necessarily in all varieties. However the hectolitre weight effect on weeds is mostly variety independent, so the best strategy to manage hectolitre weight is to select varieties

with higher inherent hectolitre weight when high weed competition is expected.

Finally, we have provided Table 2 as a summary of this experiment and a tool for growers to introduce wheat variety selection as part of their IWM program. When considered alongside the other agronomic, disease resistance and quality features of these varieties, this should enable growers to increase their returns when growing wheat in a high weed competition environment.

Take home messages

Herbicide resistance in weeds is an ongoing problem for cereal growers that requires an integrated management approach. This study illustrates that variety selection can be an important part of an IWM strategy. *Axe*[®] is the stand out variety for combined weed suppression (MR), tolerance (MT-MI) and gross return in the presence of weeds. Demonstrating good weed suppression (MR-MS) along with being tolerant to Intervix[®] herbicide, Grenade CL Plus[®] provides a two pronged approach to weed management.

Gladius[®] is the most tolerant to weed

competition, followed closely by *Axe*[®], *Yitpi*[®] and *Estoc*[®]. However, while these varieties display the lowest percentage yield loss, when yield potential and the quality grade of these varieties are taken into account, *Axe*[®], *Gladius*[®] and *Mace*[®] are likely to produce the highest gross returns when growing wheat in high weed competition paddocks.

Figure 3. Average effect of weeds on hectolitre weight in 2012 and 2013.

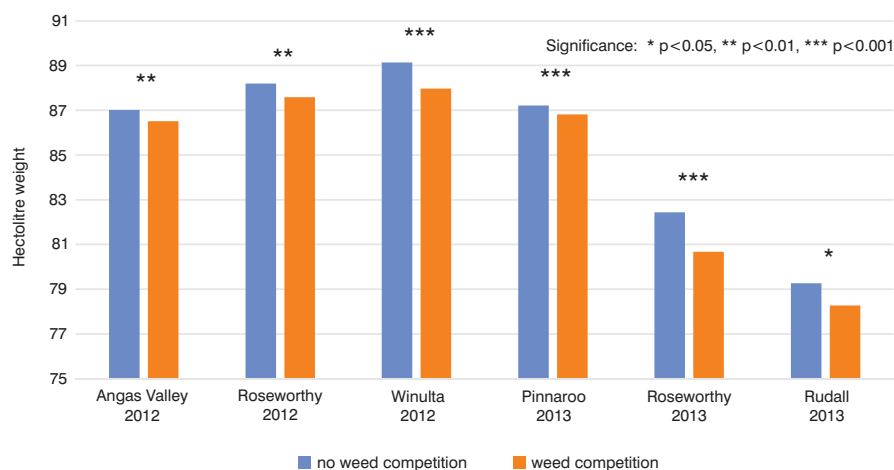


Table 2. AGT ratings for variety tolerance and resistance to weeds.

Variety	Weed tolerance	Weed suppression (resistance)
<i>Axe</i> [®]	MT-MI	MR
<i>Corack</i> [®]	I	MS-S
<i>Estoc</i> [®]	MT-MI	MS
<i>Gladius</i> [®]	MT-MI	MS
<i>Grenade CL Plus</i> [®]	MI	MR-MS
<i>Mace</i> [®]	MI	MS
<i>Scout</i> [®]	MI	MS
<i>Shield</i> [®]	I	S
<i>Wyalkatchem</i> [®]	I-VI	MS-S
<i>Yitpi</i> [®]	MT-MI	MS

MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible, MT=Moderately Tolerant, MI=Moderately Intolerant, I=Intolerant, VI=Very Intolerant.

Contacts

For further information please contact:

Haydn Kuchel, Wheat Breeder: 0428 817 402
 James Edwards, Wheat Breeder: 0427 055 659
 Dan Vater, SA/Vic Marketing Manager: 0427 188 919
 Andrew Egarr, Research Agronomist: 0435 608 182

www.ausgraintech.com

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