Aphids in Winter Cereals on the Liverpool Plains – the Consultant's View

Jim Hunt, Hunt Ag Solutions (formerly Landmark) Gunnedah NSW

There has been a growing issue with respect to increasing aphid populations and pressure over the last 5yrs in particular. Historically, I have dismissed aphids as an occasional secondary pest posing little yield impact to cereal crops except in isolated years with epidemic populations. I recall investigating a minor outbreak in Southern QLD in early 2000 with researchers offering more personal experience than actual data.

Since the transition from the Darling Downs to Liverpool Plains my agronomic advice has changed. Clearly this region experiences higher aphid pressure than I have previously encountered. Over the last 5 years I have observed more incidences of aphid infestations in barley and wheat crops than in previous years. Also, the incidence of BYDV has been widespread, particularly in wheat, barley & forage oats. Simply, I have made decisions to control aphids based on limited threshold data and more on local consensus among district agronomists.

Commercially its been hard to capture yield data when there is an epidemic of aphid activity in crops, but isolated spraying mishaps have revealed uncontrolled areas yielding 1T/ha behind the commercially sprayed crop. Most of these incidences have been subjected to intense aphid pressures >100/tiller with more than 1 species present.

In 2008 season early sown crops on good soil profiles harboured the most aphid pressure. This coincided with the highest incidences of BYDV in all winter cereals I have ever seen. But what was causing the yield damage, aphid pressure or BYDV ?

In 2009 Landmark R&D undertook a number of seed treatment and foliar insecticide trials throughout the district. Also, since aphid management was highlighted as a priority with NGA in our region's working group, research was undertaken in conjunction with NSW DPI and DEEDI to identify species and their impact on crop damage. We had dismissed the early root/rhizosphere feeding species like the Cereal Oat aphid as a minor problem but the later colonising species such as the Rose Grain and Corn aphid appeared to present the greatest problem to many crops causing notable wilting and nutrient stress.

Strategies to control aphids in-crop are presenting issues to growers and agronomists. Many of us have already adopted preventative strategies to manage Stripe Rust with low rates of propiconazole added to herbicide sprays. Now with posing aphid issues herbicide, fungicide and insecticide mixes are becoming expensive and complex.

The data compiled by NGA over the last 3 seasons have helped to confirm what most agronomists have suspected. There is a clear economic benefit to control aphid populations in winter cereals on the Liverpool Plains. Landmark trials in our district have not clearly identified an economic yield saving with foliar insecticides such as Pirimor and Dimethoate but this work was done under low aphid pressure and with the assistance of parasitic wasps. Alternatively, our seed treatment trials have recorded yield benefits of >0.5T/ha in cereals suggesting continual feeding from root aphids or even low aphid pressure throughout the crop could be discretely impacting on yield. One major observation has been the reduction in BYDV throughout the trials which I suspect maybe having a greater impact on yield than the obvious pressure from aphids.

Imidacloprid seed treatments have been adopted in this area as a standard treatment offering at least 90days control of sucking insects like aphids and mites. Although these seed treatments offer a very cost effective way of managing the problem and preventing early infections of BYDV, my

colleagues and I emphasis the need for further research into aphid ecology and IPM. The good work done by NGA, DEEDI & NSW DPI has helped agronomists identify aphid species and beneficial insects that can control outbreaks. Certainly more work is required with decisions behind predator – parasite relationships but I would suggest that collaboration between the Cotton CRC & GRDC is essential before we have widespread resistance with Neonicotinoid products such as imidacloprid.

Sit back and recall how many crops in our farming system have seed treated with this product. Without a collaborative approach to plant breeding for viral resistance in cereals, Neonicotinoids remain our major line of defence!

Aphid Control Under the Microscope 2008-2010 – the Research View (NGA)

At a glance

- *Cereal aphids were found at all 18 trial sites planted during 2008, 2009 and 2010 but at, or exceeding, a 'provisional' spray threshold of 10-15 aphids/ tiller at 11 of the 18 sites*
- *Similar populations of oat and rose grain aphid were found in barley, wheat and durum*
- *Corn aphids were nearly exclusively found in barley*
- *Seed treatment containing imidacloprid consistently provided significant reductions in aphid numbers for at least 70 days from planting*
- *Mean yield benefits from insecticide seed treatment have ranged from ~330 kg/ha (under high aphid pressure in 2008) to ~200 kg/ha (under pressure of ~10 aphids/tiller or more in 2009 and 2010) to only ~80 kg/ha (where aphid pressure was <2 aphids/tiller in 4 of 5 trials in 2009)*
- *Net benefits of ~$20-40/ha were generated from the standard rate of imidacloprid in all three years with aphid pressure >10 aphids/tiller (marginal but still positive returns in low aphid trials)*
- *Economics of foliar insecticide application were generally marginal with useful returns only achieved at 5 of the 18 sites*
- *Beneficial insect activity appeared to be responsible for rapid natural population crashes at most sites*

Background

NGA recently completed a three year project evaluating the impact of aphids in winter cereals. In total, eighteen individual trial sites were planted and evaluated across the northern grains region. Six trials were focussed on the impact in barley alone with an additional twelve trials comparing the affects in barley, bread wheat and durum. Aphid control, yield, grain quality and the costs and benefits of different management approaches were evaluated in each situation. The 2008 and 2009 trial work benefited from collaborative activity with DEEDI (formerly QDPI&F) and NSW DPI – including the involvement of NSW DPI District Agronomists from Dubbo to Moree and the northern barley agronomy group led by Dr Guy McMullen.

Management approaches evaluated

The two aphid management approaches evaluated were the use of an insecticidal seed treatment (active ingredient imidacloprid) or a foliar insecticide application (active ingredients pirimicarb or dimethoate). Evaluation of the seed treatment was conducted in all trials at 72 g

ai/100 kg seed (eg Zorro® at 400 mL/100 kg seed) and also at 144 g ai/100 kg (eg Emerge® at 240 mL/100 kg seed) in all fourteen trials in 2009 and 2010. All treatments had an identical loading of basic seed treatment fungicide eg tebuconazole or triadimenol.

Pirimicarb was the main foliar insecticide and primarily used at 75 g ai/ha (eg Pirimor® at 150 g/ha). Dimethoate was only evaluated in 2008 and used at 200 g ai/ha (eg Farmoz Dimethoate 400 at 500 mL/ha).

In 2008 three barley varieties were evaluated (Fitzroy◊, Grout◊ and Gairdner◊) with both Fitzroy◊ and Grout◊ also evaluated in 2009 in the intensive barley trials. Fitzroy◊, Livingston◊ and EGA Bellaroi◊ were compared in all winter cereal evaluations. The wheat varieties were chosen to have similar phenology to the barley variety. All trials conducted had four replicates with plot sizes ~20 m^2.

What was found ?

Establishment

Although the use of insecticide seed treatments can improve crop establishment in the presence of some soil pests, there was no significant improvement in establishment from insecticide seed treatment in any of the eighteen individual trials.

Aphid species and populations

Aphids were found in ALL cereal varieties at EVERY location. At nearly all sites, three different species of aphid were found: the oat aphid (*Rhopalosiphum padi*), the corn aphid (*Rhopalosiphum maidis*) and the rose grain aphid (*Metopolophium dirhodum*). Each species invariably colonised a different part of the crop canopy with the oat aphid around the crown and lower stems, the corn aphid nearly exclusively in the leaf whorl of the uppermost emerging leaf and the rose grain aphid in the mid to upper canopy, primarily on the leaves.

Although there were differences in aphid population size and species mix between every site, the overall pattern was:

1. 2008 – high pressure (all 4 sites had peak ‘assessed’ populations >70 aphids/tiller
2. 2009 – low to moderate pressure (6 of 10 sites had >10 aphids/tiller, maximum 44 aphids/tiller)
3. 2010 – low pressure (all 4 sites only had ~5-10 aphids/tiller)

Oat aphids

Corn aphids

Rose grain aphids

Crop preference ?

Barley is generally characterised as the most ‘aphid susceptible’ of the winter cereals and more often warranting management consideration. Although there were differences in aphid population and mix between crops and varieties at each site, the overall pattern was:

1. Oat aphid – similar populations in all winter cereals
2. **Corn aphid – nearly exclusively in barley**
3. Rose grain aphid – similar populations in all winter cereals

In 2009 corn aphid was widespread and barley generally experienced higher aphid pressure than wheat and durum. In 2010 corn aphid numbers were low and barley experienced similar aphid pressure to wheat and durum.

Population dynamics

A common feature in most trials was a rapid build-up and then natural decline of the aphid population over a ~3-4 week period. Figures 1 and 2 show the aphid build-up and decline at all multi crop sites in 2009 and 2010 respectively. It is believed that beneficial insect activity (parasitic wasps and predators) is primarily responsible for this decline.

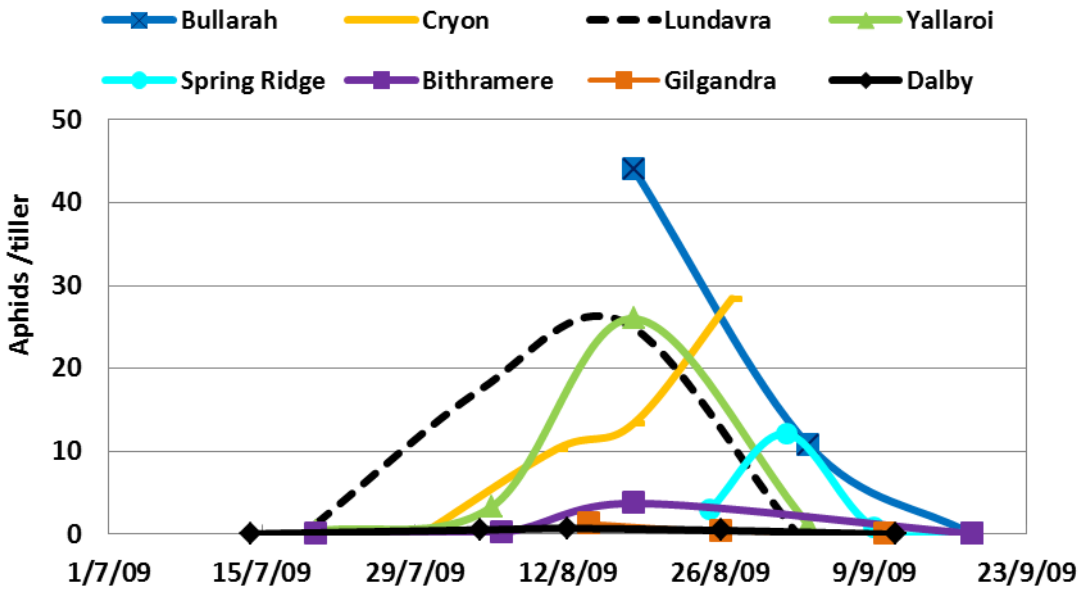


Figure 1 – Total aphids on untreated Fitzroy barley, 2009

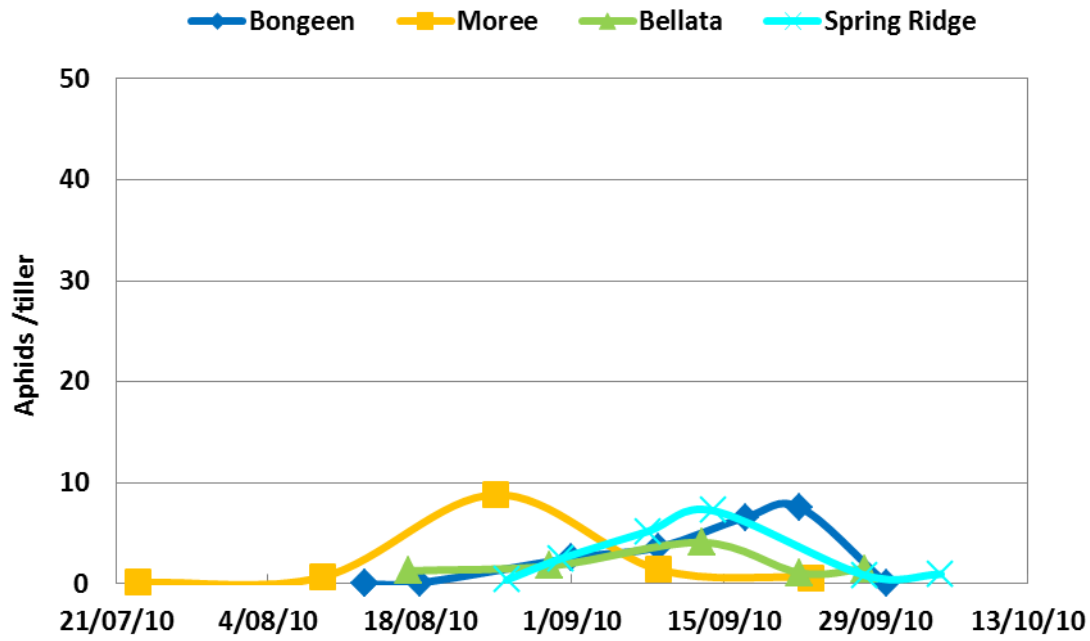
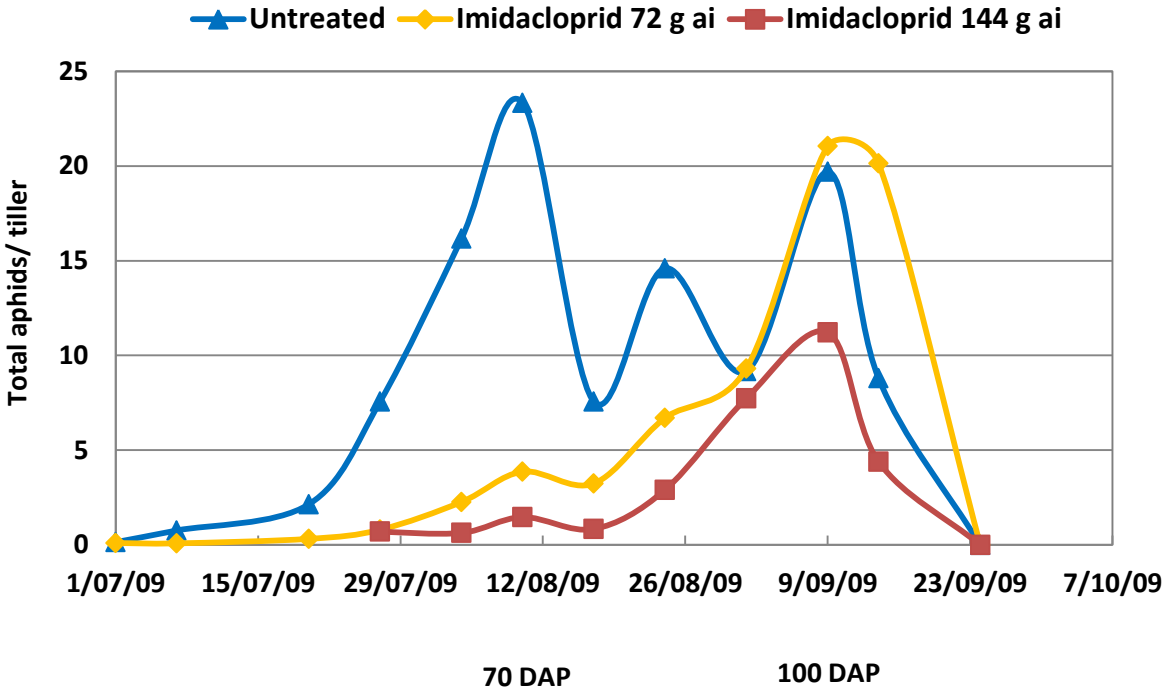


Figure 2 – Total aphids on untreated Fitzroy barley, 2010

Aphid control

The standard rate of imidacloprid (72 g ai/100 kg seed) consistently provided significant control of both the oat and corn aphid species for a minimum of ~70 days from planting. Use of the higher rate extended the length of aphid control by ~7-14 days. No clear efficacy data was generated on the rose grain aphid with this species generally the last to colonise crops.

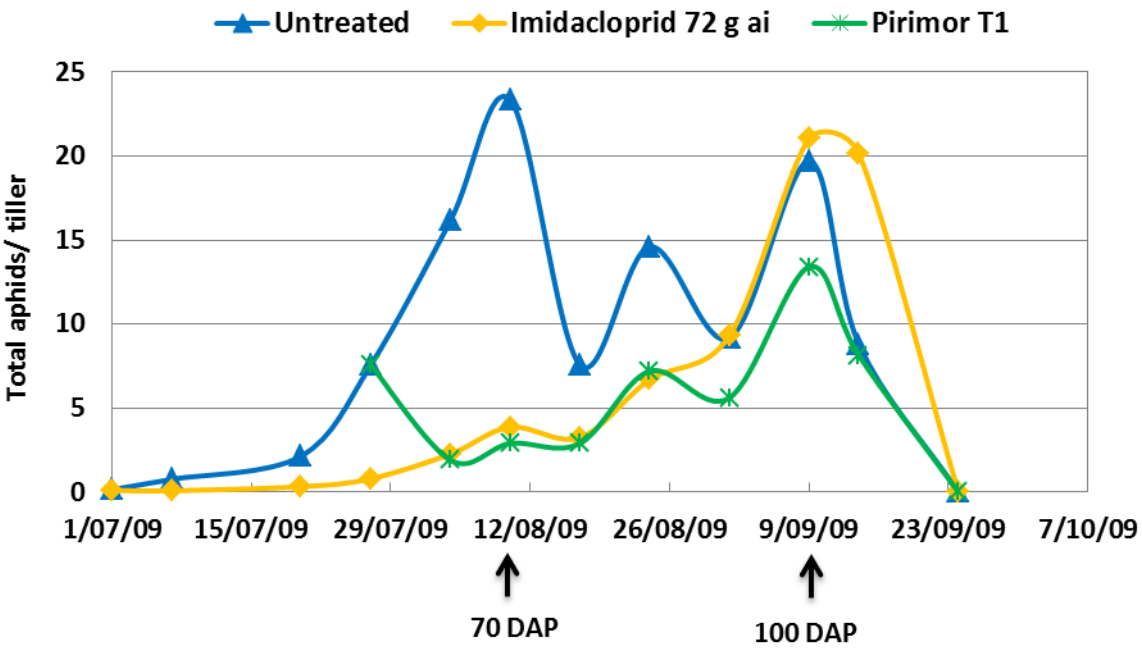
Figure 3 below is indicative of the insecticide seed treatment impact on aphids observed during this project. The Moree site in 2009 was intensively assessed on a weekly basis from July to September. The three peaks in aphid population largely showed the population timing and dynamics of the three aphid species. The first peak was primarily oat aphid, the second peak was corn aphid and the third peak was rose grain aphid.



NB 70 DAP = 70 days after planting

Figure 3 – seed treatment aphid control in Fitzroy barley (Moree 2009)

Figure 4 below compares the control achieved with seed treatment to that from an early foliar spray when aphid numbers were nearing 10/tiller. In this trial a clear benefit was obtained from this foliar timing as the Untreated population continued to increase. However in the majority of trials conducted the natural aphid population crashed shortly after the foliar application timing.



NB 70 DAP = 70 days after planting

Figure 4 – seed treatment v foliar aphid control in Fitzroy barley (Moree 2009)

Beneficial insects

Although both aphid active seed treatment and foliar insecticide application are effective management tools for aphids, we should not overlook the importance and impact of beneficial insects in managing cereal aphids. In a number of trials in 2009, and all trials in 2010, aphid populations were kept below the 10-15 aphids/tiller threshold without any insecticide. The primary insect responsible in 2009 appeared to be the small parasitic wasp *Lysiphlebus testaceipes*. In contrast in 2010, ladybirds were the most obvious and abundant beneficial insect.

Yield impact

Figure 5 shows the mean yield benefits compared to the Untreated grouped by year and whether trials had reached a nominal aphid threshold for spraying in 2009. The highest aphid pressure was seen in 2008 where the standard rate of imidacloprid averaged a 330 kg/ha benefit over the Untreated. Under lower pressure in 2009 and 2010 the mean benefit was ~200 kg/ha. Although foliar sprays can be effective, the mean yield benefits have ranged between 100-240 kg/ha and were generally similar or slightly poorer than the standard rate of imidacloprid. The last set of columns show the apparent benefit from seed treatment in 2009 when aphid populations were present but did not reach a spray threshold.

In 2009, larger benefits were found in barley than in bread or durum wheat. In that year there were significant numbers of corn aphid which primarily colonise barley. In 2010 there was no pattern of larger benefits in barley with only low numbers of corn aphid apparent at any site.

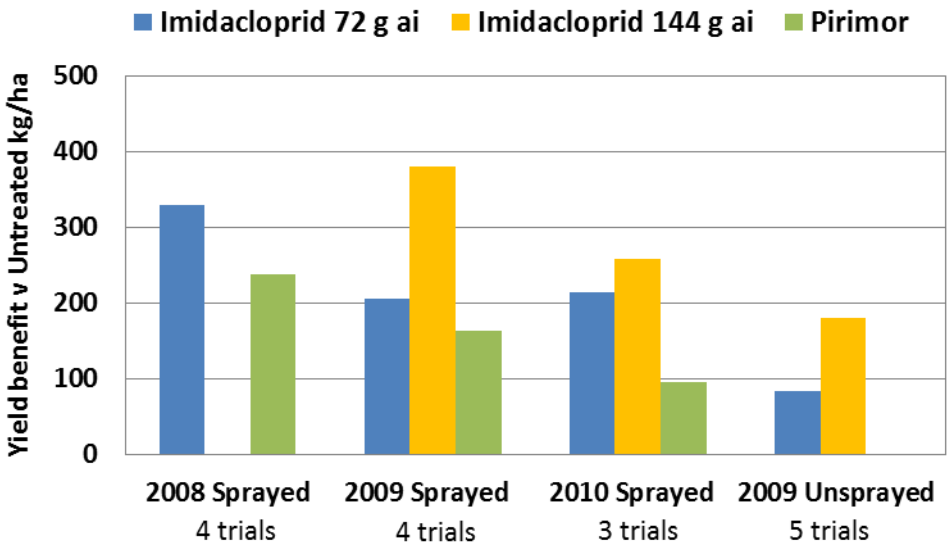


Figure 5 – Mean yield benefits

Of the eighteen trials, barley yellow dwarf virus (BYDV or CYDV) was only evident at one site. At all other sites direct aphid feeding damage appears to be the cause of any yield impact.

Grain quality

There was negligible impact on grain quality with test weight, screenings, protein and retention assessed.

Economics

The standard rate of imidacloprid provided mean net benefits of $37/ha in 2008 under high aphid pressure assuming a barley price of $125/t. In 2009 and 2010 the same rate provided net benefits of $20-30/ha at sites with aphid pressure of 10/tiller or more assuming barley prices of $152/t and $160/t respectively. Even at sites in 2009 with less than 10 aphids/tiller, the results were neutral to marginally positive with a mean net benefit of $9/ha. The high rate of imidacloprid evaluated in 2009 and 2010 resulted in increased net benefits.

Foliar application results were less encouraging. In 2008 a mean net benefit of $33/ha was obtained but largely driven by good results at two sites with peak aphid populations of 100/tiller or more. In 2009 and 2010 the mean net benefit was only $6 and $4/ha respectively. The key to generating good economic returns from the foliar application is application on a rapidly increasing population in a year when it is going to continue to build. Obviously very difficult to predict and monitor.

Barley yellow dwarf virus

Symptoms of BYDV were only observed at the Liverpool Plains trial site in 2010. Samples were taken from the other (asymptomatic) sites in 2010 for testing but no trace of BYDV was found. Visual effects of BYDV were most prominent in the bread wheat varieties and durums at the Liverpool Plains site with symptoms much less prominent in the barley varieties. Foliar insecticide application at this site on a population of 8-10 aphids/tiller did not have any impact on virus ratings. Both rates

of imidacloprid seed treatment significantly reduced the severity of BYDV symptoms at this site but symptoms were still present. The photo shows symptoms of BYDV in untreated Livingston in 2010.

Conclusions

- This comprehensive series of trials suggest direct feeding damage from aphids in the northern region is frequently causing yield loss of 5-15% in winter cereals but with little consistent impact on grain quality
- Imidacloprid seed treatment generally provided aphid suppression for at least 70 days from planting
- Imidacloprid seed treatment provided more consistent yield and economic benefits than foliar applications
- Imidacloprid seed treatments should be considered as a management option for growers in higher aphid pressure situations
- The economics of foliar application for aphid management in winter cereals were marginal except in a very high aphid pressure season
- A foliar spray threshold of ~10/tiller appears realistic but needs to be made on an increasing aphid population and where beneficial insect activity is limited
- Foliar application with 'soft' options should be considered due to the effective role of many parasitoids and predators.